

Hornsea Project Four:

Report to Inform Appropriate Assessment (Draft)

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Glossary

Term	Definition
Appropriate Assessment	An assessment to determine the implications of a plan or project on a European site in view of the site's Conservation Objectives. An AA forms part of the Habitats Regulations Assessment and is required when a plan or project likely to have a significant effect on a European site.
Annex I Habitat	Natural Habitat types of community interest whose conservation requires the designation of Special Area of Conservation.
Annex II Species	Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation.
Barrier Effect	The potential for birds to fly around an array of turbines causing an increase in the overall distance flown than would otherwise have been the case if the wind turbines had not been present.
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 th November 2009 on the Conservation of Wild Birds.
Collision Risk	A potential risk that birds collide with wind turbine or its blades.
Commitment	A term used interchangeably with mitigation. Commitments are embedded mitigation measures. Commitments are either primary (design) or tertiary (Inherent) and embedded within the assessment at the relevant point in the Environmental Impact Assessment (EIA) (e.g. at Scoping or Preliminary Environmental Information Report (PEIR)). The purpose of Commitments are to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms.
Cumulative Effect	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Four.
Development Consent Order	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIPs).
Displacement	The potential for birds and other animals to avoid an area due to the presence of the wind turbines or from vessel activity.
Environmental Impact Assessment	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and the EIA Regulations, including the publication of an Environmental Statement (ES).
European Site	A Special Area of Conservation (SAC) or candidate SAC (cSAC), a Special Protection Area (SPA) or potential SPA (pSPA), a site listed as a Site of Community Importance (SCI) or a Ramsar site.
Habitats Regulations Assessment	A process which helps determine Likely Significant Effects and (where appropriate) assesses adverse effects on the integrity of European Conservation Sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI).

Term	Definition
High Voltage Alternating Current	High voltage alternating current is the bulk of electricity by alternating current, whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current	The bulk transmission of electricity by direct current, whereby the flow of electric charge is in one direction.
In-Combination Effect	The combined effect of Hornsea Four in-combination with the effects from a number of different projects on the same feature/receptor.
Landfall	The area between Mean High Water Springs and Mean Low Water Springs in which all of the export cables will be landed and is the transitional area between the offshore export cabling and the onshore export cabling.
Marine Mammal Mitigation Protocol	A document detailing the protocol to be implemented in the event that driven or part-driven pile foundations are proposed to be used. The protocol identifies the methods for detection, potential mitigation and monitoring/reporting protocols for marine mammals.
Mean High Water Springs	The height of mean high water during spring tides in a year.
Mean Low Water Springs	The height of mean low water during spring tides in a year.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR).
Planning Inspectorate	The executive agency of the Department of Communities and Local Government responsible for operating the planning process for NSIPs.
Preliminary Environmental Information Report	Defined in the EIA regulations as information referred to in part 1, Schedule 4 information for inclusion in environmental statements which has been compiled by the applicant and is reasonably required to assess the environmental effects of the development.
Project Description	A summary of the engineering design elements of Hornsea Four.
Ramsar Site	Wetlands of international importance, designated under the Ramsar Convention.
Sites of Community Importance	Sites that have been adopted by the European Commission in accordance with the Habitats Directives but not yet formally designated by the government of each country.
Special Area of Conservation	Strictly protected sites designated under Article 3 of the Habitats Directive for habitats listed on Annex I and animals listed on Annex II of the directive.
Special Protection Area	Strictly protected sites designated under Article 4 of the Birds Directive for species listed on Annex I of the Directive and for regularly occurring migratory species.
Transboundary	Crossing into other European Economic Area (EEA) states.

Acronyms

Acronym	Definition
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AEol	Adverse Effect on Integrity
AfL	Agreement for Lease
AoS	Area of Search
BEIS	Department of Business, Energy and Industrial Strategy
CD	Chart Datum
Cefas	Centre for Fisheries and Aquaculture Science
CfD	Contract for Difference
CIEEM	Chartered Institute for Ecology and Environmental Management
CMS	Construction Method Statement
CoCP	Code of Construction Practice
CRM	Collision Risk Modelling
cSAC	Candidate SAC
CTV	Crew Transfer Vessel
DCO	Development Consent Order
DIN	Dissolved Inorganic Nitrogen
DO	Dissolved Oxygen
DECC (now (BEIS)	Department of Energy and Climate Change (now Business, Energy and Industrial Strategy
dML	Deemed Marine Licence
EA	Environment Agency
EBI	Electrical Balancing Infrastructure
EC	European Commission
ECR	Export Cable Route
ECJ	European Court of Justice
EDR	Effect Distance Radius
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPS	European Protected Species
ES	Environmental Statement
HDD	Horizontal Direction Drill
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IFCA	Inshore Fisheries Conservation Authority
INNS	Invasive and Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
JNCC	Joint Nature Conservation Committee
JUV	Jack-Up Vessel
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effect

Acronym	Definition
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MSL	Mean Sea Level
MU	Management Unit
Natural England	Natural England
O&M	Operation and Maintenance
OnSS	Onshore Substation
OSS	Offshore Substation
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PEMMP	Project Environmental Management and Monitoring Plan
PINS	The Planning Inspectorate
pSPA	Possible Special Protection Area
PTS	Permanent Threshold Shift
RIAA	Report to Inform Appropriate Assessment
RLB	Red Line Boundary
rMCZ	Recommended MCZ
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCI	Site of Community Importance
SIP	Site Integrity Plan
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SoCG	Statement of Common Ground
SoS	Secretary of State
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
TJB	Transition Joint Bay
TPO	Tree Preservation Order
TTS	Temporary Threshold Shift
UK	United Kingdom
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator

Units

Unit	Definition
dB	Decibel
kJ	Kilojoule
km	Kilometre
km ²	Square kilometre
l	Litre
m	Metre
m ²	Square metre
m ³	Cubic metre
mg/l	Milligrams per litre
nm	Nautical mile

1 Introduction

1.1 Background to the project

- 1.1.1.1 This document comprises the Draft Report to Inform Appropriate Assessment (RIAA) for the Hornsea Project Four Offshore Wind Farm (hereafter Hornsea Four) promoted by Ørsted Hornsea Project Four Limited (hereafter the Applicant). The project will be comprised of a number of onshore and offshore elements, with the wind turbine array being located approximately 65 km east of Flamborough Head off the Yorkshire coast, within the UK's Exclusive Economic Zone (EEZ) ([Figure 1](#)). A full project description is provided in [Volume 2, Chapter 4: Project Description](#).
- 1.1.1.2 The power from the Hornsea Four array area to the UK National Grid will be transmitted using High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC) with up to six cable circuits installed within the export cable corridor. The offshore export cables will make landfall near Fraisthorpe. Electricity generated will be transported via a maximum of 18 onshore export cables buried in up to six trenches and an onshore HVDC converter/HVAC substation to allow the power to be transferred to the National Grid via the existing Creyke Beck National Grid substation.
- 1.1.1.3 The former Hornsea Zone is situated in the southern North Sea east of the Yorkshire Coast. The Hornsea Zone was one of several offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during the third round of wind licensing. Hornsea Four is the fourth proposed project in the former Hornsea Zone being brought forward by the Applicant.

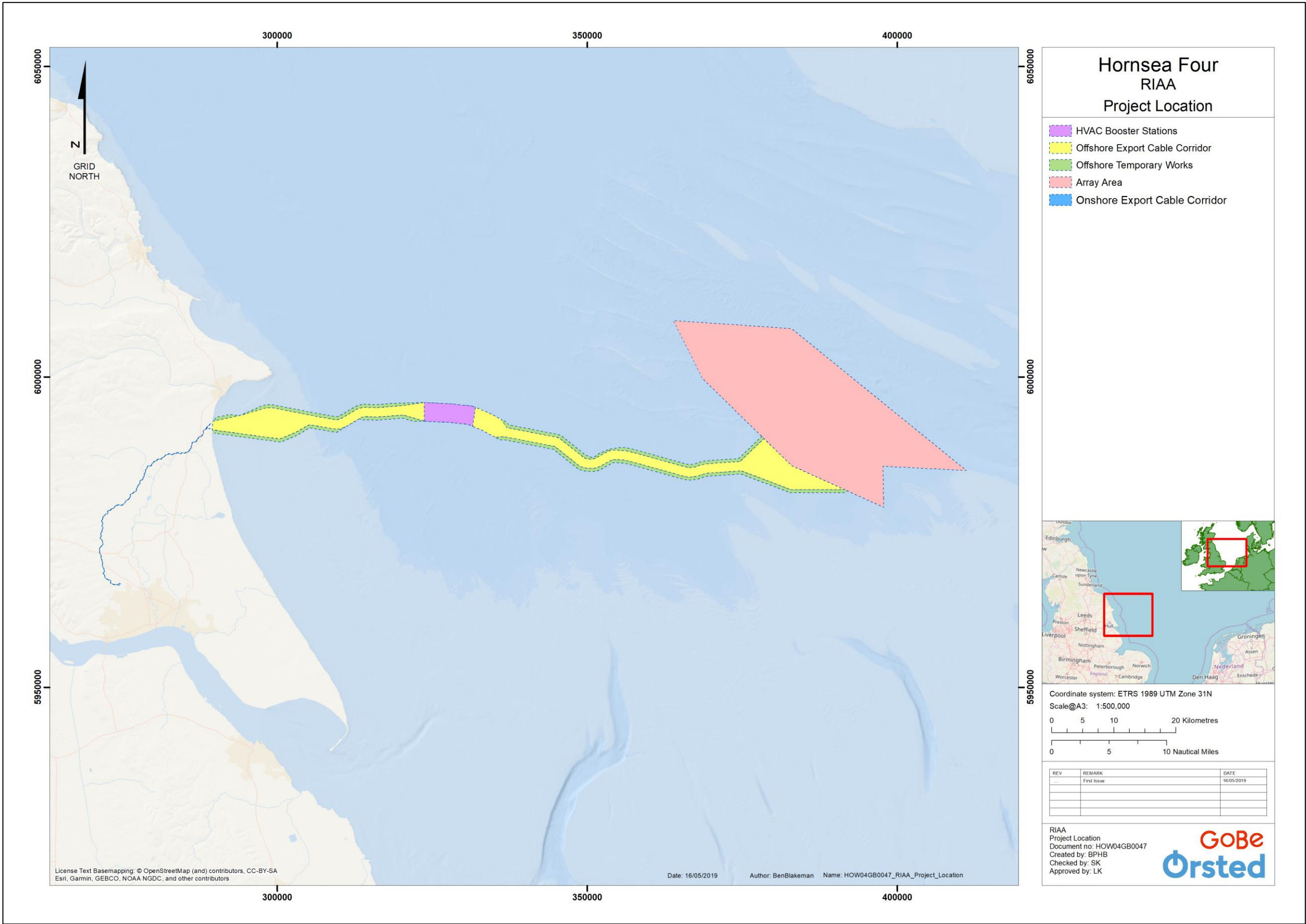


Figure 1: Hornsea Four development area (not to scale).

1.2 Purpose of the report

- 1.2.1.1 This report, together with the Appendices (the Screening Report ([Appendix A](#)) and an update to the Screening Report ([Appendix B](#)) together with the Screening and Integrity Matrices ([Appendix C](#) and [Appendix D](#)) has been issued as a draft, enabling consultation in the same timeframe as that for the Preliminary Environmental Information Report (PEIR). The RIAA will be updated and re-issued in-line with the Environmental Statement (ES) and the full application, when submitted to the Planning Inspectorate.
- 1.2.1.2 The European Commission's guidance on Assessment of plans and projects significantly affecting Natura 2000 sites, identifies a staged process to the assessment of the effects of plans and projects on European sites. Together, these stages are referred to as the Habitats Regulations Assessment (HRA), in order to clearly distinguish the whole process from the second stage within it, which is referred to as the 'Appropriate Assessment' (AA). There are potentially up to four stages to the HRA process:
- Screening;
 - Appropriate Assessment;
 - Assessment of alternatives; and
 - Assessment where no alternative solutions exist and where adverse impacts remain including Imperative Reasons of Overriding Public Interest (IROPI) and compensation.
- 1.2.1.3 This document has been produced as part of the overall HRA process for Hornsea Four. This report draws on the Screening Report ([Appendix A](#) to this report) undertaken in 2018. The Screening Report was issued to consultees on 8th October 2018, to accompany the project Scoping Report. A subsequent update to screening was issued to Natural England following their request on 28th May 2019 (receptors other than offshore ornithology) and 18th June 2019 (offshore ornithology) ([Appendix B](#)). A summary of the consultation process, including comments received and how/where these are addressed, is provided in [Section 5](#).
- 1.2.1.4 That Screening Report and subsequent updates have been appended to the current document ([Appendix A](#) and [Appendix B](#) to this report), but screening has not been revisited in its entirety here. Instead, an update to screening has been provided in [Section 8](#), which summarises any changes to screening since October 2018 (including those made in response to Natural England) and confirms the current position on screening. These changes have been made in response to revisions to the project red line boundary, comments received following screening, comments received during wider consultation and in response to project specific technical reports. [Section 8](#) will continue to document any changes to screening (and the driver for those changes) as the project progresses, to ensure the screening process remains 'live' and reactive to relevant changes.
- 1.2.1.5 This document applies the conclusions on the potential for a Likely Significant Effect (LSE), as drawn in the Screening Report, and updated here in [Section 8](#), with respect to the conservation objectives of the screened in European and Ramsar sites, to determine the potential for an Adverse Effect on Integrity (AEol) alone and or in-combination. It is the information on the potential for an AEol that is required by the competent authority (in this

case the Secretary of State (SoS) for Business, Energy and Industrial Strategy (BEIS)), although all potential LSE, including any that may be regulated by other competent authorities, have been addressed in order to undertake the AA (hence the document title 'Report to Inform Appropriate Assessment', or RIAA, applied here).

1.3 Project Literature

1.3.1.1 This RIAA has not been prepared in isolation, but instead follows a suite of documents prepared as part of the Preliminary Environmental Information Report (PEIR). The RIAA is considered a 'live document' and will subsequently be updated, as relevant, following PEIR and issued with the DCO Application. Key documents issued with the PEIR include technical reports (both for site-specific survey but also modelling and desk-based studies), with many of these being the key source documents for the information presented here. For ease of reference, and to minimise repetition, the main sources of project literature (including relevant PEIR chapters, technical reports etc) for the current report are as follows:

- Volume 1, Chapter 1: Introduction;
- Volume 1, Chapter 2: Planning and Policy Context;
- Volume 1, Chapter 3: Site Selection and Consideration of Alternatives;
- Volume 1, Chapter 4: Project Description;
- Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes;
- Volume 2, Chapter 2: Benthic and Intertidal Ecology;
- Volume 2, Chapter 3: Fish and Shellfish Ecology;
- Volume 2, Chapter 4: Marine Mammals;
- Volume 2, Chapter 5: Offshore and Intertidal Ornithology;
- Volume 3, Chapter 3: Ecology and Nature Conservation;
- Volume 3, Chapter 8: Noise and Vibration;
- Volume 3, Chapter 9: Air Quality;
- Volume 4, Annex 4.5: Subsea Noise Technical Report;
- Volume 5, Annex 1.1: Marine Processes Technical Report;
- Volume 5, Annex 2.1: Benthic and Intertidal Ecology Technical Report;
- Volume 5, Annex 3.1: Fish and Shellfish Ecology Technical Report;
- Volume 5, Annex 4.1: Marine Mammals Technical Report;
- Volume 5, Annex 5.1: Offshore Ornithology Baseline Characterisation Report;
- Volume 5, Annex 5.2: Offshore Ornithology Displacement Analysis;
- Volume 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling;
- Volume 6, Annex 3.1: Ecology and Nature Conservation Technical Report; and
- Volume 6, Annex 3.2: Extended Phase 1 Habitat Survey Report;
- Volume 6, Annex 3.3: Onshore Ornithology – Wintering and Migratory Birds Survey Report; and
- Volume 6, Annex 3.5: Great Crested Newt Survey Report.

1.3.1.2 It is noted in Advice Note 10 (PINS, 2017) that the EIA and HRA apply differently to decision making, with the ES informing the decision (its findings must be taken into consideration) whereas the Development Consent Order (DCO) can only be made if the decision-maker has followed the stages prescribed by the 2010 Habitats Regulations (see [Figure 2](#)).

Therefore, the information contained in the above chapters and documents, which will inform the subsequent ES, has been used to inform the decisions made here in the RIAA, with the RIAA following the prescribed stages.

1.3.1.3 Since the submission of the Hornsea Four Screening Report (Ørsted, 2018), a suite of onshore ecological field surveys have been undertaken. These surveys include:

- Overwintering and Migratory Bird Surveys – undertaken between November 2018 and March 2019 (inclusive);
- Updated Extended Phase 1 Habitat Survey (EP1HS) – February 2019;
- Great crested newt eDNA Survey – April and June 2019;
- Bat Activity Transect Survey – May to October 2019 (inclusive);
- Bat Static Detector Survey – May to October 2019 (inclusive);
- Bat Roost Emergence/Re-entry Surveys – June to August 2019 (inclusive);
- Breeding Bird Surveys – April to June 2019 (inclusive);
- Water vole and otter Presence/absence Survey – April and September 2019; and
- Badger Presence/absence Survey – February and September 2019.

1.3.1.4 At the time of submitting the Hornsea Four PEIR, some of the onshore ecological surveys listed above are ongoing and therefore not all survey findings are known at this time. This is due to the seasonal nature of survey periods for specific species. Approximately 50% of the onshore Hornsea Four boundaries has been covered at this time but, as noted above, survey work is ongoing, as part of the Phase 1 surveys, with more coverage to follow as part of Phase 2.

1.3.1.5 Details on the baseline information that is available is included within the onshore ecology and nature conservation PEIR chapter, [Volume 3, Chapter 3: Ecology and Nature Conservation](#). For those onshore ecological surveys that have been completed, the findings are reported within technical annexes which accompany the onshore ecology and nature conservation PEIR chapter as described above.

2 Structure of the RIAA

2.1.1.1 This document is set out in a number of stages that mirror the HRA process, with the overall structure of the document summarised below. It is noted that the RIAA as issued with the PEIR is a working document and therefore not all of these sections are fully complete at this point. Where gaps exist as a result of ongoing work prior to finalisation of the application, this has been noted in the relevant section (together with a comment as relevant as regards the status of the work). As the project progresses, these will be completed and updated as relevant within the RIAA that will accompany the application.

- **Section 1: Introduction.** Providing a background to the project, including the purpose of the project and where additional project related information (including baseline environment and impact assessment) can be found;
- **Section 2: Structure of the RIAA.** Providing an overview of the structure of the document and section headings;

- **Section 3: Legislation, Policy and Guidance.** To identify the legislation driving the need for the report, together with the policy and guidance defining the structure and content;
- **Section 4: Roles and Responsibilities.** Identifying key individuals and organisations with a role in the HRA process;
- **Section 5: Consultation.** Summarising the consultation undertaken, with whom, when, the issues raised, how and where these have been addressed. Including the Evidence Plan and need for Transboundary Consultation;
- **Section 6: Project Overview.** Drawing on the information presented in relevant chapters of the Preliminary Environmental Information Report (PEIR), providing the maximum adverse scenario for each receptor group including temporal and spatial aspects;
- **Section 7: Commitments.** To include project specific mitigation included per receptor group;
- **Section 8: The Screening Process for the Project Alone.** Summarising the screening undertaken, including the approach, conclusion on the potential for LSE and any changes to Screening following completion of the PEIR;
- **Section 9: The Screening Process for the Project In-Combination.** Presenting the approach to identifying the plans and projects to consider in-combination;
- **Section 10: Summary of Designated Sites.** Summarising site-specific information for all designated sites screened in;
- **Section 11: Assessment of Adverse Effect Alone.** Determination of whether the project alone will result in an adverse effect;
- **Section 12: Assessment of Adverse Effect In-combination.** Determination of whether the project in-combination with other plans and projects will result in an adverse effect;
- **Section 13: Transboundary Statement;**
- **Section 14: Conclusion of the Assessment.** Summarising the conclusions on adverse effect, alone or in-combination; and
- **Section 15: References.**

3 Legislation, policy and guidance

3.1 Legislative Context and Government Policy

- 3.1.1.1 The Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora, protects habitats and species of European nature conservation importance. Together with the Council Directive (2009/147/EC) on the conservation of wild birds (the 'Birds Directive'), the Habitats Directive establishes a network of internationally important sites, designated for their ecological status. SACs are designated under the Habitats Directive and promote the protection of flora, fauna and habitats. Special Protection Areas (SPAs) are designated under the Birds Directive in order to protect rare, vulnerable and migratory birds. These sites combine to create a Europe-wide 'Natura 2000' network of designated sites, which are hereafter referred to as 'European sites'.

- 3.1.1.2 Terrestrial areas of the UK, and territorial waters out to 12 nautical miles (nm), are covered under The Conservation of Habitats and Species Regulations 2017 (herein referred to as the Habitats Regulations) which transposes the European legislation into UK legislation. The Habitats Regulations incorporate all SPAs into the definition of 'European sites' and, consequently, the protections afforded to European sites under the Habitats Directive apply to SPAs designated under the Birds Directive.
- 3.1.1.3 The Conservation of Offshore Marine Habitats and Species Regulations 2017 (the Offshore Habitats Regulations) transpose the Habitats and Birds Directives into national law, covering waters beyond 12 nm, to the extent of the British Fishery Limits and UK Continental Shelf Designated Area.
- 3.1.1.4 In addition, UK Government policy (ODPM Circular 06/2005) states that internationally important wetlands designated under the Convention on Wetlands 1971, called the Ramsar Convention (Ramsar sites) are afforded the same protection as SPAs and SACs for the purpose of considering development proposals that may affect them. The Government also affords the same level of protection to potential SPAs (pSPAs) and candidate SACs (cSACs) and to sites identified, or required, as compensatory measures for adverse effects on any of the above sites.
- 3.1.1.5 Under the Habitats Regulations and the Offshore Habitats Regulations, before granting approval (i.e. planning permissions, licences and consents) for a development likely to have a significant effect on an SAC, SPA or Ramsar site, an appropriate assessment must be made by a Competent Authority of its implications for the site in view of that site's conservation objectives.
- 3.1.1.6 Of note are recent rulings by the ECJ, referred to here as Sweetman II or 'People over Wind'¹, and Holohan². The People over Wind ruling relates to how screening for potential Likely Significant Effect (LSE) is carried out, specifically that mitigation cannot be taken into account at that stage (but remains applicable for the determination of adverse effect). The Holohan ruling relates to the importance of species and habitats which are not a reason for the designation of the site but are relevant to the conservation objectives of the site (e.g. prey items of a designated species). Both these rulings have been taken into consideration during preparation of the HRA Screening Report and the RIAA.

3.2 Guidance Documents

- 3.2.1.1 A number of guidance documents are available regarding the HRA process and associated topics. Some of these have been issued at European level, others at UK level (or constituent country). Documents are available that provide guidance on the whole HRA process, part of that process, or are relevant to a particular receptor. A list of the available HRA guidance, as relevant to the current RIAA, is provided in [Appendix F](#); documents issued by the EC, UK Government (or devolved administrations) or statutory bodies are provided first,

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A62017CJ0323>

² <http://curia.europa.eu/juris/liste.jsf?language=en&td=ALL&num=C-461/17>

with documents issued by other agencies or organisations together with other relevant but not HRA specific guidance listed separately.

3.3 The HRA Process

- 3.3.1.1 The Habitats Regulations require that whenever a project that is not directly connected to, or necessary for the management of a Natura 2000 site, is likely to have a significant effect on the conservation objectives of the site (directly, indirectly, alone or in-combination with other plans or projects), then an Appropriate Assessment (AA) must be undertaken by the Competent Authority (Regulation 63 of the Habitats Regulations). The AA must be carried out before consent or authorisation can be given for the project.
- 3.3.1.2 PINS Advice Note 10 'Habitat Regulations Assessment relevant to national significant infrastructure projects' (Version 8, November 2017), defines HRA as a step by step process which determines potential LSE and (where appropriate) assesses adverse impacts on the integrity of a European site, examines alternative solutions, and provides justification of IROPI. As noted above in [Section 2](#), HRA includes a four-stage process, as summarised below and illustrated in [Figure 2](#).
- **HRA Stage 1 – Screening:** Screening for potential LSE (alone or in-combination with other projects or plans);
 - **HRA Stage 2 – Appropriate Assessment:** Assessment of implications of identified potential LSEs on the conservation objectives of a European site to ascertain if the proposal will adversely affect the integrity of a European site;
 - **HRA Stage 3 – Assessment of Alternatives:** Where it cannot be ascertained that the proposal will not adversely affect the integrity of a European site, alternative solutions must be considered; and
 - **HRA Stage 4 – Assessment of IROPI:** Where it can be demonstrated that there are no alternative solutions to the project that would have a lesser effect or avoid an adverse effect on the integrity of the European site(s), the project may still be carried out if the competent authority is satisfied that the scheme must be carried out for IROPI.
- 3.3.1.3 All four stages of the process are referred to as the HRA to clearly distinguish the whole process from the one step within it referred to as the 'AA'. The first stage (Screening), as noted above in [Section 3](#), has been completed for Hornsea Four alone and a summary available in [Section 8](#) (including updates to that screening where relevant). The full HRA screening is available in [Appendix A](#) of this report, with the subsequent updates to screening issued to Natural England available as [Appendix B](#) of this report. Screening for the Project in-combination is presented here in [Section 9](#). Where the screening process concludes the potential for a LSE, then there is a requirement for an AA (Stage 2). Screening for Hornsea Four has identified the possibility of LSE for certain features and effects. The required AA will be conducted by the SoS, with the information necessary to inform that assessment provided here in the RIAA. On the basis that no adverse effect has been concluded within the current report, there is no requirement to progress beyond Stage 2.

- 3.3.1.4 Included within Advice Note 10 is the need for two matrices to be completed; the Screening Matrix and the Integrity Matrix. These have been completed in the required format and are included in [Appendix C](#) and [Appendix D](#) of this report.
- 3.3.1.5 The integrity of a site has been defined as the coherence of the site's main ecological structure and function across the whole of its area, which enables it to sustain the habitat, complex of habitats and/ or populations of species for which the site has been designated (EC, 2001). An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status as it did at the time of designation.
- 3.3.1.6 PINS Advice Note 10 includes a number of points to be considered under Stage 2 and as such they have been considered in this RIAA. These are defined as follows (including the section where each is considered):
- Evidence about the project's impacts on the integrity of protected sites (consideration of adverse effect alone is presented in [Section 11](#));
 - A description of any mitigation measures proposed which avoid or reduce each impact, and any residual effect (mitigation measures, which apply to the assessment of integrity but not during screening, are set out in [Section 7](#), with conclusions on adverse effect summarised in [Sections 11](#) and [12](#));
 - A schedule indicating the timing of mitigation measures in relation to the progress of the development (timing of mitigation measures, where relevant, is included in [Section 7](#)), with conclusions on adverse effect summarised in [Section 14](#);
 - Cross references to the relevant DCO requirements and provisions that secure these mitigation measures, and identification of any factors that might affect the certainty of their implementation (as highlighted in [Section 7](#) on mitigation);
 - A statement as to which (if any) effects constitute an adverse impact on the integrity of European sites either alone or in combination with other plans or projects and therefore need to be included within the AA (a summary of the conclusions on the potential for an adverse effect alone or in-combination is provided in [Section 14](#)); and
 - Evidence to demonstrate that the applicant has fully consulted and had regard to comments received by the relevant Statutory Nature Conservation Bodies (SNCBs) during pre-application consultation (consultation conducted to July 2019 is described in [Section 5](#)).
- 3.3.1.7 Stages 3 and 4, as outlined within [Figure 2](#), are only required where a conclusion of adverse effect on integrity is drawn following Stage 2.

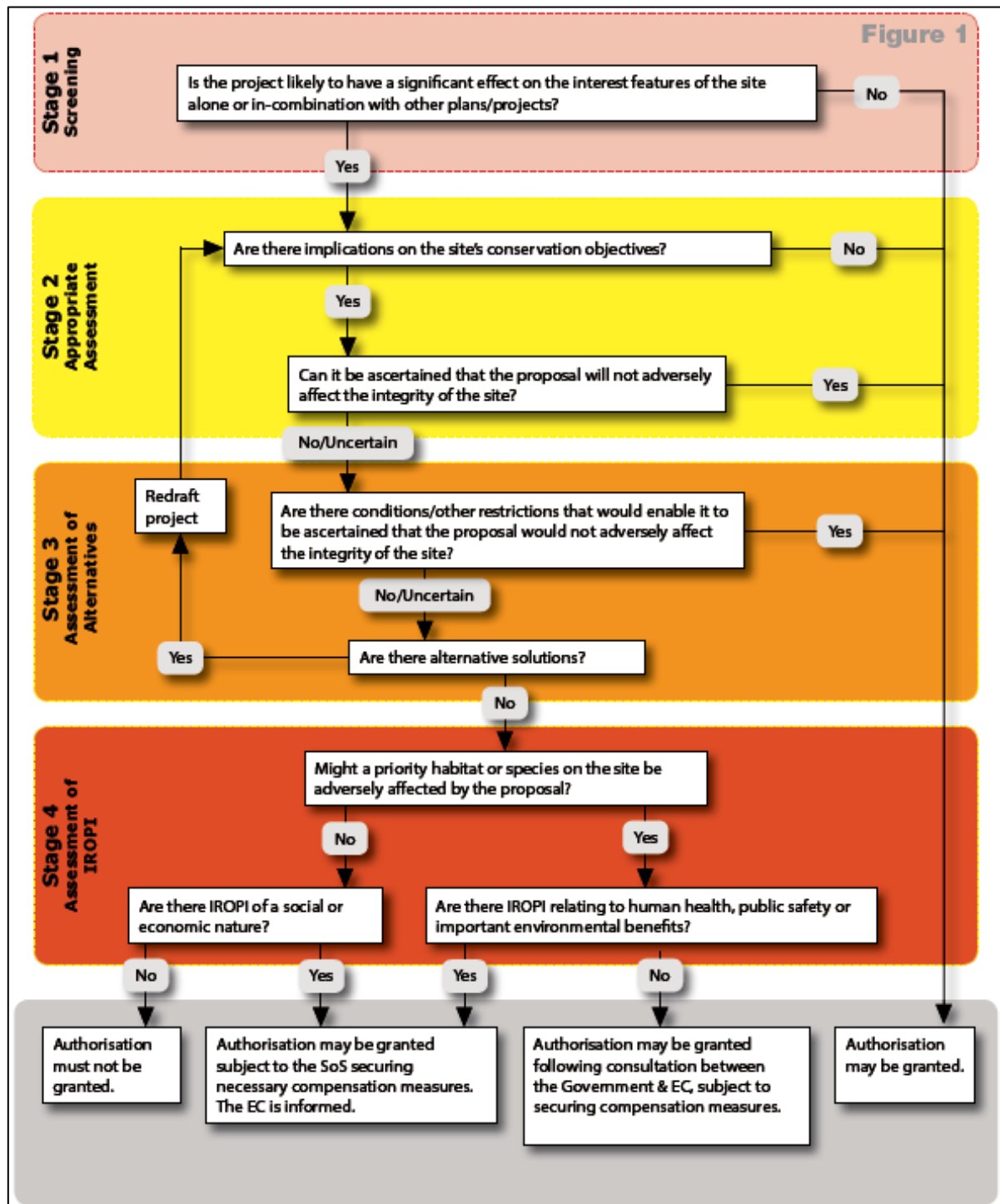


Figure 2: HRA Stages (from PINS, 2006).

4 Roles and responsibilities

- 4.1.1.1 The purpose of a RIAA is to provide the information to the Competent Authority (in this case the SoS for BEIS), in consultation with the relevant SNCB (in this case Natural England and JNCC), required to enable them to undertake the AA. Consultation with SNCBs (and other relevant bodies) prior to Application provides the process through which assurances can be sought that all potential effects have been addressed appropriately and in sufficient detail. Consultation during Examination result will inwill resulting in Statements of Common Ground (SoCG) that identify areas of agreement and disagreement between Applicant and SNCB (and other relevant bodies). Wider consultation (including the role of the Evidence Plan Process) is discussed below in [Section 5](#).
- 4.1.1.2 This RIAA (and any supporting documentation, notably the attached appendices) produced as part of the application for a DCO for Hornsea Four provides the information required by the competent authority to enable it to undertake an appropriate assessment of the implications of the project on the integrity of designated interests of relevant European sites (in accordance with Article 6(3) of the Habitats Directive) and any relevant Ramsar sites (relevant site designations defined in [Section 3](#) above).

5 Consultation

- 5.1.1.1 Extensive consultation has been ongoing for Hornsea Four since the Scoping Report was issued in October 2018. For PEIR submission, consultation to date is presented in [Volume 1, Chapter 6: Consultation](#), with a Consultation Report to be submitted with the application. Consultation undertaken specifically with regard to the HRA process has been, and will be managed through the following:
- Consultation on the Scoping Report (COMPLETE, with consultation relevant to the HRA process summarised in this RIAA in [Table 1](#) and taken into account within the draft RIAA);
 - Consultation on the Screening Report (COMPLETE, with all comments received until the 4th of July 2019 summarised in this RIAA in [Table 1](#) and taken into account within the draft RIAA);
 - Meetings of the Hornsea Four Evidence Plan (ONGOING, with all comments received until the end of June 2019 summarised and taken into account within the draft RIAA);
 - Consultation on the draft RIAA (to be undertaken following issue of the PEIR, with all comments received prior to submission of the application to be summarised and taken into account within the RIAA at the point of application); and
 - Preparation of a Statement of Common Ground (SoCG) (submission finalised during Examination).
- 5.1.1.2 The above is therefore consistent with the 'live document' approach adopted to the RIAA, in that screening and assessment has been updated during the course of the assessment and consultation process, and will continue to be so until the point of Application.

5.2 Transboundary Consultation

- 5.2.1.1 PINS Advice Note 10 (PINS, 2017) notes that where an application is 'likely to have a significant effect (either alone or in-combination) on a Natura 2000 site in another Member State, the applicant should obtain and provide all relevant information, as reasonably practicable with their DCO application'. That position is reiterated by DECC in their 2015 guidance on transboundary impacts on Natura 2000. DECC (2015) went on to say that 'the format and extent of transboundary consultation is for the applicant to agree with the Planning Inspectorate'.
- 5.2.1.2 It is anticipated that PINS will undertake Transboundary Screening following the Applicant's request for a Scoping Opinion and again following the Application. Copies of such consultation are expected to be made available on the PINS website³. No transboundary responses have been received up to as of July 2019. Any consultation subsequent to PEIR (and up to the point of application) will be included within an updated RIAA at application. It should be noted that the Screening Report (appended here at [Appendix A](#)) undertook screening for all sites/features, regardless of the member state within which they occur; where transboundary sites were screened in for potential LSE, these are included within the RIAA.
- 5.2.1.3 The RIAA provides the information necessary for transboundary consultation on HRA matters, initially through the identification of transboundary sites where potential LSE applies in relation to the project alone in the Screening Report, followed by consideration of potential LSE in-combination (drawing on recent Examination stages of similar projects in the region and the transboundary projects identified during that process) and the determination of adverse effect alone or in-combination made here within the RIAA. That information is provided to inform the AA, to be undertaken by the SoS.

5.3 The Evidence Plan Process

- 5.3.1.1 The Evidence Plan process has been followed during the drafting of the RIAA and includes a number of relevant authorities and stakeholders although not all provide comment directly on the HRA process. All those organisations involved in the Evidence Plan Process (as relevant to the RIAA) are as follows:
- Natural England;
 - Eastern IFCA;
 - Northern IFCA;
 - East Ridings of Yorkshire Council;
 - Marine Management Organisation;
 - Marine Scotland Licensing Operations Team;
 - The Wildlife Trust (and the Yorkshire Wildlife Trust);
 - The Environment Agency;
 - Cefas;

³<https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/hornsea-project-four-offshore-wind-farm-generating-stations/?ipcsection=docs>

- JNCC; and
- Royal Society for the Protection of Birds.

5.3.1.2 To date (July 2019), no response has been received from the Environment Agency, Northern IFCA, Cefas, JNCC or SNH. A summary of consultation responses received until the end of June 2019 is provided below in [Table 1](#).

5.3.1.3 The Evidence Plan process has been managed through a series of Technical Panel meetings, with meetings held until PEIR (and with comment on the RIAA) summarised in [Table 1](#) below. Such meetings will continue after issue of the PEIR and up to submission of the Application. Comments aimed at the PEIR and subsequent ES more widely have been incorporated into those documents, on which the RIAA draws, and have therefore been taken into account during the preparation of the RIAA where relevant. Such comments are therefore not repeated here but are summarised within the following documents (including reference to where and how each comment has been addressed):

- Comments made in relation to subtidal and intertidal benthic ecology are summarised in [Table 2.6](#) of [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#);
- Comments made in relation to marine mammals are summarised in [Table 4.3](#) of [Volume 2, Chapter 4: Marine Mammals](#);
- Comments made in relation to offshore ornithology are summarised in [Table 5.3](#) of [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#);
- Comments made in relation to onshore ecology are summarised in [Table 3.4](#) of [Volume 3, Chapter 3: Ecology and Nature Conservation](#); and
- Comments made in relation to migratory fish are summarised in [Table 3.5](#) of [Volume 2, Chapter 3: Fish and Shellfish Ecology](#).

Table 1: Summary of Consultation Relating to the HRA Process.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
Meeting as part of the Evidence Plan Process 12/09/2018	Natural England	<p>Natural England agreed that a 16km buffer would be appropriate for benthic and intertidal ecology features.</p> <p>Natural England agreed that the terrestrial elements of Flamborough Head SAC could be screened out.</p> <p>Confirmed that the People over Wind ruling means mitigation cannot be taken into account for screening.</p> <p>Lamprey should be considered.</p> <p>Natural England confirmed that the approach to HRA screening seemed appropriate.</p>	Section 8
Scoping Opinion – November 2018	PINS	HRA will be required	Noted
	MMO (contained within PINS)	The MMO notes that UXO clearance will not be included in the application at this stage, however a high-level assessment will be provided. A detailed assessment of UXO clearance will be developed for a separate marine licence at a later stage. The MMO considers that this is a reasonable approach.	UXO assessed alone (Section 11) and in-combination (Section 12)
		The MMO notes the proposals of soft start procedures and a Marine Mammal Mitigation Protocol (MMMP) as part of noise mitigation. The MMO acknowledges that these are the standard measures typically proposed for OWF developments and support that a MMMP will be implemented.	Mitigation identified in Section 7 .
		Noise mitigation at source should be considered as a primary means of reducing the potential acoustic impact of pile driving operations.	Mitigation is included as necessary to ensure compliance (see Section 7).
		The MMO recommends the JNCC guidance to use a threshold approach for assessing potential impacts of underwater noise in the Southern North Sea cSAC, and subsequent management, of noise disturbance in the harbour porpoise cSACs.	Threshold approach applied alone (Section 11) and in-combination (Section 12).
		The MMO wish to make the applicant aware a European Protected Species licence application should accompany a marine licence application for UXO works.	Noted.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		The MMO agree that the impacts in relation to noise, accidental release of pollutants and indirect disturbance from electromagnetic fields (EMFs) generated by cables to benthic communities can be scoped out based on the available literature and the mitigation proposed.	Noted.
		The Environment Agency carry out fisheries surveys to monitor coastal and transitional waters, including the river Humber. Data can be downloaded via; https://data.gov.uk/dataset/41308817-191b-459d-aa39-788f74c76623/trac-fishcounts-for-all-species-for-all-estuaries-and-all-years	Dataset accessed and referenced in Appendix F .
	Natural England (contained within PINS)	In accordance with the 2010 Habitats Regulations (as amended) 61(2) anyone applying for development consent for an NSIP must provide the competent authority with such information as may reasonably be required “for the purposes of the assessment” or “to enable them to determine whether an appropriate assessment is required”. The SNCBs advise that this information should therefore be provided and appraised as part of the EIA process.	Noted. That information is contained within the RIAA and Annexes.
		Key environmental issues: Potential effects on birds: displacement, indirect effects (prey species) and collision mortality –alone or in-combination. Potential effects on marine mammals: construction noise– alone or in-combination. Potential impacts on designated site features along the offshore export cable route – alone or in-combination. Potential impacts at the landfall location both alone or in-combination/cumulative other sea defence and coastal infrastructure projects.	Effects considered for Screening (Section 8 and Section 9) and assessment alone (Section 11) and in-combination (Section 12).
		Possible modelling of UXOs is mentioned. An assessment albeit a simple one, will be required to assess the impact of UXOs alone or in combination with other underwater noise producing activities.	Effects considered alone (Section 11) and in-combination (Section 12).
		Existing benthic data do not cover the whole of the Hornsea Project Four array area (c. 20% has not been surveyed), most of the Array Export Cable Corridor Funnel and the whole of the Marine Export Cable Corridor (ECC), with some	Noted. However the cable corridor has been amended to avoid physical overlap with sites designated for benthic features.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		coverage on the Nearshore ECC Funnel. There is a certain degree of uncertainty regarding these unsurveyed areas. Additionally, there is limited detail on cable installation and potential for cable protection.	Mitigation is given in Section 7 , with the assessment alone (Section 11) and in-combination (Section 12).
		Natural England is unable to agree that the mitigation measures described are suitable to manage and mitigate all potential effects of Hornsea Four on marine mammal receptors.	Noted. Mitigation will be revisited on completion of the assessment.
		Natural England has been discussing the lack of evidence on operational noise levels of large turbines with others in order to develop a scope of work to gather that empirical evidence. We recommend that this remains scoped in until further evidence has been generated to show that the risk is low.	Noted Operational noise screened in for potential LSE for sites with physical overlap with the array boundary.
		We advise that the developer use data collected from tracking studies from Bempton Cliffs and other colonies, for example Langston <i>et al.</i> (2013) and Wakefield <i>et al.</i> (2017), as well as sensitivity analyses such as SeaMAST, to fully characterise the importance of the Hornsea Project Four site for SPA species.	Noted. These data sources and others were used to characterise the baseline for Hornsea Four and where applicable in assessments within this RIAA.
		There is little mention of impacts during migration. This will apply both to migrating seabirds (e.g. gannets in autumn and spring) and to migrating waterbirds travelling to/from breeding areas to winter in SPAs. This might particularly apply to waterbird features of east coast SPAs such as the Humber Estuary SPA, Hornsea Mere SPA, The Wash SPA, and the Greater Wash SPA for little gull.	Consideration of migratory seabirds and non-seabirds has been afforded within the assessment of all designated sites included in this RIAA
		We do not agree that disturbance / displacement issues (in any period) requires only 'simple' assessment, particularly in the context of impacts on SPA waterbirds or seabirds. We also note that displacement effects from different phases of the development (especially construction – operation) should be considered cumulatively rather than in isolation.	Consideration of displacement is provided, where necessary, for potentially effected species from all designated sites within this RIAA.
		The potential inter-related effects on offshore ornithology do not appear to have been robustly considered. For example, marine process impacts on the	An inter-related effects screening exercise was undertaken at Scoping. For the ES and final

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		Flamborough-Helgoland Front have the potential to affect prey availability for breeding seabirds.	application, a standalone inter-related effects chapter will be submitted.
		There will be plenty of colony-specific data from Flamborough & Filey Coast SPA to inform the seasonal definitions for breeding features. Natural England advises the use of the full breeding seasons set out in Furness (2015) rather than the 'migration-free' breeding seasons, unless compelling evidence to do otherwise is produced.	Use of the most recent colony counts from Aitken <i>et al</i> (2019) have been referenced within this RIAA, whilst the generic bio-seasons from Furness (2015) have been relied upon for the assessments.
		The ES should present a more comprehensive assessment of the potential impacts on passage little gull, as 'snapshot' DAS may not detect main movements. Previous Hornsea projects have used the migratory CRM to consider such impacts, whilst Norfolk Vanguard have explicitly assessed the impacts to the Greater Wash SPA, now a fully classified site.	Consideration of migratory seabirds and non-seabirds has been afforded within the assessment of all designated sites included in this RIAA
		The EIA should consider barrier effects across the breeding season for relevant species, including adult guillemot and razorbill swimming with their chicks from the colony to offshore waters. The modelling work carried out by CEH for the Firth of Forth and Tay windfarms should be considered as a potential method to quantify the impacts of barrier effects and also displacement as regards SPA productivity and adult mortality.	Consideration of barrier effect on seabirds has been completed in the assessment of all relevant species / designated sites included in this RIAA.
		<p>Cable maintenance should be considered cumulatively with the construction and operation/maintenance of the array for sensitive receptors, such as Greater Wash SPA red-throated diver, rather than scoped out. Mitigating the impacts is likely to require more than selecting a route avoiding high concentrations of the species (though that is welcomed): other standard mitigation measures have been proposed and adopted for other offshore wind projects.</p> <p>A buffer zone around the export cable corridor to assess red-throated diver disturbance will need to be used, as disturbance reactions to boats can occur at ~2 km. All available data sources should be used to characterise the use of inshore waters by red-throated diver and inform the likely impact to the Greater Wash SPA, for example the JNCC report informing SPA classification (Lawson <i>et al.</i> 2015), SeaMaST, and Marine Ecosystems Research Programme</p>	Consideration of potential disturbance and displacement effects on red-throated diver from the Greater Wash are included in Section 11.3.1 .

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		density maps. We note that the inshore waters to the north of the Greater Wash SPA (not surveyed in Lawson <i>et al</i> 2015), are also known to support appreciable numbers of red-throated divers in the winter.	
		The onshore scoping document does not include reference to Internationally designated sites (Ramsar, SAC, SPA). Natural England advise that sites of international importance are scoped into the assessment in order to allow consideration of alone or in combination effects. In particular the Greater Wash SPA, which overlaps with the potential landfall corridor, should be within the scope.	Onshore screening has been revisited, see Section 8.9.4 . The export cable corridor and landfall no longer have physical overlap with the Greater Wash SPA (being > 1.5km at the nearest point). No features were screened in via the IRZ approach and therefore the site remains screened out for onshore ecology, but remains screened in for birds (the designated features).
HRA Screening Report – November 2018	Eastern IFCA	Do not intend to make a formal response.	Noted
HRA Screening Report – November 2018	ERYC	No comment on offshore matters	Noted
		Agree with the proposed screening criteria and the approach to the in-combination assessment.	Noted
		Noted the need to consider impact risk zones (IRZ) onshore, especially for pink footed goose.	Onshore screening has been revisited, see Section 8.9.4 .
HRA Screening Report – November 2018	MMO	The MMO defer to any comments made by Natural England as the Statutory Nature Conservation Body.	Noted
HRA Screening Report – November 2018	MS-LOT	No response to the consultation but recommended contacting SNH.	SNH contacted 19 November 2018 (no response received to date).
HRA Screening Report – November 2018	The Wildlife Trust	We note that the cable site boundary touches Flamborough Head SAC. TWT does not support cable routing within this site. We are pleased that Orsted has committed to avoiding cabling within all marine designated sites (commitment 86 of the Commitments Register within the Scoping Report). TWT requests to work with Orsted to ensure that this commitment is withheld and any cable routing through marine designated sites are avoided.	The cable corridor has been amended and the RLB avoids all N2k sites, with the exception of the SNS SAC (within which the array is located).

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
HRA Screening Report – October 2018	RSPB	We consider that the data sources listed in paragraph 3.4.1.2 are appropriate to inform the screening process for the offshore and intertidal ornithological sites and interest features for the Hornsea Four HRA Screening Report.	Noted
		It is important to note that the RSPB was given no opportunity to comment on the proposed survey methodology for the Hornsea Four array area and has instead been presented with the final data. Given the proximity of the array area to the Flamborough Head and Bempton Cliffs SPA and Flamborough and Filey Coast pSPA it is not possible for us to state at this point that the methods used and in particular the manner in which the resultant data are presented will not create difficulties in understanding the distribution of the seabirds or the implications for the potential to construct an offshore wind farm at this location.	Noted
Ecology and nature conservation Technical Panel Meeting #2 – January 2019	Ecology and Nature Conservation Evidence Plan Technical Panel	Natural England raised that Impact Risk Zones (IRZ) should be used to determine any potential impacts on European Sites from Hornsea Four, rather than a standard 2k/5k buffer	The use of IRZs is outlined, with associated figures, in Volume 3, Chapter 3 Ecology and Nature Conservation of the PEIR
Ecology and nature conservation Technical Panel Meeting #3 – April 2019	Ecology and Nature Conservation Evidence Plan Technical Panel	Natural England were presented with the information that the IRZ data had been used in combination with a search regarding impacts on European Sites and that there were no such sites onshore, and no impact zones from offshore sites on the onshore Hornsea Four boundaries	The use of IRZs is outlined, with figures, in Volume 3, Chapter 3 Ecology and Nature Conservation of the PEIR
Hornsea Four HRA Screening Report Telcon with Natural England	Natural England	Natural England raised a query with regard to the potential for over-wintering pink footed geese in agricultural landscapes within the onshore Hornsea Four boundaries.	Hornsea Four conducted an over-wintering and migratory bird survey between November 2018 and March 2019 (inclusive). No pink footed geese were recorded during the survey. Fully survey details are reported in Volume 6, Annex 3.3: Onshore Ornithology – Wintering and Migratory Birds Survey Report of the PEIR.
15 May 2019	Natural England	Natural England confirmed that March/September are the windows for updating designated site advice, with March 2019 updates including FFC SPA.	Section 9 updated.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
Technical Panel Meeting Screening Response 1 st May 2019		Natural England confirmed that it is appropriate to provide cross referencing to baseline information in topic specific chapters, with that information not repeated in the RIAA.	Noted.
		Screening Response to follow.	Noted. The Screening Response from Natural England was issued on 1 May 2019.
	Natural England	FFC SPA – please note that the site is fully classified and no longer a pSPA. The site includes the FHBC SPA, with assessment for the latter no longer required.	Noted and amended throughout.
		Approach to screening – the proportionate EIA approach is not suitable for HRA.	Discussed at steering group meeting on 28 May 2019 and confirmed that HRA Screening differs to EIA Scoping. HRA Screening revisited following that meeting (Section 8).
		The significance test is a coarse filter and Natural England did not agree with progressing beyond Table 4.9 of the Screening Report.	Discussed at steering group meeting on 16 May 2019. The importance of a pathway to link a receptor and effect stressed, with screening revisited and issued for comment from Natural England (28 May 2019 for receptors other than offshore ornithology, offshore ornithology on 10 June). Screening updated in Section 8 .
		Overlap with FFC SPA.	RLB amended and no overlap remains (Section 9).
		Natural England agrees with the receptor ranges for cetaceans, the management units considered for bottlenose dolphin and harbour porpoise. For harbour seal sites within the South East management unit should be considered and for grey seals sites within North East and South East management units should be considered.	Noted that Natural England agrees with receptor ranges for cetaceans. Screening for seals re-visited following PEIR drafting (Section 8).
		Natural England considers that both the Maximum and Mean maximum foraging ranges from Thaxter <i>et al.</i> (2012) are used to determine species connectivity for Hornsea Four, as well as any relevant species-specific tracking / tagging study data.	Noted. The Max and Mean Max foraging ranges have been used from Thaxter <i>et al.</i> (2012) as well as tracking / tagging study data, where available and relevant.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		For terrestrial sites, Natural England advises the use of the Impact Risk Zones (IRZ) for screening.	Applied and confirms all terrestrial sites/features screened out (Section 8)
		Criteria 2 (Table 4.4) The header suggests that migratory and over wintering species are being considered in here, but they do not appear to have been. Natural England requested this to be revisited, where applicable.	Species and designated sites from which those species may be connected to were considered appropriately within all of the criteria laid out. In response to Natural England's request these criteria and the outcomes from them were clearly presented within the HRA Screening revisited.
		Natural England do not agree with screening out seabird species (and associated designated sites) solely in response to being recorded on less than ten occasions within the Scoping boundary area from site-specific surveys.	Further consideration of species was provided for within the HRA Screening revisited and any new species and designated sites identified through that process are included within this RIAA.
		Table 4.7: Fulmar, kittiwake, herring gull and lesser black-backed gull form part of the seabird assemblage feature of the Farne Islands SPA and Coquet Island SPA; additionally razorbill and great black-backed gulls are part of the seabird assemblage feature of the Farne Islands SPA.	Consideration is provided within the assessments in this RIAA for all species connected to designated sites, with highest priority provided to qualifying features and named features within general seabird assemblages for all sites.
		Mitigation and potential LSE Screening.	It can be confirmed that mitigation has not been a consideration when determining potential LSE.
		Table 4.9: • Greater Wash SPA – common scoter is classified for a non-breeding rather than migratory population in this SPA. • Farne Islands SPA/Coquet Island SPA - please see our comments on Table 4.7 regarding these SPAs and revise these rows accordingly.	Noted. These two issues were addressed in the HRA Screening revisited report and the appropriate site-specific assessments in this RIAA.
		Consider beyond 4.2 to fall outside HRA Screening.	Beyond 4.2 takes account of a pathway for the effect and is therefore a valid and necessary part of screening. Discussed at the 16 May 2019 meeting, with screening reissued on 28 May and 10 June to Natural England for comment.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
Response to update to Screening (received 4 th July 2019)	Natural England	Questioned the consideration of coastal processes with respect to benthic ecology. Including sediment flow into the Humber Estuary SAC and Ramsar alone or in-combination.	Further consideration provided in Section 8.9.1 , concluding no LSE.
		Highlighted the need to consider potential LSE alone or in-combination.	Screening initially carried out alone (with updates to that, including final conclusions on screening alone, presented here in Section 8). Screening in-combination is presented in Section 9 .
		Would expect the information provided for collision risk in harbour porpoise at the SNS SAC to be 'NA' given the conclusion of no LSE.	Noted. Collision risk screened out for the project alone but included for potential LSE in-combination for the SNS SAC.
		Potential LSE in-combination for vessel disturbance and the SNS SAC (construction, O&M and decommissioning).	Vessel disturbance included here as per Section 8 (screening alone) and Section 9 (screening in-combination).
		Consideration of a prey for the SNS SAC and Humber Estuary grey seals should remain in consideration until PEIR has reported. Potential case for prey for Berwickshire and North Northumberland Coast grey seal to be screened out.	Considered in Section 8.9.2 for each relevant site. All confirmed as screened out from potential LSE.
		Question on potential for sandwave levelling in the SNS SAC and where disposal sites will be located.	Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes considers sandwave levelling within the Array boundary and ECC). Some levelling is therefore likely within the SNS SAC. The potential for impact is described in Section 1.11.1 , concluding no impact on coastal processes. Section 3.11.1 of Volume 2, Chapter 3: Fish and Shellfish Ecology considered the potential impact on harbour porpoise prey from the sediment released, concluding negligible for sandeel. As previously concluded in Table 5.1 of the Appendix A , harbour porpoise are not considered sensitive to the short lived increases in suspended sediment levels predicted. No need to re-consider the issue for potential LSE here.

Date and consultation phase/ type	Consultee	Consultation and key issues raised	Section where comment addressed
		Natural England will only comment on English sites (not Scottish or transboundary).	Noted
		Not much connectivity expected between the Wash harbour seal population, with potential for the site to be screened out subject to PEIR.	Noted and agreed. However, site currently remains screened in on a precautionary basis. Potential for revision for the RIAA submission at application.
		Humber Estuary and Berwickshire and North Northumberland Coast grey seal collision risk – needs to consider potential for LSE in-combination.	Noted. Collision risk screened out for the project alone but considered for potential LSE in-combination for the Humber Estuary SAC and Ramsar only (distance to Berwickshire and North Northumberland SAC is located a considerable distance from Hornsea Four and not considered for potential LSE).
		Questioned sea lamprey migration risk.	potentialpotential Sea lamprey now screened out in all cases following the removal of accidental pollution from potential LSE (see Sections 8)
		Long term physical habitat loss within the SNS SAC during O&M needs to be quantified.	That is quantified in Section 8.9.2 , where it is clear that 0.0001% loss of water column and 0.01% loss of benthic habitat for the duration of the project does not present potential for LSE.
		Referenced the phrase 'long term physical loss of habitat' with respect to the Flamborough Head SAC and stated a preference for referring to 'direct habitat loss'.	Noted. The term has been applied to differentiate from a temporary loss of habitat. The effect can also include nay indirect habitat loss (should any be apparent from assessments, which have not been found in PEIR).
		Operational underwater noise impacts alone or in-combination need to be based on the potential for impact from Hornsea Four. Referenced with respect to harbour seal and grey seal sites only.	Noted. Screened in for potential LSE for harbour porpoise and the SNS SAC only. Section 8.9.2 summarises the changes to potential LSE, including on operational noise, with the effect considered alone in Section 11 .

6 Project Overview

6.1 Introduction

- 6.1.1.1 At this early stage in the Hornsea Four development process, the project description is indicative and the 'envelope' has been designed to include sufficient flexibility to accommodate further project refinement during detailed design, post consent. The proposed wind farm array area is 600 km², located approximately 65 km from the Yorkshire coastline at its closest point. A maximum of 180 wind turbines is proposed, with the maximum rotor blade diameter of 305 m and the maximum blade tip height above LAT of 370 m. The ultimate capacity of the project can only be determined post-consent based on technical and commercial factors, for example the capacity awarded at auction.
- 6.1.1.2 The power from the Hornsea Four array area to the UK National Grid will be transmitted using High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC) with up to six cable circuits installed within the export cable corridor. Hornsea Four requires flexibility in the choice of transmission system to ensure that anticipated changes in available technology and project economics can be accommodated within the Hornsea Four design.
- 6.1.1.3 The offshore export cables will make landfall south of Bridlington. Electricity generated will be transported via a maximum of six circuits installed in six trenches and an onshore HVDC converter/HVAC substation to allow the power to be transferred to the National Grid via the existing Creyke Beck National Grid substation.
- 6.1.1.4 Full details on the project description are presented within the PEIR, specifically in [Volume 1, Chapter 4: Project Description](#). It is noted that for a number of aspects of the project, a range of options are available, particularly during the construction phase. To manage the potential for impact, and in line with both the PEIR and PINS Advice Note 9: Rochdale Envelope, the project elements that represent the maximum adverse scenario for each topic (the 'Rochdale Envelope') have been identified and taken forward.
- 6.1.1.5 The Screening report identified a number of receptor groups, with the topic specific worst-case scenario for each group presented within the relevant chapter from the PEIR. The receptor groups are outlined below, together with the relevant PEIR chapter.
- Benthic and Intertidal Ecology ([Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#));
 - Marine Mammals ([Volume 2, Chapter 4: Marine Mammals](#));
 - Offshore and Intertidal Ornithology ([Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#));
 - (Onshore) Ecology and Nature Conservation ([Volume 3, Chapter 3: Ecology and Nature Conservation](#)); and
 - Migratory fish (Fish and Shellfish Ecology) ([Volume 2, Chapter 3: Fish and Shellfish Ecology](#)).

- 6.1.1.6 The relevant worst-case scenarios applied here, and drawing on the above PEIR chapters, are described below.

6.2 Project Description

- 6.2.1.1 The project description is described in detail in [Volume 1, Chapter 4: Project Description](#). Impact-specific maximum design scenarios relevant to the RIAA are described in [Appendix G](#).

6.2.2 Hornsea Four array area

- 6.2.2.1 The Hornsea Four array area is approximately 65 km due east of Flamborough Head, at its closest point and adjacent to Hornsea Project Two on the eastern boundary. Water depths generally vary from around 30 m below Chart Datum (CD) in the south of the Hornsea Four array area to more than 60 m below CD in the north, although the greatest depths are on the north-eastern flank which shelves into Outer Silver Pit. Sandwaves are present within the Hornsea Four array area, particularly across the north western corner and also along the southern margin. Surficial sediments across the Hornsea Four array area are typically sandy material with small amounts of gravel and muds. The main exception is along the southern boundary where there is a slightly higher percentage of gravels and a coarser substrate described as slightly gravelly sand

6.2.3 Hornsea Four offshore export cable corridor

- 6.2.3.1 Depths across the Hornsea Four offshore export cable corridor are relatively similar to the Hornsea Four array area until closer to the coastline. Sediments across the Hornsea Four offshore Export Cable Corridor show an increasing gravel content towards the coast, transiting from the sandy Hornsea Four array area into slightly gravelly sand, gravelly sand to sandy gravel. The beach at landfall, south of Bridlington, itself is a thin veneer of sand over rock.

6.2.4 Hornsea Four onshore export cable corridor

- 6.2.4.1 Underground cables will connect the landfall first to the onshore substation and then on to the National Grid substation at Creyke Beck. Where possible and practical, less intrusive construction methods will be adopted (see Co1 in [Volume 4, Annex 5.2](#) of PEIR) All main rivers, Internal Drainage Board (IDB) maintained drains, main roads and railways will be crossed by HDD or other trenchless technology as set out in the Onshore Crossing Schedule (see [Volume 4, Annex 4.2](#) of PEIR). Where HDD technologies are not practical, the crossing of ordinary watercourses may be undertaken by open cut methods. In such cases, temporary measures will be employed to maintain flow of water along the watercourse. Cables will be delivered in sections and buried in trenches, which will subsequently be reinstated to pre-existing condition as far as reasonably practical. Sections will be connected within jointing bays.

6.2.5 Hornsea Four onshore substation

- 6.2.5.1 The onshore substation will be located as close as practical to the National Grid substation at Creyke Beck and will include all necessary electrical plant to meet the requirements of the National Grid. The onshore substation contains the electrical components for transforming the power supplied from the wind farm to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid.

6.2.6 Hornsea Four electrical balancing infrastructure

- 6.2.6.1 Hornsea Four will incorporate Energy Balancing Infrastructure (EBI) to provide valuable services to the electrical grid; such as importing, storing and exporting energy to meet the grid needs and improve stability and reliability. Because the way we produce and use electricity is changing, traditional methods used to operate our electricity networks also need to adapt. EBI will therefore become increasingly widespread to effectively and cost efficiently balance the supply and demand of electricity within the electrical transmission network, thus improving the overall performance and utilisation of renewable energy generation and its interaction with the grid.
- 6.2.6.2 EBI is proposed to be housed in single or multiple building(s), several containers, in an open yard or a combination of the above. All energy balancing equipment will be housed wholly within the footprint of the onshore substation.

6.3 Consideration of Alternatives

- 6.3.1.1 The Applicant has undertaken an extensive process to determine final site selection and a consideration of alternatives. The process followed, together with the reasons behind the final project site selection and alternatives considered (in terms of location and methods) is presented in full in [Volume 1, Chapter 3: Site Selection and Consideration of Alternatives](#) of the PEIR.
- 6.3.1.2 The approach taken to site selection and alternatives has involved early engagement with stakeholders, together with a range of electrical, engineering, ecological and socio-economic considerations.
- 6.3.1.3 The site selection process began early in the project lifetime and involved the following stages:
- Stage 1 – Identification of the Offshore Array and Infrastructure;
 - Stage 2 – Identification of an Electrical Infrastructure Study Area;
 - Stage 3 – Identification of the Landfall;
 - Stage 4 – Identification of the Onshore Site Substation; and
 - Stage 5 – Identification of the Onshore and Offshore Export Cable Routes.

6.3.1.4 These stages reflect the sequential nature of the site selection process between components, as follows:

- The location of the wind farm array is determined by the terms of the AfL, combined with a further site refinement process as part of the Developable Area approach (DAA) that resulted in major a reduction to the AfL. The AfL area of search was determined by Hornsea Zone as part of Round Three. Within the Zone, Orsted went through a Zone Appraisal and Planning (ZAP) and site selection exercise to determine the areas of HOW 1-4 to seek AFL's on;
- The grid connection point is agreed in dialogue with National Grid as part of the Connection and Infrastructure Options Note (CION) process. The location of the OnSS has been the subject of a site selection process led by Orsted;
- The location of the landfall is influenced by the location of the AfL and OnSS;
- The route of the offshore ECR is influenced by the location of the wind farm array and the landfall; and
- The route of the onshore ECR is influenced by the location of the landfall and OnSS.

6.3.1.5 Key principles applied during the site selection and alternatives process can be summarised as follows:

- Shortest route preference for cable routing to minimise environmental impact (such as minimising overlap with European sites), disturbance, cost and transmission losses;
- Avoidance of key sensitive features (such as European site boundaries and features) where possible;
- Minimisation of disruption to populated areas; and
- The need to accommodate the range of technology sought within the design envelope.

6.3.2 Consultation site selection

6.3.2.1 Consideration has been given to feasible alternatives at every stage of the process of developing Hornsea Four. This has formed a fundamental driver for every decision within the project, from the technical options within the engineering side to the micro-siting and route changes during the development of the cable routes.

6.3.2.2 Consultation is a key part of this process informing all stages and has helped to refine the project through wider spatial, design and process considerations discussed in broader forums, both formally through Evidence Plan meetings or more informally through public events. Following receipt of the Scoping Opinion, the project consulted with a range of interested parties on the potential for array area refinement (see [Table 2](#)). This process was iterative, taking account of refinements to the offshore ECC search area and the latest site-specific data to ensure that options were aligned and site appropriate. Consideration was given to several technical, commercial and environmental consenting constraints ([Section 7.1](#) of [Volume 4, Annex 3.2: Benthic Subtidal and Intertidal Ecology](#)) informed by data

analysis and constraints mapping prior to presentation and consultation with key stakeholders.

- 6.3.2.3 Full details of the project consultation process and mechanisms are presented within **Volume 1, Chapter 6: Consultation. Table 2** provides a summary of events undertaken and scheduled to inform the site selection process.

Table 2: Summary of Consultation Undertaken to Inform the Site Selection Process.

Dates	Events	Objective
Offshore ECC		
November 2018	Informal consultation events	To acquire public and stakeholder feedback to inform route planning within scoping boundary to enable cable route refinement and inform PEIR submission.
September 2019	Section 42 and 47 consultation	To inform route planning and site selection.
Offshore Array		
November 2018	Informal consultation events for public and stakeholders	To inform route planning and site selection process within the scoping boundary.
Q2 2019	Developable Area Approach (DAA) stakeholder engagement	Meeting relevant stakeholders to obtain information and opinions on the Developable Area Approach
June 2019	Developable Area Approach (DAA)	Inform on the Hornsea Four decision to adopt a major site reduction as a consequence of the DAA process.
September 2019	Section 42 and 47 Consultation	Public and stakeholder consultation to inform developable area
Landfall Array		
November 2018	Informal consultation events to acquire public and stakeholder feedback	To inform route planning within the scoping boundary
Q2 2019 and Q3-4 2019	Landfall Working Group meetings	To obtain information and opinions on the landfall site selection
September 2019	Section 42 and 47 consultation	To inform final site selection and mitigation
Onshore ECC		
October 2018	Local Information Events	Series of events to obtain feedback to inform route planning within the scoping boundary
Q3 2018 – Q1 2019	Landowner Feedback	Liaison with landowners on indicative 80m export cable corridor
Q3 2018 – Q1 2019 and Q3-Q4 2019	Cable Corridor Working Group	Meetings with local parish councils to obtain information and opinions on route planning
September 2019	Section 42 and 47 consultation	To Inform route refinement and mitigation
Onshore substation		
November 2018	Informal Consultation events	To inform site selection within scoping boundary
Q1-Q2 2019	Onshore Substation Working Group	Meetings with local parish councils to obtain information and opinions on site selection

Dates	Events	Objective
September 2019	Section 42 and 47 consultation	To obtain feedback to inform detailed site layout design and mitigation
Q3-Q4 2019	Onshore Substation Working Group	Engagement on design amendments and mitigation

6.4 Maximum Design Scenario

- 6.4.1.1 The 'Maximum Design Scenario' (MDS) is referred to throughout the PEIR and here in the RIAA. This approach ensures that the scenario that would have the greatest impact (e.g. largest footprint, longest exposure, or tallest dimensions, depending on the topic) is assessed; we can be confident that any other (lesser) scenarios will have an impact that is no greater than that assessed.
- 6.4.1.2 The Screening Report identified a number of receptor groups, with the topic specific maximum adverse scenario for each group presented within the relevant chapter from the PEIR, with those drawn on here. The receptor groups are outlined below, together with the relevant PEIR chapter:
- Table 2.15 from [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#);
 - Table 4.12 from [Volume 2, Chapter 4: Marine Mammals](#);
 - Table 5.18 from [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#);
 - Table 3.13 from [Volume 3, Chapter 3: Ecology and Nature Conservation](#); and
 - Table 3.10 from [Volume 2, Chapter 3: Fish and Shellfish Ecology](#);
- 6.4.1.3 The maximum design scenario, as it applies to each receptor group, is defined in [Appendix G](#) and draws on the information presented in the tables listed above in the individual PEIR chapters. For clarity regarding the differences between receptor groups, the information is presented according to individual project parameters, including a note regarding why the scenario is relevant to that receptor. Where relevant, the information includes any designed-in features which, whilst also providing mitigation, are integral to the design or physical characteristics of the project.

6.5 Construction Programme

- 6.5.1.1 An indicative programme of relevant construction works is presented in [Figure 3](#) below, illustrating the main project infrastructure elements and the window within which construction is expected to occur. The earliest possible date that construction could commence is August 2023, with offshore construction scheduled to commence in Year 3 of works (i.e. in 2025). Pre-construction works required prior to that period (potentially including geophysical survey and clearance of UXO) may occur from August 2023 onwards. Offshore construction will take place within a three year window (i.e. 2025-2028).

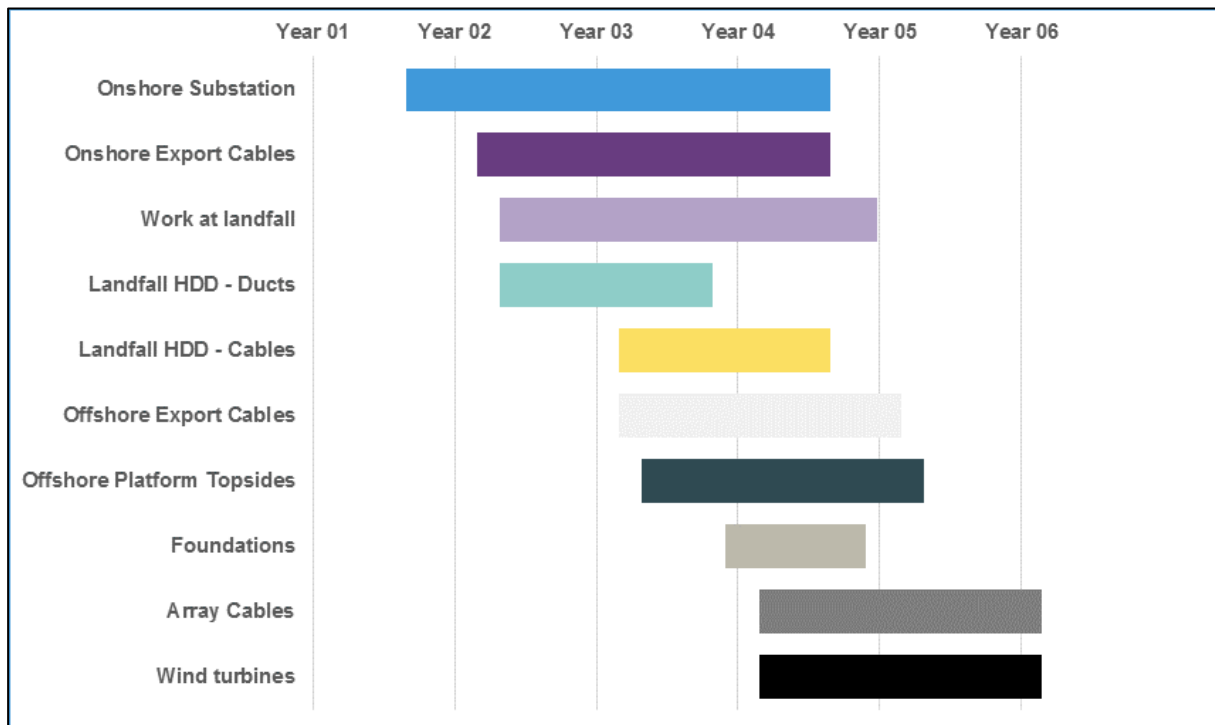


Figure 3: Indicative construction programme for Hornsea Four.

6.6 Operation, Maintenance and Decommissioning Programme

- 6.6.1.1 A full project description is provided in [Volume 2, Chapter 4: Project Description](#), with Operation and Maintenance addressed in [Section 4.11](#) of that chapter. [Appendix G](#) presents a summary of the maximum design scenario per receptor, including that during all phases of the project. A summary is provided here.
- 6.6.1.2 The overall operation and maintenance strategy will be finalised once the operation and maintenance base location and technical specification of Hornsea Four are known, including wind turbine generator type, electrical export option and final project layout. Maintenance operations will be undertaken throughout the operational life of Hornsea Four (anticipated 35 years) and will be both preventive (scheduled) and corrective (unexpected repairs).
- 6.6.1.3 The onshore operation and maintenance requirements for the onshore export cables will be largely corrective (because there is limited requirement for preventative maintenance on the onshore cables), accompanied by infrequent on-site inspections of the onshore export cables. Whereas, operation and maintenance requirements for the onshore substation and electrical balancing infrastructure will be both preventative and corrective.
- 6.6.1.4 At the end of the operational lifetime of Hornsea Four, it is anticipated that all structures above the seabed or ground level will be completely removed. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. The decommissioning plan and programme

will be updated during Hornsea Four's lifespan to take account of changing best practice and new technologies. The approach and methodologies employed at decommissioning will be compliant with the legislation and policy requirements at the time of decommissioning.

7 Commitments

- 7.1.1.1 The information on Commitments per receptor draws on individual topic chapters. All Commitments relevant to the RIAA are summarised below in [Table 3](#) including the route for securing each Commitment. Further details on these Commitments is presented in [Volume 4, Annex 5.2: Commitments Register](#). Commitments are not taken into account during the consideration of potential LSE, however Commitments are a consideration during the determination of potential for adverse effect within the design scenario assessed. The approach ensures the RIAA is compliant with the People over Wind ruling referenced in [Section 3.1.1.6](#).

Table 3: Hornsea Four Commitments.

Commitment ID	Commitment	Mechanism for Securing Commitment
<i>Subtidal and intertidal benthic ecology</i>		
Co 44	The Holderness Inshore Marine Conservation Zone (MCZ) will not be crossed by the offshore cable corridor including the associated temporary works area.	Project boundary was redefined to avoid the MCZ plus a buffer of 50 m.
Co45	The Holderness Offshore recommended MCZ (rMCZ) will not be crossed by the offshore export cable corridor including the associated temporary works area.	Project boundary was redefined to avoid the MCZ plus a buffer of 50 m.
Co48	Annex 1 habitats will be avoided where possible, informed through the undertaking of geophysical survey works pre-construction. This excludes features of Smithic Sands which at the time of application is not designated.	A pre-construction geophysical survey and analyses will be undertaken.
Co83	Where possible, Cable burial will be the preferred option for cable protection.	Secured in the dMLs through the requirement for a CSIP.
Co84	Presence of sensitive habitats will be identified through a review of the latest available benthic datasets and pre-construction surveys. Wind turbine foundations and the offshore export cable will be micro-sited around annex one habitat wherever reasonably practicable (subject to agreement with the MMO) to an extent not resulting in a hazard for marine traffic and Search & Rescue capability.	No sensitive features have been found / are expected to be found within the development area. However, if any sensitive habitat features are identified following additional survey, these features will be micro-sited around to avoid disturbance (this will be agreed through the evidence plan process).
Co86	The offshore export cable corridor and cable landfall (below MHWS) will avoid the Greater Wash SPA, Flamborough & Filey Coast SPA and the Flamborough Head SAC.	Secured by means of the Order limits as defined in the DCO and dMLs
Co111	A Marine Pollution Contingency Plan (MPCP) will be developed. This MPCP will outline procedures to protect personnel working and to safeguard the marine environment and mitigation measures in the event of an accidental pollution event arising from offshore operations relating to Hornsea Four. The MPCP will also include relevant key emergency contact details	Secured in the dMLs through the requirement for a PEMMP and Decommissioning Programme
<i>Marine Mammals</i>		
Co108	A Vessel Management Plan (VMP) will be developed pre-construction which will determine vessel routing to and from construction areas and ports to minimise encounters with marine mammals.	Secured in the dMLs through the requirement for a PEMMP.
Co110	A piling Marine Mammal Mitigation Protocol (MMMP), will be implemented during construction and will be developed in accordance with JNCC (2010) guidance. The piling MMMP will include	Secured in the dMLs through the requirement for a MMMP.

Commitment ID	Commitment	Mechanism for Securing Commitment
	details of soft starts to be used during piling operations with lower hammer energies used at the beginning of the piling sequence before increasing energies to the higher levels.	
Co111	A Marine Pollution Contingency Plan (MPCP) will be developed. This MPCP will outline procedures to protect personnel working and to safeguard the marine environment and mitigation measures in the event of an accidental pollution event arising from offshore operations relating to Hornsea Four. The MPCP will also include relevant key emergency contact details	Secured in the dMLs through the requirement for a PEMMP and Decommissioning Programme.
Co113	A Decommissioning Marine Mammal Mitigation Protocol (MMMP), will be implemented during decommissioning. The Decommissioning MMMP will include measures to ensure the risk of permanent threshold shift (PTS) to marine mammals is negligible and will be in line with the latest relevant available guidance.	Secured in the dMLs through the requirement for a Decommissioning Programme

Offshore Ornithology

Co86	The offshore export cable corridor and cable landfall (below MHWS) will avoid the Greater Wash SPA, Flamborough & Filey Coast SPA and the Flamborough Head SAC.	Secured by means of the Order limits as defined in the DCO and dMLs
Co88	Construction and operational maintenance vessels (e.g. CTVs) will avoid high concentrations of rafting red-throated diver between the port of origin and the array area.	Secured in the dMLs through the requirement for a Construction Method Statement (CMS)
Co138	Lower air draught of wind turbines will be a minimum of 35 m above Mean Sea Level (MSL).	Secured in the dMLs through the requirement for a Design Plan

Onshore Ecology

Details regarding Commitments that Hornsea Four have embedded within the project design that are related to onshore ecology are presented in [Table 3.12](#) of [Volume 3, Chapter 3 Ecology and Nature Conservation](#).

Co1	All main rivers, Internal Drainage Board (IDB) maintained drains, main roads and railways will be crossed by HDD or other trenchless technology as set out in the Onshore Crossing Schedule. Where HDD technologies are not practical, the crossing of ordinary watercourses may be undertaken by open cut methods. In such cases, temporary measures will be employed to maintain flow of water along the watercourse.	CoCP, secured by DCO requirement
Co2	The following sensitive sites will be avoided by the permanent project footprint: Listed Buildings (580 sites), Registered Parks and Gardens (Thwaite Hall and Risby Hall), Scheduled Monuments (30 sites), Conservation Areas (19 sites), non-designated built heritage assets (368 sites) and	DCO Works Plans, DCO Requirement (Ecological Management Plan)

Commitment ID	Commitment	Mechanism for Securing Commitment
	<p>Ancient Woodland (10 sites and TPOs). Please refer to PEIR Volume 6, Annex 6.5.1 Appendix B Designated Assets Gazetteer for detailed lists of designated heritage assets that are avoided by Hornsea Four. With the exception of River Hull Headwaters SSSI, sensitive sites have been avoided. Please refer to PEIR Volume 6, Annex 3.1: Extended Phase 1 Habitat Survey Report for details.</p> <p>Where possible, unprotected areas of woodland, mature, and protected trees (e.g. veteran trees) shall also be avoided or micro sited around.</p>	
Co7	<p>The temporary work area associated with onshore export cable corridor will be 80m working width to minimise the construction footprint, except the Network Rail Crossing near Beswick where the footprint is extended to 120m to facilitate HDD of the railway line.</p> <p>The permanent onshore export cable corridor width will be 60m except the Network Rail Crossing near Beswick where the footprint is extended to 120m to facilitate HDD of the railway line.</p>	DCO Works Plans and Order limits
Co26	Where hedgerows require removal, this will be undertaken prior to topsoil removal and the width of hedge removed will be limited where practical. Removed hedges and trees will be replaced with locally appropriate native species.	DCO
Co36	<p>CoreCore working hours for the construction of the onshore components of Hornsea Four will be as follows:</p> <ul style="list-style-type: none"> • Monday to Friday: 07:00 - 18:00 hours; • Saturday: 07:00 - 13:00 hours; • Up to one hour before and after core working hours for mobilisation ("mobilisation period"), i.e. 06:00 to 19:00 weekdays and 06:00 to 14:00 Saturdays; and • Maintenance period 13:00 to 17:00 Saturdays. <p>Activities carried out during mobilisation and maintenance will not generate significant noise levels (such as piling, or other such noisy activities).</p> <p>In circumstances outside of core working practices, specific works may have to be undertaken outside the core working hours. ERYC will be informed in writing.</p>	DCO
Co78	PondsPonds will be avoided through micro-siting of the onshore export cable where practical.	DCO

Commitment ID	Commitment	Mechanism for Securing Commitment
Co114	Good practice air quality management measures will be applied where it is relevant, as described in Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction 2014, version 1.1, or latest relevant available guidance.	DCO
Co123	Based on noise modelling results, where noise has the potential to cause disturbance mufflers, acoustic barriers will be used where HDD is undertaken.	DCO
<i>Migratory Fish</i>		
Co83	Where possible, cable burial will be the preferred option for cable protection.	Secured in the dMLs through the requirement for a Cable Specification and Installation Plan (CSIP).
Co85	No more than a maximum of two foundations to be installed simultaneously.	Secured in the dMLs through details presented in the Construction Method Statement (CMS).
Co110	A piling Marine Mammal Mitigation Protocol (MMMP) will be implemented during construction and will be developed in accordance with JNCC (2010) guidance. The piling MMMP will include details of soft starts to be used during piling operations with lower hammer energies used at the beginning of the piling sequence before increasing energies to the higher levels.	Secured in the dMLs through the requirement for a MMMP.
Co111	A Marine Pollution Contingency Plan (MPCP) will be developed. The MPCP will outline procedures to protect personnel working and to safeguard the marine environment and mitigation measures in the event of an accidental pollution event arising from offshore operations relating to Hornsea Four. The MPCP will also include relevant key emergency contact details.	Secured in the dMLs through the requirement for a PEMMP.

8 The Screening Process for the Project Alone

8.1 Screening Undertaken for Hornsea Four Alone

- 8.1.1.1 As noted in [Section 2](#) above, the first stage to the HRA process is Screening, the process followed to identify the potential for LSE from the project, alone or in-combination, on European sites of nature conservation importance. Screening for Hornsea Four alone was undertaken during Scoping, with the Screening Report issued in October 2018 along with the Scoping Report. An update to screening was issued to Natural England in May 2019 ([Appendix B](#)).
- 8.1.1.2 The Screening Report, as finalised at that time, has been appended to the RIAA ([Appendix A](#)) but has not repeated in full. Instead, the approach taken has been to revisit the screening, together with the updates from May 2019, within the current section of the RIAA and update conclusions on potential LSE where relevant, for example where subsequent consultation identified an additional designated site for consideration. The Screening Matrix is appended as [Appendix C](#), following the structure provided in PINS Advice Note 10⁴.

8.2 Approach to Screening Alone

- 8.2.1.1 The purpose of Screening is to identify the European and Ramsar sites (with their associated features) for consideration within the overall HRA process. Once screened in for consideration, the potential for LSE is determined, taking account of the relevant effects and presence/absence of a pathway linking such effects to the feature(s). The screening process followed a series of defined criteria, to ensure a clear and transparent process. The criteria applied are summarised below in [Table 4](#). All screened in sites and features are summarised in [Table 6](#), including the conclusions on the potential for LSE.

Table 4: Screening Criteria for the Initial Identification of SACs, SPAs and Ramsar Sites (*italics indicate screening criteria applied for offshore ornithology*).

Criteria used for initial identification of European and Ramsar sites		Specific criteria
1	European or Ramsar site that overlaps with Hornsea Four boundary (array, cable corridor, substation AoS).	Physical overlap between project boundary and designated site.
2	SAC supports mobile populations of qualifying features (e.g. marine mammals, migratory fish, bats and otters) that may interact with potential effects associated with Hornsea Four. <i>SPA or Ramsar site has interest features that nest and raise their young within the site during the breeding season and then occur in the region of Hornsea Four outside the breeding season, either on migration (passage) or throughout the winter.</i>	Where a designated site hosts a mobile species, whose range may include Hornsea Four – e.g. North Sea Management Unit for cetaceans. <i>Identified by the application of the information on migratory movements and winter distribution (e.g. Wernham et al., 2002; Balmer et al., 2013).</i>

⁴ <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/06/Advice-note-10v4.pdf>

Criteria used for initial identification of European and Ramsar sites	Specific criteria
3 SAC with qualifying species whose mean maximum foraging or migratory range overlaps with Hornsea Four. <i>SPA or Ramsar site is outside the offshore zone (i.e. above MLWS) but has interest features that, whilst nesting onshore, forage offshore during the breeding season.</i>	Where a qualifying species has a known foraging or migratory range that includes Hornsea Four (e.g. seabirds). <i>Identified by the application of the mean maximum foraging range from the standard reference: Thaxter et al. (2012).</i>
4 SAC and/ or a qualifying feature located within the potential range of effect associated with Hornsea Four. <i>SPA or Ramsar site overlaps with the potential extent of impacts associated with Hornsea Four.</i>	Where the potential effects associated with Hornsea Four extend beyond the boundary of the project and reach a designated site. <i>Identified by a physical overlap of the designated site and the potential extent of impact.</i>
5 SAC qualifying habitat or species recorded during site-specific surveys. <i>SPA or Ramsar site has interest features that use that site in the non-breeding season and then occur in the region of Hornsea Four on migration (passage).</i>	Presence of a qualifying habitat or species at Hornsea Four that can be associated with a SAC. <i>Identified by the application of the information on migratory movements to and from the UK in the standard reference: Wright et al., 2012.</i>

8.2.1.2 Following consultation with Natural England on the HRA Screening Report an updated screening was undertaken and presented within a HRA Screening Revisited Report. Updates to the screening process were based on the following broad points;

- A request by Natural England to consider revised screening ranges to account for greater foraging distances for breeding birds from UK SPAs, including the maximum foraging ranges from Thaxter et al. (2012) and additional tagging data, where appropriate. The revised foraging ranges considered for the revisited screening were based predominantly on the mean maximum and maximum foraging ranges presented in Thaxter et al. (2012), with the exception of kittiwake that includes additional tagging data (RSPB FAME and STAR data). This was agreed with Natural England to include species recorded within the Hornsea Four array area and offshore export cable corridor (ECC) during the breeding bio-season that may be from breeding colonies at a greater distance from those included by using only the mean-max foraging range from Thaxter et al. (2012);
- A request by Natural England to revisit screening of the Farne Islands SPA and Coquet Island SPA to account for the seabird assemblage species (and accounting for the maximum foraging ranges described above); and
- A request by Natural England to consider further screening for migratory seabirds and non-seabirds from additional designated sites including, but not limited to, the Humber Estuary SPA and Hornsea Mere SPA.

8.2.1.3 These updates were applied for the revisited HRA Screening to ensure all species from relevant designated sites are accounted for in the first test for the potential for LSE.

Following consultation with Natural England on the HRA Screening Revisited Report the following additional points were received and included within this assessment;

- To include qualifying species, named assemblage species and all other seabird species known for all English designated sites. This has been applied, where practical through a proportional approach and use of professional judgement (i.e. not all seabird species ever recorded at a site are included in the seabird assemblages considered in this assessment);
- Sandwich tern and some other seabirds are sensitive to construction activities, particularly if occurring within close proximity to a colony. The assessments within this draft RIAA acknowledge Natural England's comment, who provided clarification that that these seabirds are not sensitive to construction activities from Hornsea Four because the areas of the SPA used by Sandwich terns and some other sensitive seabirds are very distant from the Hornsea Four ECC and array area, and therefore are simply not exposed to any effects. In order to assist stakeholders and the Examining Authority (ExA) it is recognised that certain species may well be sensitive to construction activities more generally, but as this assessment is on those activities associated with Hornsea Four it is reasonable to assume that the definition of sensitivity is used in this instance in relation to the activities of Hornsea Four only; and
- The Northumberland Marine SPA protects the foraging ranges of terns from a number of tern breeding colony SPAs in Northumberland as well as waters important to guillemot and puffin from two SPAs for maintenance behaviours. Given the HRA screening assesses the relevant SPAs (Farne Islands, and Coquet Island and Northumbria Coast) separately Natural England considers (in their response to the HRA Screening revisited, detailed in Table 4 1) that it is not necessary to also assess Northumberland Marine SPA for this case. In light of this comment this assessment includes only the individual SPAs and not the overarching Northumberland Marine SPA.

8.3 Definition of the HRA Study Areas

- 8.3.1.1 The extent of the study area for each receptor group is a function of the screening process, and therefore takes account of the ecology of the habitat(s) and/ or species and the potential for effect (the latter including the predicted scale of effect).

8.4 Study Area for Subtidal and Intertidal Benthic Receptors

- 8.4.1.1 The study area for subtidal and intertidal benthic ecology included designated sites that triggered one or more of the following:
- Designated sites with a physical overlap with the array or offshore cable corridor (including landfall); and
 - Designated sites within the maximum range of relevant effect (being up to 15 km from the project boundary). It should be noted that a range of 16 km was originally used, was later refined down to 15 km following further study into physical processes for the PEIR.

8.5 Study area for Marine Mammal Receptors

- 8.5.1.1 The study area for the highly mobile marine mammal species is within that applied within the PEIR (**Volume 2, Chapter 4: Marine Mammals**), with the PEIR marine mammal study area being species specific but taking account of ecology and behaviour. For harbour porpoise (*Phocoena phocoena*), the range applied is 26 km (derived from the advice issued by JNCC⁵, which identified that 'HRA will be considered for all new (or review of consent) developments (coastal and marine) using pile driving within the site or within 26km of site boundaries'). For seals, the screening area applied in the Screening Report (**Appendix A**) was effectively defined by the foraging range of harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*), being 120 km and 145 km respectively (SMRU, 2011 for harbour seal and Thompson *et al.* 1996 for grey seal). It should be noted that subsequent to issue of the draft Marine Mammal Technical Report (**Volume 2, Chapter 4: Marine Mammals**), further site connectivity for grey seals has been identified, with these sites screened in for potential LSE here. No additional connectivity was identified for other species (including harbour seal, harbour porpoise and bottlenose dolphin), with no additional sites screened in for other marine mammal species.

8.6 Study Area for Onshore Ecology Receptors

- 8.6.1.1 The study area for onshore ecology receptors is a 2 km (5 km for bird and bat species) buffer of the onshore elements of Hornsea Four, taking into consideration Natural England Impact Risk Zones (IRZ), this was agreed during scoping and confirmed at the Ecology Technical Panel Meeting in January 2019. There is one European protected site within the onshore ecology study area, namely The Greater Wash SPA, which is located >1.5 km south west of the Hornsea Four landfall area at its closest point. This was previously identified as being within 25 m of the onshore Hornsea Four boundaries during Scoping, however further refinements have been made to the landfall zone, and as a result, the Greater Wash SPA is now further from the project boundary than stated at scoping.
- 8.6.1.2 The qualifying features for the Greater Wash SPA are a wide range of birds, specifically red throated diver, common scoter, little gull, breeding sandwich tern, common tern and little tern. There are no qualifying features onshore, therefore there is unlikely to be a potential LSE from the onshore project to these bird species. Hornsea Four has undertaken an over-wintering and migratory bird survey effort in 2018/2019, the findings of which are reported within **Volume 6, Annex 3.3: Wintering and Migratory Bird Survey Report**. Hornsea Four has also undertaken a survey regarding the presence of breeding birds, however at the time of submitting this document, survey results are being analysed and the reporting completed. This will be fully reported with the Hornsea Four Environmental Statement.
- 8.6.1.3 Hornsea Four submitted an update to Screening in May 2019 (**Appendix B**), presenting updated information to Natural England and confirming no sites and/or features have been

⁵ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

screened in for onshore ecology. Natural England provided had no comment with regard to onshore ecology at that stage.

8.7 Study Area for Offshore Ornithological Receptors

- 8.7.1.1 For offshore and intertidal ornithology receptors, the study area includes all of the sea and coasts within the Hornsea Four array area (at PEIR), a 4 km buffer surrounding the array area, the offshore export cable corridor (ECC) and the cable landfall areas, with a particular focus on the sea within a 4 km buffer surrounding the Hornsea Four array area, the latter of which follows Natural England recommendations. Account also has to be taken of the mobility of birds, noting that for instance, birds that breed outside the study area might fly in to or across the study area to feed during the breeding season, might fly into the study area outside of the breeding season to spend the winter or might fly across the study area on migration.

8.8 Definition of Effects (Subtidal and Intertidal Benthic Ecology)

- 8.8.1.1 The Screening Report identified a number of potential effects with respect to subtidal and intertidal benthic ecology that may arise during the construction, O&M and decommissioning of Hornsea Four. However, it is recognised that the terminology used to define potential effects within the screening process (and therefore within the current report) may differ from that applied within relevant Advice on Operations (specifically the advice on operations provided by Natural England for the Flamborough Head SAC, where they are termed 'pressure' not effect⁶). For simplicity and consistency, a comparison of relevant terms for the effects screened in for potential LSE is provided below in **Table 5** (noting that the advice does not identify sensitivity to all pressures for all features, with feature specificity taken into account for the assessment). Full consideration has therefore been given to pressures detailed for Flamborough Head SAC under Natural England's Advice on Operations.

Table 5: Comparison of Relevant Terms Used to Define Potential Effects for Subtidal and Intertidal Benthic Ecology.

Potential effect term applied here	Equivalent term(s) from Advice on Operations
Temporary increases in suspended sediments, with subsequent deposition	Physical change (to another seabed type) Changes in suspended solids (water clarity) Smothering and siltation rate changes (Light-heavy)
Increased nitrogen deposition	Introduction of other substances (solid, liquid or gas) Nutrient enrichment
Invasive non-native species	Introduction or spread of invasive non-indigenous species

⁶<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0013036&SiteName=flambor&SiteNameDisplay=Flamborough+Head+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAAarea=>

8.9 Confirmation of Screening Alone

8.9.1 Subtidal and Intertidal Benthic Ecology

- 8.9.1.1 The recent ECJ ruling 'People over Wind', as referenced above in [Section 3.1.1.6](#), relates to the role of mitigation when determining potential for LSE. Recent government advice is relevant here too, specifically the July 2019 revision to the Planning Policy Guidance 'Guidance on the Use of Habitats Regulations Assessment'⁷. It is noted that until that point (see Appendix A and B), potential for accidental pollution had been screened in for potential LSE for a number of sites/features (despite the legislative requirement for mitigation as integral to the project and unrelated to the HRA process). However, the recent guidance provides clarity on this issue, specifically 'Features that are integral to the design or physical characteristics of the project that is being assessed, for example, the layout, timing and location of a scheme, may be considered at the screening stage'. The measures to address risk of accidental pollution are considered integral to the project and have not been 'included in a plan or project only to respond to likely effects on a habitats site'. Therefore, the measures to address the risk of accidental pollution have been included here in the determination of potential for LSE.
- 8.9.1.2 The result of the above is, whereas previously accidental pollution had been screened in for potential LSE, that position has been revised and the potential effect has been screened out from potential LSE in all cases (alone or in-combination), on the basis of the relevant commitments (see [Table 3](#)). For subtidal and intertidal benthic ecology, that affects the Flamborough Head SAC only (reef and submerged or partially submerged sea caves only – vegetated sea cliffs having been agreed previously with Natural England at the Evidence Plan Process meeting on 12/9/2018 as screened out in all cases).
- 8.9.1.3 Following issue of the Screening Report ([Appendix A](#)), the extent of the export cable corridor has been amended specifically to avoid physical overlap with Natura 2000 sites (with the exception of the Southern North Sea SAC, within which the array boundary sits). That change has resulted in slight changes to screening for subtidal benthic ecological features, specifically through the removal of risk in relation for disturbance/loss of such features and from EMF. That change resulted in the following:
- Flamborough Head SAC – the removal of physical overlap between the export cable corridor and the SAC boundary, now being 1.64 km distant at its closest point, has removed 'temporary habitat disturbance' during construction, operation & maintenance and decommissioning and 'long term physical loss of habitat' and 'EMF' during operation & maintenance from potential LSE for all features.
- 8.9.1.4 As regards intertidal features, it is important to note that [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#) identifies the potential for effect (construction and decommissioning) at cable landfall as being a small scale, highly localised and intermittent activity limited to the short-term, with the operation and maintenance similarly being small-scale, highly localised and limited to the short-term. The revised RLB

⁷ <https://www.gov.uk/guidance/appropriate-assessment#contents>

means that cable landfall is now, at its closest point, at least 32 km from the closest site designated for intertidal habitats, the Humber Estuary SAC, SPA and Ramsar. The Greater Wash SPA, designated for bird species only, at >1.5 km is closer; however the Physical Processes assessment is clear in its assessment for landfall, specifically that the potential for effect is so small (negligible at most) that no further assessment was warranted. The change in the RLB confirms the existing screening conclusions, specifically that no designated intertidal habitat feature(s) are vulnerable to potential LSE associated with Hornsea Four and therefore no LSE applies in relation to all designated intertidal features

- 8.9.1.5 During consultation, Natural England have raised concern about the potential effect of the project on the Humber Estuary SAC and Ramsar site through changes in physical processes such as alteration to sediment pathways. The ECC is situated at least 32km from the Humber European site. The effect of the project on coastal processes was examined in the [Volume 5, Annex 1.1: Marine Processes Technical Report](#). This concluded that if any effects were to occur on coastal processes (including sediment transport), these would be limited to the vicinity of the scheme and therefore effects on the Humber Estuary area are screened out for LSE.
- 8.9.1.6 During production of the PEIR, the assessment of air quality (see [Volume 3, Chapter 9: Air Quality and Health](#)) highlighted that the project may increase levels of nitrogen deposition through increased traffic generation. This has the potential to affect vegetation within close vicinity of affected roads. There is an area of saltmarsh on the Humber Estuary that lies within 200m of an affected road. For this reason, effects on saltmarsh have been screened in for potential LSE as a result of nitrogen deposition on the Humber Estuary SAC (Atlantic salt meadows and Salicornia and other annuals colonising mud and sand) and Humber Estuary Ramsar (Criterion 1 – saltmarshes).
- 8.9.1.7 Effects on Saltmarsh Through Changes to Air Quality (Highways Agency, 2007). As such, impacts beyond this distance are not considered to be significant.
- 8.9.1.8 [Volume 3, Chapter 9: Air Quality and Health](#) has highlighted that the project may increase levels of nitrogen deposition through increased traffic generation from Hornsea Four. This will arise during construction only. Potential impacts are only likely to occur within 200m of the road edge (Highways Agency, 2007), as impacts beyond this are generally considered to be insignificant as sufficient dilution and dispersion of pollutants will occur across this distance to minimise effects. As such, impacts beyond this distance are not considered to be significant.
- 8.9.1.9 The only European designated sites that lies within 200m of the affected roads are the Humber Estuary SAC, SPA and Ramsar. The location affected is near the A63 at Kingston-Upon-Hull. The Humber SAC in this location contains a narrow strip of saltmarsh (approximately 20-50m wide) bordered by mudflats on the waters edge.
- 8.9.1.10 To investigate this impact, levels of nitrogen deposition have been modelled as part of the PEIR on a transect at 10-50m intervals back from the road edge (in accordance with DMRB guidance (Highways Agency 2007)). The modelling calculated the predicted increase in

levels of nitrogen deposition and compared them to existing levels and also increases in background traffic flows. The results were then compared to the UK Air Pollution Information System (APIS) which contains information on the sensitivity of coastal saltmarsh to nitrogen and recommends a critical load. For saltmarsh, the critical load is 20 – 30 kg N ha⁻¹ yr⁻¹. Increased nitrogen in saltmarsh can potentially cause eutrophication effects such as accelerating successional changes.

- 8.9.1.11 The modelling found that for Hornsea Four alone, the project would not exceed more than 1% of the critical load of nitrogen deposition for saltmarsh. However, when considered in-combination with background increases in traffic flows, the levels of nitrogen deposition increase to 1.9% of the critical load within 20m of the road boundary. This strip overlaps with 0.029 km² of the Humber SAC and contains saltmarsh. Beyond 20m effects will be below the 1% threshold.
- 8.9.1.12 It is considered that the elevated levels of nitrogen deposition would not cause a potential LSE on the Humber SAC, SPA and Ramsar for the following reasons:
- 8.9.1.13 Only a very small area of the SAC would be affected (<0.001% of the SAC).
- 8.9.1.14 It is a temporary impact lasting a maximum of 36 months. Excess forms of soluble nitrogen within the rooting zone of salt marsh plants can either be taken up by the plants or they would be washed out by the regular tidal inundation (CCW, 2012).
- 8.9.1.15 The critical load will only be marginally exceeded, and it is likely that this would have, at worst, a minor temporary effect on the saltmarsh community in this area. Nitrogen deposition is considered by APIS to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs.
- 8.9.1.16 In light of the above, no LSE has been concluded and impact was not considered further in the HRA.

8.9.2 Marine Mammals

- 8.9.2.1 Following issue of the Screening Report, a number of changes to marine mammal screening have been included within the RIAA. These can be summarised as follows:
 - As noted above, recent advice from government provides clarity on 'People over Wind', enabling accidental pollution to be screened out from potential LSE in all cases (alone or in-combination);
 - In the PINS response to Scoping, when referencing Natural England, it notes that there is a lack of evidence on operational noise levels of large turbines, with a recommendation to scope the issue in until further evidence is available to show that the risk is low. Operational noise is therefore screened in here for harbour porpoise and the Southern North Sea SAC only (a further change following the issue of revised screening to Natural England on 28 May 2019) – noting that the Evidence Plan has an existing action against the issue (as of May 2019), seeking clarity from PINs on this

issue. The Marine Mammal Chapter for PEIR considered operation noise further, finding the effect to be of negligible significance ([Section 4.11.2](#));

- Following the availability of the baseline Marine Mammal Technical Report, the data indicates potential connectivity between grey seals associated with the Berwickshire and North Northumberland Coast SAC and Hornsea Four. Therefore, the site has been screened in for potential LSE, for grey seal only, for 'increase in underwater noise' (construction and decommissioning) and 'vessel disturbance' (all stages of the project);
- Following the availability of the baseline Marine Mammal Technical Report, the data indicates that there may be potential connectivity between grey seals associated with designated sites in mainland Europe and Hornsea Four. Therefore, a number of transboundary sites have been screened in for potential LSE, for grey seal only (in addition to two offshore transboundary sites already screened in), for 'increase in underwater noise' (construction and decommissioning) and 'vessel disturbance' (all stages of the project). Those sites are as follows:
 - Bancs des Flandres;
 - Vlaamse Banken;
 - SBZ 1;
 - SBZ 2;
 - SBZ 3;
 - Vlake van de Raan;
 - Westerschelde & Saeftinghe;
 - Voordelta;
 - Noordzeekustzone; and
 - Waddenzee.
- A response to comments made by Natural England, specifically a need to re-consider screening of sites for bottlenose dolphin and grey seal. Note on grey seal sites is provided above. With respect to bottlenose dolphin, confirmation has been sought from the baseline [Volume 5, Annex 4.1: Marine Mammal Technical Report](#) and [Volume 2, Chapter 4: Marine Mammals](#), which confirm a lack of connectivity for bottlenose dolphin and Hornsea Four. Therefore, all bottlenose dolphin sites remain screened out from LSE;
- Following availability of the Marine Mammal chapter for PEIR (and subsequent to the updates to screening provided to Natural England in May 2019), vessel disturbance has been screened in for the Southern North Sea SAC (harbour porpoise) and the Wash and North Norfolk coast SAC (harbour seal); and
- In response to further comments made by Natural England on Screening, further revisions as identified below.

8.9.2.2 It is noted that for a number of effects, LSE are screened out for marine mammals in line with previous screening assessments (and on the expectation of no pathway or insignificant/negligible effects). It was noted that these conclusions would be subject to confirmation post PEIR, once the site-specific assessment has been conducted (in case new information came forward that would alter the existing position). If the conclusions need to be updated (based on new evidence) or amended (based on site-specific issues) then this will be reflected in the final RIAA prior to submission with the Application. The approach is

deemed compatible with the 'live document' approach taken to the RIAA and follows the approach taken to date – for example the inclusion of additional sites for grey seals once baseline data became available. A determination of no LSE for the project alone does not automatically mean a determination of no LSE in-combination.

Southern North Sea SAC (harbour porpoise):

- Operational Noise. Initially screened out as no LSE in Screening. In response to Natural England's concerns, **has been screened in for potential LSE;**
- Vessel Disturbance. Initially screened out as no LSE in Screening. [Section 4.11.1](#) found harbour porpoise sensitivity to vessel disturbance to be low, with low vulnerability, and a minor magnitude of impact. Further, the total number of vessels per day (including those for Hornsea Four) will be below that suggested by Heinänen and Skov (2015) to be a threshold above which harbour porpoise density would be significantly lower. Despite the low potential for effect, given the location of the project (within the boundary of the SAC) **the existing conclusion of no LSE has been amended and is now screened in as potential LSE;**
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE for the project alone, but has been screened in for the project in-combination assessment;** and
- Changes in prey availability and behaviour. Screened out as no LSE. Confirmed as not needing further assessment within [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#). Can be further confirmed through calculations of maximum loss of volume of prey habitat (i.e. volume of the water column lost due to the presence of the piles), calculated to be 0.0001%⁸ of the total volume of the SAC, with maximum loss of benthic habitat within the SNS SAC being 0.01%⁹ of the SNS SAC, both of which are considered trivial and inconsequential (especially as loss of such a small percentage of available habitat is not directly correlated to loss of prey). Therefore, **no change required to the existing conclusion of no LSE.**

Moray Firth SAC (bottlenose dolphin):

- All effects screened out as no LSE. Bottlenose dolphin were scoped out of assessment in the Marine Mammal Chapter of the Scoping Report, with [Volume 5, Annex 4.1: Marine Mammals Technical Report](#) not identifying bottlenose dolphin as a key species, including not identifying a need to consider SACs for bottlenose dolphin within the assessment. As a result, [Volume 2, Chapter 4: Marine Mammals](#) of the PEIR does not consider bottlenose dolphin beyond its use as a proxy for other mid frequency cetaceans for assessment purposes. **No change required to the existing conclusion of no LSE.**

⁸ Based on total area of SNS SAC of 36,951km², an assumed average water depth of 40m, and maximum volume taken up due to 180 x monopiles (1.5m diameter) plus 144 pin piles for ancillary structures (4m diameter)

⁹ Based on total area of SNS SAC of 36,951km² and an assumed maximum design scenario of benthic habitat loss of 3.71km²

The Wash and North Norfolk Coast SAC (harbour seal):

- Operational Noise. Initially screened out as no LSE in Screening. On receipt of Natural England's comments, regarding operational noise in general, for this specific SAC the distance from the SAC, low harbour seal numbers at the site and the small scale and localised potential for effect results in the **existing conclusion of no LSE remaining**;
- Vessel Disturbance. Initially screened out as no LSE. [Section 4.11.1](#) found harbour seal sensitivity to be low, with a low vulnerability and minor magnitude of impact. Given the location of Hornsea Four relative to the SAC **the existing conclusion of no LSE has been amended and is now screened in as potential LSE**;
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE**; and
- Changes in prey availability and behaviour. Screened out as no LSE. Confirmed as not needing further assessment within [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#). and therefore **no change required to the existing conclusion of no LSE**.

The Humber Estuary SAC (grey seal):

- Operational Noise. Initially screened out as no LSE in Screening. On receipt of Natural England's concerns regarding operational noise in general, for this specific SAC comments the distance from the SAC and the small scale and localised potential for effect, with grey seal density primarily to the west of the array boundary and not within it, results in the **existing conclusion of no LSE remaining**;
- Vessel Disturbance. Screened in for potential LSE. [Section 4.11.1](#) found grey seal sensitivity to be low, with a low vulnerability, and a minor magnitude of impact. **No change required to the existing conclusion of potential LSE** given the potential for north/south transit of grey seals across the export cable corridor to the west of the array;
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE for the project alone, but has been screened in for the project in-combination**; and
- Changes in prey availability and behaviour. Screened out as no LSE. Confirmed as not needing further assessment within [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#). and therefore **no change required to the existing conclusion of no LSE**.

The Humber Estuary Ramsar (grey seal):

- Operational Noise. Initially screened out as no LSE in Screening. On receipt of Natural England's comments regarding operational noise in general, for this specific SAC the distance from the SAC and the small scale and localised potential for effect, with

grey seal density primarily to the west of the array boundary and not within it, resulting in the **existing conclusion of no LSE remaining**;

- Vessel Disturbance. Screened in for potential LSE. [Section 4.11.1](#) found grey seal sensitivity to be low, with a low vulnerability, and a minor magnitude of impact. **No change required to the existing conclusion of potential LSE** given the potential for north/south transit of grey seals across the export cable corridor to the west of the array;
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE for the project alone, but has been screened in for the project in-combination**; and
- Changes in prey availability and behaviour. Screened out as no LSE. Confirmed as not needing further assessment within [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#) and therefore **no change required to the existing conclusion of no LSE**.

Berwickshire and North Northumberland Coast SAC (grey seal):

- Operational Noise. Initially screened out as no LSE in Screening. Re On receipt of Natural England's comments regarding operational noise in general, for this specific SAC the distance from the SAC and the small scale and localised potential for effect results in the **existing conclusion of no LSE remaining**;
- Vessel Disturbance. Screened in for potential LSE. [Section 4.11.1](#) found grey seal sensitivity to be low, with a low vulnerability, and a minor magnitude of impact. **No change required to the existing conclusion of potential LSE** given the potential for north/south transit of grey seals across the export cable corridor to the west of the array;
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE**; and
- Changes in prey availability and behaviour. Screened out as no LSE. Confirmed as not needing further assessment within [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#) and therefore **no change required to the existing conclusion of no LSE**.

Transboundary sites (bottlenose dolphin):

- All effects screened out as no LSE. Bottlenose dolphin were scoped out of assessment in the Marine Mammal Chapter of the Scoping Report, with [Volume 5, Annex 4.1: Marine Mammal Technical Report](#) not identifying bottlenose dolphin as a key species, including not identifying a need to consider SACs for bottlenose dolphin within the assessment. As a result, the Marine Mammal Chapter of the PEIR does not consider bottlenose dolphin beyond its use as a proxy for other mid frequency cetaceans for assessment purposes. **No change required to the existing conclusion of no LSE**.

Transboundary sites (harbour seal):

- Vessel Disturbance. Screened in for potential LSE. [Section 4.11.1](#) found harbour seal sensitivity to be low, with a minor magnitude of impact. Given the location of the designated sites relative to harbour seal track data, and the location of Hornsea Four, **no change required to the existing conclusion of potential LSE**; and
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE.**

Transboundary sites (grey seal):

- Vessel Disturbance. Screened in for potential LSE. [Section 4.11.1](#) found grey seal sensitivity to be low, with a low vulnerability, and a minor magnitude of impact. **No change required to the existing conclusion of potential LSE** given the potential for north/south transit of grey seals across the export cable corridor to the west of the array; and
- Collision Risk. Screened out as no LSE. [Volume 2, Chapter 4: Marine Mammals](#) considers marine mammal collision risk in [Section 4.11.2](#). Finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. **No change required to the existing conclusion of no LSE.**

8.9.2.3 Finally, [Section 4.11.1](#) of [Volume 2, Chapter 4: Marine Mammals](#) considered other non-piling noise, including dredging, drilling, cable laying, rock placement and trenching, separately to that for vessel noise disturbance (considered above). This found potential for PTS and TTS (for non-impulsive weighted SEL_{cum}) to be within 100m for all marine mammal species, considered to be negligible for all species (noting that the 100m range is the minimum range possible for the model to generate – ie the actual range would be expected to be less than that). [Section 4.11.1](#) specifically states that 'These values mean that animals would have to stay within these very small ranges for 24 hours before they experienced injury, which is an extremely unlikely scenario as it is far more likely that any marine mammal within the injury zone would move away from the vicinity of the vessel and the construction activity'. Despite the very low risk represented by such activity, these are screened in for potential LSE under the broad heading of 'increase in underwater noise'.

8.9.3 Offshore Ornithology

8.9.3.1 Following issue of the Screening Report, a number of changes to offshore and intertidal ornithology screening have been included within the RIAA. These can be summarised as follows:

- Following consultation responses from Natural England potential connectivity between features of designated sites within maximum foraging range during the breeding bio-seasons for seabirds were included. Further additional consideration was provided to designated sites that had potential connectivity outside of the breeding bio-season

during the screening for LSE, which included screening in multiple additional sites within Scottish waters.

8.9.3.2 Those sites that were screened in are as follows:

- Greater Wash SPA;
- Flamborough and Filey Coast SPA;
- Northumbria Coast SPA;
- Humber Estuary SPA;
- Humber Estuary Ramsar;
- Hornsea Mere SPA;
- Coquet Island SPA (additional species);
- Farne Islands SPA (additional species);
- Forth Islands (UK) SPA;
- Outer Firth of Forth and St Andrew's Complex pSPA;
- Fowlsheugh SPA;
- Buchan Ness to Collieston Coast SPA;
- Troup, Pennan and Lion's Heads SPA;
- East Caithness Cliffs SPA; and
- North Caithness Cliffs SPA.

8.9.3.3 Those sites that were screened out are as follows:

- Copinsay SPA;
- Hoy SPA;
- Marwick Head SPA;
- Rousay SPA;
- Calf of Eday SPA;
- West Westray SPA;
- Fair Isle SPA;
- Sumburgh Head SPA;
- Foula SPA;
- Fetlar SPA; and
- Hermaness, Saxa Vord and Valla Field SPA.

8.9.3.4 In response to comments made by Natural England, specifically a need to re-consider screening of sites to include qualifying features, named species within seabird assemblages and all other species within seabirds assemblages associated with designated sites a review was completed for all English sites. This facilitated inclusion of additional species to those sites considered for the first test of LSE for designated sites within English waters.

8.9.3.5 It is noted that a number of effects are screened out from LSE for offshore and intertidal ornithology in line with previous such assessments (and on the expectation of no pathway or insignificant/negligible effects). These conclusions will require confirmation post PEIR, once the site-specific assessment has been conducted. If the conclusions need to be updated (based on new evidence) or amended (based on site-specific issues) then this will

be reflected in the RIAA prior to submission with the Application. The approach is deemed compatible with the 'live document' approach taken to the RIAA and follows the approach taken to date – for example the inclusion of additional more distant sites for seabirds outside of the breeding bio-seasons. A determination of no LSE for the project alone does not automatically mean a determination of no LSE in-combination.

8.9.4 Onshore Ecology

- 8.9.4.1 As discussed within [Table 1](#) and [Section 8.2.1.2](#) of this document, there are no changes to screening and as such no LSE considerations to onshore ecology. However, as presented within [Table 1](#), Natural England had requested the use of Impact Risk Zones (IRZ) in determining proximity and impact on designated sites. This consideration has been considered and it was determined that no further designated sites would be impacted by construction activities related to Hornsea Four. This information is presented on [Figure 3.16](#) in [Figure 3.16](#) of [Volume 3, Chapter 3: Ecology and Nature Conservation](#), which confirms the absence of Natura 2000 sites within the IRZ.

8.9.5 Migratory Fish

- 8.9.5.1 No specific concerns were raised during consultation as regards sites/features/effects screened in or out from potential LSE, with more general comments received covering the following:
- MMO made reference to fisheries surveys conducted by the Environment Agency (drawn on within [Appendix F](#)); and
 - Natural England noted that lamprey should be considered (Humber Estuary SAC and River Derwent SAC included for screening with respect to for river lamprey and sea lamprey specifically in relation to barriers to migration pathways (potential barrier to migration being the key point considered).
- 8.9.5.2 Further, no comments were received from the Environment Agency or Cefas following issue of the Screening Report. The above comments do not change the screening undertaken, however it should be noted that the adjustment to the export cable corridor means that the distance of works from the mouth of the Humber Estuary (and also therefore the route to the Derwent) is now even greater, having increased from the 26 km considered in the Screening Report to 32 km now.
- 8.9.5.3 The key point to note here relates to the potential for accidental pollution, the only potential effect screened in for potential LSE in the Screening Report ([Appendix A](#)). In light of the above comments with respect to 'People over Wind' and recent government advice (together with the commitments made in [Table 3](#)), it can be confirmed that the potential for accidental pollution has been screened out from potential LSE in all cases and therefore migratory fish are screened out from the assessment in their entirety.

8.10 Updated Screening for the Project Alone

- 8.10.1.1 **Table 6** is adapted from the Screening Report ([Appendix A](#)), which provides an update to the original Table 5.1 from the Screening Report and reflects the changes that have occurred since that report was issued in October 2018. **Table 6** therefore incorporates the changes in potential LSE screening described above. The table summarises, on a site by site basis, the features screened in for potential LSE from the project alone. For information on sites/features/effects screened out from potential LSE, that is contained within the Screening Report and is not reproduced in full here in the interests of brevity.

Table 6: Summary of Potential for LSE for Hornsea Four Alone.

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
Southern North Sea SAC	Harbour porpoise	Increase in underwater noise Vessel disturbance	Increase in underwater noise Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
Flamborough Head SAC	Reef	-	Changes to physical processes	Similar to and potentially less than those outlined in the construction phase.
	Reef (array and cable corridor) Submerged and partially submerged caves (cable corridor only)	Temporary increase in suspended sediment/ smothering	Temporary increase in suspended sediment/ smothering	
	Reef Submerged and partially submerged caves	Invasive non-native species	Invasive non-native species	
The Wash and North Norfolk Coast SAC	Harbour seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
Humber Estuary SAC	Grey seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
	Atlantic saltmeadows and <i>Salicornia</i> and other annuals colonising mud and sand	Increased nitrogen deposition	-	Similar to and potentially less than those outlined in the construction phase.

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
Humber Estuary Ramsar	Grey seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
	Saltmarshes	Increased nitrogen deposition	-	Similar to and potentially less than those outlined in the construction phase.
Berwickshire and North Northumberland Coast SAC	Grey seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
Transboundary harbour seal sites (Doggersbank (Dutch) SAC and Klaverbank SCI)	Harbour seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.
Transboundary grey seal sites Doggersbank (Dutch) SAC Klaverbank SCI Bancs des Flandres Vlaamse Banken SBZ 1 SBZ 2 SBZ 3 Vlakte van de Raan	Grey seal	Increase in underwater noise Vessel disturbance	Vessel disturbance	Similar to and potentially less than those outlined in the construction phase.

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
Westerschelde & Saeftinghe Voordelta Noordzeekustzone Waddenzee				
Greater Wash SPA	Little gull	-	Risk of Collision	-
	Red-throated diver Common scoter	Disturbance and displacement	Disturbance and displacement	Similar to and potentially less than those outlined in the construction phase.
Flamborough and Filey Coast SPA	Gannet Kittiwake	-	Risk of Collision	-
	Gannet	-	Displacement and disturbance	Gannet
	Guillemot Razorbill Puffin	Disturbance and displacement	Disturbance and displacement	Similar to and potentially less than those outlined in the construction phase.
	Guillemot Razorbill Puffin	-	Barrier effect	-
Humber Estuary SPA	Avocet Golden plover Black-tailed godwit Bar-tailed godwit Ruff Shelduck Dunlin Redshank	-	Risk of collision	-

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
	Knot			
Humber Estuary Ramsar	Golden plover Black-tailed godwit Bar-tailed godwit Shelduck Dunlin Redshank Knot	-	Risk of Collision	-
Hornsea Mere SPA	Gadwall	-	Risk of Collision	-
Northumbria Coast SPA	Arctic tern Little tern	-	Risk of collision	-
Coquet Island SPA	Kittiwake Common tern Arctic tern Roseate tern Sandwich tern	-	Risk of Collision	-
	Puffin	Disturbance and displacement	Disturbance and displacement	Similar to and potentially less than those outlined in the construction phase.
Farne Islands SPA	Kittiwake Common tern Arctic tern Roseate tern Sandwich tern	-	Risk of Collision	-

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
	Guillemot Puffin	Disturbance and displacement	Disturbance and displacement	Similar to and potentially less than those outlined in the construction phase.
Forth Islands (UK) SPA	Gannet Common tern Arctic tern Roseate tern Sandwich tern	-	Risk of Collision	-
	Guillemot Razorbill Puffin	-	Disturbance and displacement	-
Outer Firth of Forth and St Andrew's Complex pSPA	Gannet	-	Risk of Collision	-
	Guillemot Razorbill Puffin	-	Disturbance and displacement	-
Fowlsheugh SPA	Kittiwake	-	Risk of Collision	-
	Guillemot Razorbill	-	Disturbance and displacement	-
Buchan Ness to Collieston Coast SPA	Kittiwake	-	Risk of Collision	-
	Guillemot	-	Disturbance and displacement	-
Troup, Pennan and Lion's Heads SPA	Kittiwake	-	Risk of Collision	-
	Guillemot Razorbill	-	Disturbance and displacement	-
East Caithness Cliffs SPA	Kittiwake Great black-backed gull	-	Risk of Collision	-

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
North Caithness Cliffs SPA	Guillemot Razorbill	-	Disturbance and displacement	-
	Kittiwake	-	Risk of Collision	-
	Guillemot Razorbill Puffin	-	Disturbance and displacement	-

* Note that additional feature(s) may be included within the designation; however those detailed here are limited to the habitat and/ or species screened in for potential LSE. All feature(s) are included within the Screening Matrix, appended at [Appendix C](#).

9 The Screening Process for the Project In-combination

9.1 Overview to In-combination Screening

- 9.1.1.1 Regulation 63 of the Habitats Regulations includes a requirement for the Competent Authority to consider the need for AA either alone or in-combination with other plans or projects, where these are not directly connected with or necessary to the management of the site. Screening for the project alone is summarised in [Section 8](#), with screening for the project in-combination provided here.
- 9.1.1.2 The legislation does not provide a definition of alone or in-combination. The following list has been applied to Hornsea Four when identifying plans and projects for consideration in-combination (taking account of relevant advice, such as the PINS Advice Note 17, which addresses Cumulative Effects):
- Permitted ongoing activities;
 - Approved or consented plans which have not yet been completed;
 - Plans and projects where the application for consent has been submitted but has not yet been approved by the competent authorities; and
 - Plans and projects which are reasonably foreseeable, i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development being assessed and for which sufficient information is available to adequately assess the likelihood of cumulative and in-combination effects.
- 9.1.1.3 A full review of such plans and projects has been conducted for Hornsea Four, with each individual topic chapter for the PEIR having undertaken screening of the full list of projects, plans and activities, to identify those relevant to individual receptor groups. The relevant plan/ project screening tables to the receptor groups within the RIAA are presented within the PEIR chapters as follows:
- Table 2.24 within [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#);
 - Table 4.40 within [Volume 2, Chapter 4: Marine Mammals](#);
 - Table 5.38 within [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#);
 - Section 3.11 within [Volume 3, Chapter 3: Ecology and Nature Conservation](#); and
 - Table 3.16 within [Volume 2, Chapter 3: Fish and Shellfish Ecology](#).
- 9.1.1.4 No additional plans or projects have been identified through consultation to date.
- 9.1.1.5 With respect to in-combination effects within the HRA process, the Screening Report ([Appendix A](#)) identified the broad categories of plans and projects to be considered within this RIAA. The specific plans and projects relevant to individual receptors draw on those identified within the individual ES chapters, as highlighted above. The intention of screening in-combination is to determine, for the plans and projects relevant to each receptor group, which of the designated sites screened in for determination of potential LSE alone may be affected by a spatial and/ or temporal overlap of effect from a relevant plan or project.

9.1.1.6 Further, it is acknowledged that the potential contribution to an AEol in-combination by Hornsea Four could stem not only from those effects where potential LSE exists in relation to the project alone (as highlighted in [Table 6](#) above), but also potentially from a not significant aspect of the project alone that may become more relevant in-combination. As such, consideration has been given where the potential exists for Hornsea Four, to contribute to potential LSE in-combination, immaterial of whether a potential LSE alone applies or not.

9.1.1.7 The determination of potential LSE in-combination takes into account the following:

- Level of detail available for project/ plans;
- Potential for an effect-pathway-receptor link;
- Potential for a physical interaction; and
- Potential for temporal interaction.

9.1.1.8 The approach applied to screening in-combination is outlined below. The overall aim is to determine the plans or projects that may affect the designated sites considered for potential LSE for the project alone.

9.1.1.9 As is typical for an in-combination assessment, for many plans and projects there is uncertainty regarding project design and timeframe but also quantified environmental impacts. For this reason, a tiered approach has been applied to the in-combination assessment, with more detail on this approach provided below. The approach to the in-combination assessment for offshore ornithology follows the advice provided by Natural England that offshore wind farm projects should be considered at a finer level of tiering that relates to the stages of their progress through the development / consenting process and the description of that receptor specific approach is given under the offshore ornithology heading ([Section 9.4](#)).

9.1.1.10 All relevant projects/ plans considered in-combination with Hornsea Four have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the in-combination impact assessment to consider several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each scenario (Tier) in the decision making process when considering the potential in-combination impact associated with Hornsea Four.

9.1.1.11 The tier structure presented below is in common with the PEIR chapters as below in [Table 7](#) (including offshore ornithology at a coarser scale, with the finer scale as requested by Natural England presented separately) and is intended to ensure that there is a clear understanding of the level of confidence in the in-combination assessment within the RIAA. It is noted that within Tier 1, however, there is significant variability in project certainty between a project in planning but not yet submitted to PINS and a project under construction, specifically as regards the 'final' scheme design and construction programme. Experience from other offshore wind projects over many years indicates that the project as assessed on application (in terms of maximum design scenario and the overall construction

window) is almost always much greater in terms of impact/timeframe than a project at the point of construction – e.g. fewer turbines, more clearly defined (and shorter) construction window etc. Such disparity in the level of certainty as to the 'final' scheme and level of impact within Tier 1 is considered an important point, particularly in the marine mammal assessment, with 'sub tiers' applied for clarity in that instance.

Table 7: Description of Tiers of Other Developments Considered for In-Combination Assessment (adopted from PINS Advice Note 17).

Tier 1	Project under construction.
	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented.
	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined.
Tier 2	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted.
Tier 3	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted.
	Identified in the relevant Development Plan (and emerging Development Plans with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.
	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.

9.2 Subtidal and Intertidal Benthic Ecology

- 9.2.1.1 The initial step to screening for plans and projects in-combination for subtidal and intertidal benthic ecology receptors is to identify those plans and projects located within sufficient proximity to the relevant designated sites (based on a receptor specific screening range). Where plans and projects are identified, these will then be considered further to determine if potential LSE in-combination with Hornsea Four applies.
- 9.2.1.2 For subtidal and intertidal benthic ecology, the full list of plans and projects identified for cumulative assessment are provided within [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#). For the purposes of the RIAA, these have been filtered, through the use of a Geographical Information System (GIS), to identify those plans and projects located within 15 km of the following designated site (applying the maximum project specific screening range):
- Flamborough Head SAC.
- 9.2.1.3 The conclusions of that screening are provided in [Table 8](#).

Table 8: Summary Plans and Projects to be Considered In-Combination in Relation to Subtidal and Intertidal Benthic Ecology.

Project/ Plan				Range to Flamborough Head SAC (km)
Development Type	Project	Status	Tier	
Dredge spoil site	Bridlington A	Open	Tier 1	0 km
Offshore windfarm ECC	Z3 Creyke Beck A OFTO	Consented	Tier 1	1.04 km
Offshore windfarm ECC	Z3 Creyke Beck B OFTO	Consented	Tier 1	1.04km

9.2.1.4 For the plans and projects highlighted above as being within sufficient proximity to the Flamborough Head SAC, it is considered that there is potential for potential LSE in-combination with Hornsea Four. The potential for such an effect will vary, depending on parameters such as the timing of works and the nature of those works, with these to be considered in full in the determination of AEol.

9.2.1.5 The effects considered in-combination for subtidal and intertidal benthic ecology are the same as those screened in for potential LSE for the project alone in [Table 6](#), with the exception of effects on saltmarsh through increased nitrogen deposition. This last impact was screened out for in-combination effects because the assessment of project alone concluded at most an inconsequential level of effect and therefore no in-combination assessment was considered necessary.

9.3 Marine Mammals

9.3.1.1 For marine mammals, screening in-combination has considered those designated sites where the potential for LSE was identified for the project alone. For all other designated sites, the distance is such that there is no pathway for effect from Hornsea Four to reach the designated site boundary and therefore no potential for an in-combination effect. The screening ranges applied for marine mammals in-combination are the same as those applied for the project alone, being 26 km for harbour porpoise (JNCC, 2016), 120 km for harbour seal (SMRU, 2011) and 145 km for grey seal (Thompson *et al.* 1996), together with consideration of site connectivity in the same manner as screening for the project alone. The ranges (in the context of site connectivity) have been applied in GIS to each of the designated sites highlighted below to identify, from the full list of plans and projects identified for marine mammal cumulative assessment within the PEIR, those to consider further for potential LSE in-combination with Hornsea Four. The screening therefore considers the following sites:

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland SAC (grey seal);

- Transboundary sites for harbour seal (Doggersbank (Dutch) SAC and Klaverbank SCI); and
- Transboundary sites for grey seal (Doggersbank (Dutch) SAC, and Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, Waddenzee SCI).

9.3.1.2 The effects considered in-combination for marine mammals are the same as those screened in for potential LSE for the project alone in [Table 6](#), with the inclusion of collision risk for the SNS SAC (harbour porpoise) and the Humber Estuary SAC and Ramsar (grey seal).

9.3.1.3 The majority of the effects screened in are highly temporal and therefore for an in-combination effect to occur, a measure of temporal overlap is required (with respect to the SNS SAC, that relates to seasonal overlap). It is widely acknowledged that uncertainty exists around the timeframe of works for projects going forward. Certainty of construction in a defined timescale is highly dependent on the stage a project has reached. Some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward or may change considerably (for example construction window changes, array boundary changes, WTG number changes etc).

9.3.1.4 There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans with consent and (if required) CfD (or similar) are more likely to contribute to in-combination impact with Hornsea Four (providing effect or spatial pathways exist), whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

9.3.1.5 That uncertainty in the context of the Hornsea Four tiering structure is noted above in [Section 9.1](#). A key part of the response to that uncertainty will be the provision of a draft Site Integrity Plan (SIP) at the point of application; the document is currently in preparation and will be secured by a requirement in the DCO. The purpose of the SIP is to provide the required level of certainty that such risk will be managed and addressed going forward (following Application, Examination and up to and including construction), thus ensuring that the conclusions of the RIAA remain valid in any given scenario. Such a SIP has been used on a number of other offshore wind projects to date and is designed to provide the required level of certainty. Although the SIP is specific to the SNS SAC, management and/or mitigation of underwater noise for one species (harbour porpoise) has wider benefits for other noise sensitive species.

9.3.1.6 The SIP will be drafted in consultation with the Evidence Plan Process, and will address the following key points:

- Introduction – to provide an overview of what the SIP is, the project and the purpose of the SIP. To include timeframe for review, updates and re-issue of the SIP as construction draws closer;

- Final Design Plan – to enable the relevant points of the final scheme design for Hornsea Four, together with an update to plans and projects in-combination, to be provided and compared to the maximum design scenario assessed here – to clarify any changes in the conclusions on AEol (alone or in-combination) presented here;
- Updated RIAA – if there is a need for an updated RIAA following any changes to scheme design (alone or in-combination);
- Mitigation Measures – measures to address the risk of injury to be included within the piling-MMMP, with measures to address the risk of an exceedance of the thresholds provided within the SIP, drawing on those measures provided in Table 2 of the JNCCs Advice on Activities for the SNS SAC¹⁰. These include primary mitigation measures (described as ‘potential for a reduction or limitation of the disturbance / displacement effects by varying the schedule of piling...Limited spatio-temporal restrictions may be needed’) and secondary mitigation measures (described as ‘sound dampers, i.e. methods that create a barrier to sound transfer (e.g. bubble curtains) and the use of alternative foundation types’);
- Additional Licensing Requirements – to be clear on additional licences e.g. Marine Licence and/ or EPS licence.

9.3.1.7 Drawing on the long list of projects identified by the application of the screening ranges, the potential for LSE in-combination has been determined based on the following:

- For a plan or project where there is potential for the construction period to have temporal overlap with that of Hornsea Four (i.e. the plan/ or project is identified by ‘yes’ in terms of construction window overlap) AND the plan/ or project is within the relevant species specific screening range of the designated site (or drawn in via potential site connectivity); and
- For a plan/ or project where there is no potential for temporal overlap with the construction period (i.e. the plan/ or project is identified by ‘no’ or ‘unknown’ in terms of construction window overlap), only those designated sites with physical overlap with the plan/ or project are screened in for potential LSE.

9.3.1.8 The differentiation between construction period and O&M period impacts is made here for marine mammals, in light of the typical scale of effects that may occur during construction compared to those during O&M (as evidenced by [Volume 2, Chapter 4: Marine Mammals](#)).

9.3.1.9 It is acknowledged that other activities have the potential to contribute to an in-combination effect, specifically with regard to underwater noise. Previous assessments within the SNS SAC (eg the recent applications made for Hornsea Three) have included consideration of seismic survey associated with oil and gas activity, together with UXO detonations. Where planned seismic survey is known in association with the plans and projects identified in [Table 8](#), these will be screened in for assessment. Given the timeframes involved (with offshore construction works at Hornsea Four due to start in 2025 at the earliest, albeit potentially preceeded from 2023 by geophysical survey and/or UXO clearance), the available information regarding planned oil and gas works¹¹ currently

¹⁰ http://archive.jncc.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

¹¹ Sourced from https://itportal.beis.gov.uk/eng/fox/live/PETS_EXTERNAL_PUBLICATION/main

extends to 2020 only (website accessed June 2019) and therefore does not cover the required period, with no certainty regarding what or where (if anything) further applications would come forward in the relevant timeframe. It is therefore not possible to include such oil and gas works here.

- 9.3.1.10 Similarly, as regards UXO clearance, where any planned works associated with projects screened in are known, these will be included within the assessment. As regards UXO clearance more widely, previous projects have considered ongoing UXO clearance, with OSPAR data providing a comprehensive source of historic information¹².
- 9.3.1.11 The RIAA only takes account (and should only take account) of planned/consented works within the licensing process. It is not considered appropriate to undertake a speculative in-combination assessment in HRA terms based on historic activity for either oil and gas works or UXO clearance. It is therefore considered appropriate within the RIAA for Hornsea Four to limit the in-combination assessment to works known to be occurring and not based on an assumption of past activity continuing. In any case, any activity that would be included within an in-combination assessment (but for which no information is as yet in the public domain) would be expected to undertake the HRA process in its own right and would therefore be the subject of assessment at that point, including consideration in combination with Hornsea Four. Finally, the delivery of a draft Site Integrity Plan (SIP) with the application for Hornsea Four with respect to the SNS SAC provides certainty that the in-combination assessment will be revisited on a defined timeframe, with additional plans/projects (or if necessary, the relevant project parameters) to be amended/included at that point as relevant. The process provides certainty in the in-combination screening process for marine mammals.
- 9.3.1.12 **Table 9** summarises all plans and projects considered for screening in-combination for marine mammals (as identified through the use of GIS), including comment on potential for temporal overlap with offshore construction and an assigned tier. Where that plan or project lies within the relevant screening range of a site screened in for potential LSE for marine mammals alone, GIS has again been used to determine the range between the plan or project and that designated site. Where the range exceeds the relevant screening range, the cell is greyed out (unless clear site connectivity is apparent). Where the range is within the relevant screening range, the minimum range (in km) is entered.

¹² Information contained <https://www.ospar.org/work-areas/eiha/munitions> and data held http://odims.ospar.org/odims_data_files/

Table 9: Summary of Plans and Projects Screened in for the Marine Mammal Assessment In-Combination.

Project/ Plan				Range to Designated Site (screening range in km)																
Type	Project	Overlap with construction	Tier	Southern North Sea SAC	The Wash and North Norfolk Coast SAC	Humber Estuary SAC	Humber Estuary Ramsar	Berwickshire and North Northumberland SAC	Doggersbank (Dutch) SAC	Klaverbank SCI	Bancs des Flandres SAC	Vlaamse Banken SAC	SBZ 1 SAC	SBZ 2 SAC	SBZ 3 SAC	Vlaakte van de Raan SAC	Westerschelde & Soetfinghe SAC	Voordelta SAC	Noordzeekustzone SAC	Waddenzee SAC
OWF	Hornsea ONatural England	No – under construction, commissioning expected 2020	1	0	94	102	102		64	44										
OWF	East Anglia One	No – under construction, commissioning expected 2021	1	0	116						93	69	103	91	95	82	93	81	138	
OWF	Hornsea TWO	No – under construction, commissioning expected 2023	1	0	91	89	89		63	50										
OWF	Triton Knoll	No – construction expected 2019-2021	1	23	40	32	32			135										
OWF	Borssele	No – construction expected 2019-2020	1	21							54	30	48	27	21	9	25	12	137	
OWF	THV Mermaid	No – construction expected 2019	1	18							47	23	48	34	39	32	49	36		
UXO	Viking Link	No – UXO clearance expected prior to summer 2021	1	0	19	9	9		17	0										
OWF	Near na Gaoithe	No – construction expected 2020-2022	1					29												
OWF	Inch Cape	No – construction expected 2020-2022	1					52												
OWF	2B Energy Methil Demonstration	Unknown	1					54												
OWF	SeaGreen Alpha	No - construction expected 2020-2022	1					65												
OWF	SeaGreen Bravo	No - construction expected 2020-2022	1					66												
OWF	Kincardine	No . Construction (non-piled) 2018-2020.	1					116												
OWF	Seastar	No - construction expected 2020	1								46	22	44	28	31	23	39	26		
OWF	Borkum Riffgrund II	No - construction expected 2019-2020	1																39	40
OWF	OWP Delta Nordsee 2	No . Construction expected to be complete prior to 2023.	1																50	50
OWF	Borkum-Riffgrund West II	No - construction expected 2019-2020	1																51	58
OWF	OWP West	No – construction expected prior to 2023.	1																50	53
OWF	Nordsee Three	No – construction expected prior to 2023	1																56	56

Project/ Plan				Range to Designated Site (screening range in km)																
Type	Project	Overlap with construction	Tier	Southern North Sea SAC	The Wash and North Norfolk Coast SAC	Humber Estuary SAC	Humber Estuary Ramsar	Berwickshire and North Northumberland SAC	Doggersbank (Dutch) SAC	Klaverbank SCI	Bancs des Flandres SAC	Vlaamse Banken SAC	SBZ 1 SAC	SBZ 2 SAC	SBZ 3 SAC	Vlaakte van de Raan SAC	Westerschelde & Soeftinghe SAC	Voordelta SAC	Noordzeekustzone SAC	Waddenzee SAC
OWF	Gode Wind III	No – construction expected prior to 2023	1																58	58
OWF	Deutsche Bucht Pilot	No - construction expected 2019	1																80	89
OWF	EnBW Hohe See	No – due to be connected 2019	1																91	93
OWF	Albatros 1	No – due to be connected 2019	1																100	103
OWF	Kaskasi I	No – expected to be commissioned 2022	1																120	119
OWF	Kaskasi II	No – expected to be commissioned 2022	1																123	123
OWF	Thanet Extension	No – piling window scheduled summer 2021-winter 2022/23.	1	0							23	39	60	75	94	99	114	107		
OWF	East Anglia Three	Yes – piling scheduled summer 2020-winter 2023/24.	1	0	113					120	136	112	143	128	126	109	117	95	101	115
OWF	Dogger Creyke Beck A	Yes – construction scheduled winter 2020-21-winter 2027-28).	1	0					47	66										
OWF	Dogger Creyke Beck B	Yes – construction scheduled winter 2020-21-winter 2028-29).	1	0					71	87										
OWF	Dogger Teesside A	Yes – construction scheduled winter 2020-21-summer 2028.	1	24					0	74										
OWF	Sofia (formerly Dogger Teesside B)	Yes – construction scheduled winter 2020-21-summer 2028.	1	0					34	69										
OWF	Norfolk Vanguard	Yes – construction scheduled 2023/24-winter 2028/29 (or phased within).	1	0	80					93		14				135	141	106	98	110
OWF	Hornsea Project Three	Yes – construction expected 2024-2028.	1	1.4	120	141	141		42	11									138	
OWF	Norfolk Boreas	Yes . Q4 2024- Q2 2025 - pre-construction survey. Q3 2025-Q1 2026 - UXO clearance. Q2 2026-Q4 2027 - foundation installation.	1	0	110				128	68								118	96	106
OWF	Seagreen Delta	Yes . Works must commence no later than 5 years following August 2018.	1					30												
OWF	Seagreen Charlie	Yes . Works must commence no later than 5 years following August 2018.	1					40												
OWF	Borkum Riffgrund West	Yes – expected to be commissioned 2024-2025	1																50	53

Project/ Plan				Range to Designated Site (screening range in km)																
Type	Project	Overlap with construction	Tier	Southern North Sea SAC	The Wash and North Norfolk Coast SAC	Humber Estuary SAC	Humber Estuary Ramsar	Berwickshire and North Northumberland SAC	Doggersbank (Dutch) SAC	Klaverbank SCI	Bancs des Flandres SAC	Vlaamse Banken SAC	SBZ 1 SAC	SBZ 2 SAC	SBZ 3 SAC	Vlaakte van de Raan SAC	Westerschelde & Saefinghe SAC	Voordelta SAC	Noordzeekustzone SAC	Waddenzee SAC
OWF	EnBW He Dreiht	Yes – scheduled for commissioning 2025	1																84	87
OWF	East Anglia One North	Yes –construction expected 2025-2028.	2	0	99						110	87	122	111	113	98	109	93	135	
OWF	East Anglia Two	Yes –construction expected 2026-2029.	2	0	99						82	59	94	84	92	82	96	84		
OWF	Sheringham Shoal Extension	Not known	3	26	8	60	60			134										
OWF	Dudgeon Extension	Not known	3	14	24	63	63		144	114										
OWF	Race Bank Extension	Not known	3		14	34	34			138										
OWF	Greater Gabbard Extension	Not known	3	0	117						37	34	64	69	82	81	99	86		
OWF	Galloper Extension	Not known	3	0							49	35	68	66	78	74	90	78		
OWF	Sea Wind I	Not known	3																96	98
OWF	Sea Wind II	Not known	3																99	102
OWF	Notos	Not known	3																100	103
OWF	Kaikas	Not known	3						143										109	113
OWF	H2-20	Not known	3						17											

9.4 Offshore Ornithology

- 9.4.1.1 In assessing the potential in-combination impacts of Hornsea Four against offshore ornithology receptors, account is taken in the assessment process of the fact that some projects, such as those put forward by developers in to the consenting process, may not be consented or built out as described within their ES. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposed but as yet unconsented projects. For example, a comparison with regards certainty of effects can be made between those projects that are under construction and those proposals not yet approved where there is much less certainty about the scale of an impact, as some may not achieve approval or may not ultimately be built due to other factors.
- 9.4.1.2 To account for this in the offshore ornithology in-combination assessment all projects considered alongside Hornsea Four have been allocated into 'tiers' and 'sub-tiers' reflecting their current stage within the planning and development process. This allows the in-combination impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. This approach also allows appropriate weight to be given to each scenario (tier) when considering the potential in-combination impact. The proposed tier structure is intended to ensure that there is a clear understanding of the level of confidence in the in-combination assessment for Hornsea Four RIAA. The arrangement of 'tiers' and 'sub-tiers' also reflects the responses received from Natural England when consulted about this issue. An explanation of each tier is included in [Table 10](#) below.

Table 10: Description of tiers and sub-tiers considered in the offshore ornithology in-combination assessment.

Tier	Sub-Tier	Description of stage of development of project
Tier 1	Tier 1a	Project under operation
	Tier 1b	Project under construction
	Tier 1c	Consented project, whether under the Planning Act 2008 or other regimes, but not yet implemented
	Tier 1d	Submitted project, whether under the Planning Act 2008 or other regimes, but not yet determined
Tier 2	Tier 2	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted and/or the developer has released details in, for instance, a PEIR
Tier 3	Tier 3a	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted
	Tier 3b	Project identified in the a Development Plan or emerging Development Plans noting that any information on the project will be limited
	Tier 3c	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward

- 9.4.1.3 The plans and projects identified as relevant to the in-combination assessment of impacts to offshore ornithology receptors are based on an initial screening exercise undertaken on a long list and published in the PEIR (see [Annex 4.5.3](#)). A consideration of effect-receptor pathways, data confidence and temporal and spatial scales has been made in order to select projects that will be included in the detailed in-combination assessment.
- 9.4.1.4 Where planned and operational projects were screened out of further consideration for potential in-combination effects this was because there was not an identified potential impact-receptor-pathway that occurred during construction, operation and maintenance or decommissioning for the following reasons:
- There is no potential impact-receptor-pathway due to the project being outside of the North Sea;
 - There is no temporal overlap between projects / activities;
 - The project / activity is ongoing and is part of the current baseline;
 - There is no data available or there is low confidence in the data.
- 9.4.1.5 The projects screened out included UK offshore wind farms evaluated as having low data confidence on the basis that no construction or operational period is known and / or it is a UK offshore wind farm outside of the North Sea. Other projects from non-offshore energy projects screened out included commercial fisheries as well as shipping and navigations, which due to already being present were evaluated as being part of the offshore baseline.
- 9.4.1.6 The specific projects screened into the in-combination assessment for offshore ornithology receptors, which includes only offshore wind farm projects, as well as the tiers (and sub-tiers) into which they have been allocated are presented in [Table 11](#) below.

Table 11: Projects screened into the offshore ornithology in-combination assessment.

Tier	Long List Project Name	Project Details/ Relevant dates (cf Hornsea 4 Construction Period Of 2026-28)	Distance to Hornsea Four Array	Distance to Hornsea Four ECC	Distance to Hornsea Four HVAC Booster Area	Reason for Project Inclusion in Hornsea 4 CEA
1a	Beatrice Demonstrator	Operational	497.86	484.58	493.60	Potential temporal overlap of operation with Hornsea Four
1a	Blyth Demonstration Site	Operational	174.71	139.88	155.81	Potential temporal overlap of operation with Hornsea Four
1a	Dudgeon	Operational	70.83	72.72	101.65	Potential temporal overlap of operation with Hornsea Four
1a	EOWDC	Operational	379.67	369.14	376.52	Potential temporal overlap of operation with Hornsea Four
1a	Galloper	Operational	219.97	223.34	251.02	Potential temporal overlap of operation with Hornsea Four
1a	Greater Gabbard	Operational	221.71	224.96	251.61	Potential temporal overlap of operation with Hornsea Four
1a	Humber Gateway	Operational	66.37	40.96	42.02	Potential temporal overlap of operation with Hornsea Four
1a	Lincs, Lynn & Inner Dowsing	Operational	96.62	83.65	89.25	Potential temporal overlap of operation with Hornsea Four
1a	Kentish Flats I	Operational	276.33	277.51	290.21	Potential temporal overlap of operation with Hornsea Four
1a	Kentish Flats II	Operational	277.24	278.22	290.25	Potential temporal overlap of operation with Hornsea Four

Hornsea 4



Tier	Long List Project Name	Project Details/ Relevant dates (cf Hornsea 4 Construction Period Of 2026-28)	Distance to Hornsea Four Array	Distance to Hornsea Four ECC	Distance to Hornsea Four HVAC Booster Area	Reason for Project Inclusion in Hornsea 4 CEA
1a	London Array	Operational	249.99	252.41	270.96	Potential temporal overlap of operation with Hornsea Four
1a	Race Bank	Operational	78.83	72.40	82.66	Potential temporal overlap of operation with Hornsea Four
1a	Sheringham Shoal	Operational	89.51	88.65	106.44	Potential temporal overlap of operation with Hornsea Four
1a	Teesside	Operational	136.72	86.37	108.47	Potential temporal overlap of operation with Hornsea Four
1a	Thanet	Operational	277.04	279.59	298.70	Potential temporal overlap of operation with Hornsea Four
1a	Westermose Rough	Operational	62.75	21.63	25.40	Potential temporal overlap of operation with Hornsea Four
1b	Beatrice	Under Construction	>500.00	489.40	497.77	Potential temporal overlap of construction with Hornsea Four
1b	East Anglia One	Under Construction	194.09	198.56	236.63	Potential temporal overlap of construction with Hornsea Four
1b	Hornsea Project One	Under Construction	5.08	21.32	82.50	Potential temporal overlap of construction with Hornsea Four
1b	Hornsea Project Two	Under Construction	0.00	5.84	66.43	Potential temporal overlap of operation with Hornsea Four
1c	Dogger Bank Creyke Beck A	Consented– construction expected 2021-2024	65.86	83.65	107.52	Potential temporal overlap of operation with Hornsea Four

Hornsea 4



Tier	Long List Project Name	Project Details/ Relevant dates (cf Hornsea 4 Construction Period Of 2026-28)	Distance to Hornsea Four Array	Distance to Hornsea Four ECC	Distance to Hornsea Four HVAC Booster Area	Reason for Project Inclusion in Hornsea 4 CEA
1c	Dogger Bank Creyke Beck B	Consented– construction expected 2021-2024	76.14	94.18	111.26	Potential temporal overlap of operation with Hornsea Four
1c	Dogger Bank Teesside A	Consented - construction expected 2023-2026	120.86	135.62	170.16	Potential temporal overlap of construction with Hornsea Four
1c	East Anglia Three	Consented - construction expected 2020-2023	157.84	164.73	211.81	Potential temporal overlap of operation with Hornsea Four
1c	Hywind 2 Demonstration	Consented	381.06	379.01	383.20	Potential temporal overlap of operation with Hornsea Four
1c	Inch Cape	Consented	311.89	291.43	303.06	Potential temporal overlap of operation with Hornsea Four
1c	Moray East	Consented	494.29	484.40	491.93	Potential temporal overlap of operation with Hornsea Four
1c	Moray West	Consented	490.62	478.40	486.94	Potential temporal overlap of operation with Hornsea Four
1c	Neart na Gaoithe	Consented	296.16	271.32	284.45	Potential temporal overlap of operation with Hornsea Four
1c	Seagreen Alpha	Consented	312.11	295.09	304.91	Potential temporal overlap of operation with Hornsea Four
1c	Seagreen Bravo	Consented	312.11	295.09	304.91	Potential temporal overlap of operation with Hornsea Four
1c	Sofia	Consented - construction expected 2023-2026	97.75	113.14	143.26	Potential temporal overlap of construction with Hornsea Four

Hornsea 4



Tier	Long List Project Name	Project Details/ Relevant dates (cf Hornsea 4 Construction Period Of 2026-28)	Distance to Hornsea Four Array	Distance to Hornsea Four ECC	Distance to Hornsea Four HVAC Booster Area	Reason for Project Inclusion in Hornsea 4 CEA
1c	Triton Knoll	Consented– construction expected 2019-2022	56.99	49.70	60.93	Potential temporal overlap of operation with Hornsea Four
1d	Hornsea Three	In planning – construction expected 2024-2030	36.34	55.47	116.10	Potential temporal overlap of construction with Hornsea Four
1d	Norfolk Boreas	In planning construction expected 2023-2025	123.34	133.68	187.40	Potential temporal overlap of construction with Hornsea Four
1d	Norfolk Vanguard	In planning construction expected 2024-2028	123.39	130.86	175.94	Potential temporal overlap of construction with Hornsea Four
1d	Thanet Extension	In planning	275.87	278.37	279.02	Potential temporal overlap of construction with Hornsea Four
2	East Anglia One North	Pre-planning Application construction expected 2025- 2028	178.58	182.88	219.69	Potential temporal overlap of construction with Hornsea Four
2	East Anglia Two	Pre-planning Application construction expected 2026- 2029	187.28	191.13	224.09	Potential temporal overlap of construction with Hornsea Four

- 9.4.1.7 The key risks in terms of potential in-combination effect on offshore ornithology receptors relates to the combined impacts on breeding and non-breeding seabirds (on passage or over-wintering) of displacement during the construction, operational & maintenance and decommissioning phases and mortality resultant from collision in the operational phase.
- 9.4.1.8 The specific European sites with offshore ornithology interest features screened into the in-combination assessment are presented in [Table 12](#) below. [Table 12](#) presents only the particular interest features of a site that have been screened in and does not list all those particular interest features that are screened out [that information is contained in [Appendix C](#)]

Table 12: European sites with offshore ornithology interest features screened into the in-combination assessment.

Designated Site	Feature(s) screened in*	Potential for Likely Significant Effect		
		Construction	O&M	Decommissioning
Flamborough and Filey Coast SPA	Gannet Kittiwake	-	Risk of Collision	-
	Guillemot Razorbill Puffin	-	Disturbance and displacement	-

9.5 Onshore Ecology

- 9.5.1.1 As baseline data collection is ongoing with regard to onshore ecology, no assessment has been made with regard to onshore inter-related effects within [Volume 3, Chapter 3: Ecology and Nature Conservation](#) of the PEIR. This process will be fully undertaken once all baseline data has been collated, and subsequently reported within the Hornsea Four Environmental Statement, to be submitted as part of the DCO application in 2020. Although there is at present no indication of potential LSE alone with regard to onshore ecology, it is recognised this does not automatically equate to no LSE in-combination with other projects.
- 9.5.1.2 The study areas that have been identified for in-combination effects for onshore ecology are in line with the study areas as described in [Section 9.5](#), namely a maximum 5 km buffer of the onshore elements of Hornsea Four, taking into consideration the Natural England IRZs. This is in order to account for highly mobile bat and bird species. For other protected species and habitats, a maximum extent of impact is considered to be 2 km, taking into consideration potential pathways (i.e. connecting habitats between projects) as well as temporal overlap on shared habitat resources.

9.6 Migratory Fish

- 9.6.1.1 potential As noted above in Screening Alone, the only effect screened in for potential LSE for migratory fish alone within the Screening Report ([Appendix A](#)) was accidental pollution. As described for the project alone, that effect has now been screened out for potential LSE alone and therefore has not been taken forward in-combination. Therefore no further consideration is made here to migratory fish, with no LSE in-combination.

10 Summary of Designated Sites

- 10.1.1.1 Summary information on each designated site screened in for potential LSE alone and/ or in combination is provided in [Appendix E](#), including the designated feature(s), key literature sources describing the site and the features/ effects screened in under potential LSE. The conservation objectives for each site are also provided.

11 Assessment of Adverse Effect Alone

- 11.1.1.1 Where potential for LSE on a European site has been identified, there is a requirement to consider whether those effects will adversely affect the integrity of the site in view of its conservation objectives. The conclusion on potential LSE for Hornsea Four alone is presented in [Table 6](#), with the conservation objectives for all relevant sites provided in [Appendix E](#). The information is presented below according to the following receptor groupings:
- Subtidal and Intertidal Benthic Ecology;
 - Marine Mammals;
 - Offshore Ornithology; and
 - Onshore Ecology
- 11.1.1.2 The assessment approach applied here is to first summarise each designated site screened in for potential LSE in turn, highlighting the feature(s) screened in together with the site's conservation objectives and the effects identified as potentially resulting in potential LSE. To minimise the potential for repetition, the determination of AEol that follows is made on a receptor by receptor basis – however the relevant sites (and their features) are identified for each receptor, together with the relevant effects.
- 11.1.1.3 The nature of each relevant effect is then described (e.g. in terms of scale, duration, frequency, etc), drawing on the relevant project literature to minimise repetition, and summarising the relevant conclusion from the PEIR. A conclusion on AEol is then drawn for each site feature screened in, with these conclusions summarised on a site by site basis in [Table 34](#).

11.2 Subtidal and intertidal benthic ecology

11.2.1 Assessment Criteria

- 11.2.1.1 The RIAA has been prepared in accordance with Advice Note 10: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2017), with the method for determining potential impact with respect to subtidal and intertidal benthic ecology being compliant with the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines (CIEEM, 2016).
- 11.2.1.2 The assessment criteria and conclusions presented within [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#) have been drawn on to inform this report when considering the potential for adverse effects on site integrity with respect to intertidal and benthic ecology features, with the PEIR conclusions on significance being considered here specifically in the context of the conservation objectives of the designated sites being assessed. The final assessment for each effect is based upon expert judgement. Where possible, parameters are quantified and predicted changes presented.
- 11.2.1.3 Full detail of the assessment criteria and assignment of significance applied within the PEIR are provided within [Section 2.10](#) of [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#), and take account of the following:
- Sensitivity/ importance of the environment (drawing on MarLIN and MARESA sensitivity categories;
 - Magnitude of impact (the degree of change from baseline, in terms of spatial extent, duration, timing, seasonality and/ or frequency);
 - Significance of potential effect in terms of major/ moderate/ minor and negative/ beneficial (defined in a matrix combining sensitivity and magnitude).

11.2.2 Description of Significance

- 11.2.2.1 A description of the significance of project level effects upon the receptors grouped under 'subtidal and intertidal benthic ecology', as relevant to the designated sites and their associated features screened in for potential LSE is provided below.
- 11.2.2.2 As described in [Table 6](#), there are two European sites which have the potential to be affected through impacts on subtidal and intertidal benthic ecology. These are:
- 11.2.2.3 The Flamborough Head SAC, which is situated 1.64 km from the ECC. The HRA Screening Revisited report ([Appendix B](#)), concluded that the following impacts should be screened in for consideration in the RIAA because a potential LSE could not be discounted for these impacts:
- Temporary increases in suspended sediments / smothering
 - Invasive non-nature species
 - Changes to physical processes

- 11.2.2.4 The Humber Estuary SAC and Ramsar which has a potential LSE for effects on saltmarsh from increased nitrogen deposition.

11.2.3 Construction and Decommissioning

Temporary increases in suspended sediments concentrations (SSC) / smothering

- 11.2.3.1 The potential for an AEol as a result of an increase in SSC and subsequent deposition on subtidal and benthic intertidal habitats during construction and decommissioning relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE):

Flamborough Head

- Reefs; and
- Submerged or partially submerged sea caves.

- 11.2.3.2 There is the potential for a temporary increase in SSCs and subsequent deposition to result from construction operations within the ECC. The distance between the array boundary and the SAC is such that effects resulting from the array have been screened out ([Appendix B](#)).

- 11.2.3.3 Temporary, intermittent and localised increase in SSCs could potentially affect the benthos e.g. through lower light levels, with deposition potentially leading to smothering. Temporary increases in SSC and associated sediment deposition are expected from the cable installation works. [Volume 5, Annex 1.1: Marine Processes Technical Report](#) provides a full description of the physical assessment, with a summary of the existing baseline and the maximum design scenarios associated with the impact summarised below.

- 11.2.3.4 SSC in the southern North Sea varies widely both spatially and temporally, with a general pattern of an inshore to offshore gradient in SSC. SSC's vary seasonally and are generally in the range 2 to 14 mg/l closer inshore on the ECC. SSC's reduce further on the offshore portion of the ECC reaching levels of around 2 to 3 mg/l. The larger variations and higher concentrations in the inshore region are mainly due to fine sediments eroded from the cliffs during winter periods, shallower water and locally stronger flows maintaining the material in suspension, preventing local deposition. Surface turbidity (represented by suspended particulate matter) is relatively low across the offshore array area, with monthly averaged concentrations typically less than 5 mg/l across the whole year (Cefas, 2016), with minimal seasonal variation.

- 11.2.3.5 [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Process](#) assessed the increase in suspended sediments, with the subsequent effect on benthic habitats and species assessed in [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#).

- 11.2.3.6 The PEIR concluded that sandwave clearance and cable installation are likely to occur where the ECC is in close proximity to the Flamborough Head SAC. It is likely that effects of

deposition from the construction works for Hornsea Four would be limited primarily to the immediate vicinity of the cable trench, with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally. The ES concluded that the magnitude of effect to these protected features was therefore, considered to be low.

11.2.3.7 The communities associated with subtidal chalk reef habitat, which is a protected feature of the Flamborough Head SAC, are expected to have some tolerance to increases in SSC (De-Bastos and Hill, 2016; Tillin and Hill, 2016), particularly as these habitats are near the coast, where SSC are naturally highest. Sensitivity of many animals associated with soft rock habitats to light sediment deposition would also be expected to be limited due to the resilience of some characterising species (De-Bastos and Hill, 2016) and the natural sediment mobility in these areas. The PEIR concluded that the subtidal chalk reef habitat exposures of the Flamborough Head SAC is deemed to be of (worst-case) medium vulnerability, medium to high recoverability and international importance. The sensitivity of these receptors was therefore, considered to be medium. The PEIR chapter concluded that the effect on subtidal benthic ecology is of minor adverse significance, which is not significant in EIA terms.

11.2.3.8 The PEIR concluded a not-sensitive to low MarESA sensitivity for 'submerged or partially submerged sea caves', which is a protected feature of the Flamborough Head SAC (Tyler-Walters, 2018). The upper, vertical walls of caves are unlikely to be subject to any smothering, but the inner reaches of caves with shallow slopes or horizontal ledges may be. In the wave exposed conditions experienced by biotopes typical of this habitat, light smothering of sediment may be removed quickly, depending on the shape of the cave. It is unlikely that the magnitude of this impact would result in any localised effect on the biota within the cave, and a Low vulnerability is therefore recorded. The PEIR found that recovery is likely to be high and the habitat is of international value. The sensitivity of the receptor to light smothering is considered to be Low. The significance was therefore considered in the PEIR chapter to be Negligible.

11.2.3.9 It is concluded that given the short-term and temporary nature of the change, the existing levels of SSC in the area and the PEIR conclusion of minor significance for the reef feature (being negligible for sea caves); the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEol, having regard to the conservation objectives of the reef and sea cave features of the Flamborough Coast SAC, in relation to temporary and short-term increased SSC and associated deposition from Hornsea Four alone and therefore, subject to natural change, the reef and sea cave features will be maintained in the long term as favourable.

Invasive non-native species

11.2.3.10 The potential for an AEol as a result of spread of invasive non-native species (INNS) during construction and decommissioning relates to the following designated site and the relevant features (i.e. those features screened in for potential LSE):

Flamborough Head

- Reefs; and
- Submerged or partially submerged sea caves.

11.2.3.11 There is a risk that the project could increase the spread of INNS through the movement of vessels in and out of the benthic subtidal study area, should work vessels arrive from outside the UK.

11.2.3.12 There will be up to 5,736 round trips to port during the construction phase, which will contribute to the risk of introduction or spread of INNS in ballast water (should any of these contain ballast water and arrive from a non UK port). A series of mitigation measures are proposed including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines. These will ensure that the risk of potential introduction and spread of INNS is minimised.

11.2.3.13 There is a lack of evidence to date from other offshore wind farm developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS. The ES concluded that overall, the sensitivity of the receptor is high and the magnitude is negligible. The effect is of minor adverse significance, which is not significant in EIA terms.

11.2.3.14 It is concluded that due to the lack of evidence of any adverse effect and the project level commitments, there is a low risk of promoting the spread of INNS and the ES conclusion of minor significance; the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEol to the conservation objectives of the reef and sea cave features of the Flamborough Coast SAC in relation to spread of INNS from Hornsea Four alone and therefore, subject to natural change, the reef and sea cave features will be maintained in the long term as favourable in the long term.

Nitrogen deposition

11.2.3.15 The potential for an AEol as a result of increased nitrogen deposition during construction and decommissioning relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE):

Humber Estuary SAC

- Atlantic saltmeadows; and
- *Salicornia* and other annuals colonising mud and sand.

Humber Estuary Ramsar

- Saltmarshes.

- 11.2.3.16 Any impact would arise during construction and decommissioning only. Potential impacts are only likely to occur within 200m of the road edge, as impacts beyond this are generally considered to be insignificant as sufficient dilution and dispersion of pollutants will occur across this distance to minimise effects.
- 11.2.3.17 The only European designated sites that lie within 200m of the affected roads are the Humber Estuary SAC, SPA and Ramsar. Of these three sites, the Humber Estuary SPA has not been considered further as it is not designated for plant communities. The location affected is in the vicinity of the A63 at Kingston-Upon-Hull. The Humber SAC in this location contains a narrow strip of saltmarsh (approximately 20-50m wide) bordered by mudflats on the waters edge¹³.
- 11.2.3.18 In order to investigate this impact, levels of nitrogen deposition have been modelled as part of the PEIR on a transect at 10-50m intervals back from the road edge (in accordance with DMRB guidance (Highways Agency 2007)). The modelling calculated the predicted increase in levels of nitrogen deposition and compared them to existing levels and also increases in background traffic flows. The results were then compared to the UK Air Pollution Information System (APIS) which contains information on the sensitivity of coastal saltmarsh to nitrogen and recommends a critical load. For saltmarsh, the critical load is 20 – 30 kg N ha⁻¹ yr⁻¹. Increased nitrogen in saltmarsh can potentially cause eutrophication effects such as accelerating successional changes.
- 11.2.3.19 The modelling found that for Hornsea Four alone, the project would not exceed more than 1% of the critical load of nitrogen deposition for saltmarsh. However, when considered in combination with background increases in traffic flows, the levels of nitrogen deposition increase to 1.9% of the critical load within 20m of the road boundary. This strip overlaps with 0.029 km² of the Humber SAC and contains saltmarsh. Beyond 20m effects will be below the 1% threshold.
- 11.2.3.20 It is considered that the elevated levels of nitrogen deposition would have an inconsequential level of impact on the SAC and Ramsar sites for the following reasons:
- Only a very small area of the SAC and Ramsar would be affected (<0.01% of the SAC and Ramsar) and only a very small proportion of saltmarsh within those sites (0.35% of the saltmarsh within the SAC and 0.16% of saltmarsh within the Ramsar site).
 - If an impact were to occur it would be temporary and intermittent, lasting a maximum of 36 months during construction. Excess forms of soluble nitrogen within the rooting zone of salt marsh plants can either be taken up by the plants or they would be washed out by the regular tidal inundation (CCW, 2012).
 - The critical load will only be marginally exceeded, and it is likely that this would have, at worst, a minor temporary effect on a small area of saltmarsh community in this location. Nitrogen deposition is considered by APIS to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs.¹⁴

¹³ Data on habitat distribution obtained from www.magic.gov.uk accessed 22/7/19

¹⁴ Accessed 22/7/19 <http://www.apis.ac.uk/node/968>

- 11.2.3.21 In light of the above, it is concluded that there is no potential for an AEol to the conservation objectives of the saltmarsh features of the Humber Estuary SAC and Ramsar in relation to increased nitrogen deposition from Hornsea Four alone and therefore, subject to natural change, the reef and sea cave features will be maintained in the long term as favourable in the long term.

11.2.4 Operation and Maintenance

Temporary increases in suspended sediments / smothering

- 11.2.4.1 The HRA screening report ([Appendix A](#)) identified the potential for LSE through sediment disturbance during operation and maintenance. It identified that there was the potential for suspended sediment released during maintenance works within the ECC to reach the SAC within which the reef and sea cave features are located.
- 11.2.4.2 Since the HRA screening report was completed, further study into the effects of the project on physical processes has been undertaken. [Volume 5, Annex 1.1: Marine Processes Technical Report](#) identifies that the potential for sediment release during operation and maintenance is considered less than during construction. Sediment release during operation was not identified as an operational impact in the Table 1 of the Technical Report and was also not identified as an impact in [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#). However, for the purposes of consistency and completeness with the HRA screening report ([Appendix A](#)), this impact has been considered below.
- 11.2.4.3 The potential for an AEol as a result of an increase in SSC and subsequent deposition on subtidal and benthic intertidal habitats during operation and maintenance relates to the following designated site and the relevant features (i.e. those features screened in for potential LSE):
- Flamborough Head
- Reefs; and
 - Submerged or partially submerged sea caves.
- 11.2.4.4 The distance between the array boundary and the SAC is such that effects resulting from the array have been screened out ([Appendix A](#)).
- 11.2.4.5 Temporary, intermittent and localised increase in SSCs could potentially affect the benthos e.g. through lower light levels, with deposition potentially leading to smothering. SSC in the southern North Sea varies widely both spatially and temporally, with a general pattern of an inshore to offshore gradient in SSC. SSC's vary seasonally and are generally in the range 2 to 14 mg/l closer inshore on the ECC. SSC's reduce further on the offshore portion of the ECC reaching levels of around 2 to 3 mg/l. The larger variations and higher concentrations in the inshore region are mainly due to fine sediments eroded from the cliffs during winter periods, shallower water and locally stronger flows maintaining the material in suspension,

preventing local deposition. Surface turbidity (represented by suspended particulate matter) is relatively low across the offshore array area, with monthly averaged concentrations typically less than 5 mg/l across the whole year (Cefas, 2016), with minimal seasonal variation.

11.2.4.6 **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** assessed the increase in suspended sediments from the project as a whole and the subsequent effect on benthic habitats and species was assessed in **Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology** of the PEIR.

11.2.4.7 The PEIR and Technical report concluded that the potential for sediment release during operation and maintenance is considered less than during construction. The PEIR chapter concluded that the effect on subtidal benthic ecology during construction would be short-term and temporary in nature and the change is of minor adverse significance, which is not significant in EIA terms. Any effect during operation and maintenance will therefore be less than this.

11.2.4.8 Given the small scale and magnitude of possible impact, it is concluded there is no potential for an AEol to the conservation objectives of the reef and sea cave features of the Flamborough Coast SAC in relation to temporary and short-term increased SSC and associated deposition from Hornsea Four alone and therefore, subject to natural change, the reef and sea cave features will be maintained as favourable in the long term.

Invasive non-native species

11.2.4.9 The potential for an AEol as a result of spread of invasive non-native species (INNS) during operation and maintenance relates to the following designated site and the relevant features (i.e. those features screened in for potential LSE):

Flamborough Head

- Reefs; and
- Submerged or partially submerged sea caves.

11.2.4.10 There is a risk that the project could increase the spread of INNS through the introduction of hard substrate into a sedimentary habitat and also the movement of vessels in and out of the benthic subtidal study area (should those vessels arrive from a non UK port).

11.2.4.11 As presented in **Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology** up to 3,707,730 m² of new hard substrate habitat will be introduced into the Hornsea Four benthic subtidal ecology study area, which will provide new habitat for potential colonisation by marine INNS. In addition to this, there will be up to 2,885 round trips to port by operational and maintenance vessels, which will contribute to the risk of introduction or spread of INNS in ballast water (should any of those vessels use ballast water and originate from a non UK port).

- 11.2.4.12 A series of mitigation measures are proposed including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines. These will ensure that the risk of potential introduction and spread of INNS is minimised.
- 11.2.4.13 There is a lack of evidence to date from other offshore wind farm development within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS. The PEIR concluded that overall, it is predicted that the sensitivity of the receptor is high and the magnitude is negligible. The effect is of minor adverse significance, which is/is not significant in EIA terms.
- 11.2.4.14 It is concluded that due to the lack of evidence of any adverse effect, the project level commitments and PEIR conclusion of minor significance; there is highly limited potential to promote the risk of spread of INNS and the the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEol to the conservation objectives of the reef and sea cave features of the Flamborough Coast SAC in relation to spread of INNS from Hornsea Four alone and therefore, subject to natural change, the reef and sea cave features will be maintained in the long term as favourable in the long term.

Changes to physical processes

- 11.2.4.15 The potential for an AEol as a result changes to physical processes during operation and maintenance relates to the following designated site and the relevant features (i.e. those features screened in for potential LSE):
- Flamborough Head
- Reefs.
- 11.2.4.16 **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes** assessed the potential for changes to physical processes and the subsequent effect on benthic habitats and species was assessed in **Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology** of the PEIR.
- 11.2.4.17 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.
- 11.2.4.18 The use of correctly designed scour protection at foundations and sufficiently buried cables will prevent scour occurring (**Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**). The impacts of the use of this scour protection has been assessed within this chapter (**paragraph 2.11.1.27 et seq.**) and found to have no significant effects on the benthic environment.

- 11.2.4.19 The Marine Geology, Oceanography and Physical Processes assessment has determined that the impacts on hydrodynamic and wave regimes will be negligible and would not result in significant changes to sediment transport and consequently will not have any impacts on benthic ecology.
- 11.2.4.20 It is concluded that there is no potential for an AEol to the conservation objectives of the reef of the Flamborough Coast SAC in relation to changes to physical processes from Hornsea Four alone and therefore, subject to natural change, the reef features will be maintained in the long term as favourable in the long term with respect to this effect.

11.3 Marine Mammals

11.3.1 Assessment Criteria

- 11.3.1.1 The assessment of the risk of injury in marine mammals follows the draft 2010 advice issued by JNCC, CCW and Natural England, titled 'The protection of marine European Protected Species from injury and disturbance'. In the UK, EPS include all species of cetacean, turtles and Atlantic sturgeon –the same definition for injury is applied here for seals. The guidance refers to the deliberate capture, injury or mortality of any EPS – ie where the risk of injury relates to any individual, in contrast to the risk of deliberate disturbance for which a threshold is set (for which relevant criteria are provided below). The risk of injury is seen as deriving from physical (e.g. collision) and underwater noise (defined as the onset of a permanent threshold shift, or PTS).
- 11.3.1.2 Certain assumptions have been made regarding disturbance in harbour porpoise that may arise as a result of various activities that generate noise. As regards piling, these assumptions have drawn on a body of literature, which in turn are drawn on within JNCC 2016 (and confirmed in JNCC, 2019), namely Dahne *et al.* (2013) and Tougaard *et al.* (2014), the latter being a report produced by an expert group convened under the Habitats and Wild Birds Directives – Marine Evidence Group. The Tougaard *et al.* (2014) report drew on a number of empirical sources, including Dahne *et al.* (2013), but also Brandt *et al.* (2011), Brandt *et al.* (2012) (contained within Popper & Hawkins (2012)), Braasch *et al.* (2013) and Thompson *et al.* (2010). These studies reported direct observations during wind farm construction at projects across Europe, thus enabling an Effective Deterrent Radius (EDR) of 26 km to be established for percussive piling. The EDR is defined by Tougaard *et al.* as reflecting the overall loss of habitat that would occur if all animals vacated an area with a radius of the EDR around the pile driver, being equivalent to the mean loss of habitat per animal. More noise-tolerant animals will lose less than this mean area, while less noise-tolerant animals would lose more. It is acknowledged in the JNCC advice that there is, however, the potential for a reduced EDR should project specific details allow.
- 11.3.1.3 For seismic survey, no EDR is provided within the revised Advice on Activities provided by JNCC in 2019¹⁵. The draft conservation advice published in January 2016 had identified a range of 5 km for seismic surveys, later called into question and resulting in a more precautionary 10 km range for seismic survey (although it is pertinent to note that the 10

¹⁵ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

km range is in relation to the firing of small air guns and is therefore not considered typical of all types of seismic survey and particularly the types typically used for offshore wind farm site investigation work). The EDRs drew on a 2013 Thompson *et al.* paper (which investigated short-term disturbance of harbour porpoise from an air gun survey), which found avoidance movements in harbour porpoise within a 5-10 km range of the seismic vessel. The revised 2019 advice for the SNS SAC did not include an EDR for geophysical or seismic survey, instead finding that some geophysical surveys may require consent and be subject to HRA – with each case to be assessed individually (with the caveat that cumulative impacts of geophysical surveys will require consideration).

11.3.1.4 It is understood that further advice on the matter is pending, however in the interim the current report has adopted the following assumptions as regards geophysical and seismic survey:

- Seismic survey includes surveys using air guns;
- An assumption of a 10 km EDR around seismic operations;
- Where the nature of a survey is unknown (geophysics or seismic) a 10 km EDR is assumed;
- Where a survey is known to be geophysics only (i.e. non sub-bottom/ air gun) an EDR of 5km is applied.

11.3.1.5 No formal EDR information has been provided for explosion of UXO, although the 26 km value has been applied in several recent assessments (including Norfolk Vanguard¹⁶ and Thanet Extension¹⁷, both under advice from Natural England). The 26 km EDR for UXO has therefore been applied here.

11.3.1.6 In summary, the EDRs applied here are as follows:

- An EDR of 26 km from the location of piling;
- A range of EDRs for seismic survey, being 5 or 10 km from the location of seismic activity; and
- An EDR of 26 km from UXO clearance.

11.3.1.7 The spatial aspect of disturbance in harbour porpoise, as defined through the relevant EDRs, has a defined limit above which disturbance would be considered significant¹⁸. That limit is 20% of the relevant area (defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive)) on any given day (determined here as a 24 hour period).

11.3.1.8 That spatial aspect is accompanied by a temporal element, as defined through the use of the temporal thresholds. These are effectively up to 20% per day (24 hours) or 10% when

¹⁶<https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001479-5.03%20Norfolk%20Vanguard%20Information%20to%20Support%20HRA.pdf>

¹⁷<https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010084/EN010084-001159-Vattenfall%20Wind%20Power%20Limited%20-%20Report%20to%20Inform%20Appropriate%20Assessment%201.pdf>

¹⁸http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

averaged across a season (summer being April to September inclusive, winter being October to March inclusive), of the relevant seasonal component of the designated site.

- 11.3.1.9 For seals, the approach to disturbance followed applies that used within the PEIR (as defined in [Section 4.10.2](#) of [Volume 2, Chapter 4: Marine Mammals](#)), including the determination of the number of seals that may be affected as part of the overall population within the study area, as considered in the context of the conservation objectives of the relevant sites.

11.3.2 Description of Significance

- 11.3.2.1 A description of the significance of project level effects upon the receptors grouped under 'marine mammals', as relevant to the designated sites and their associated features screened in for potential LSE, is provided below.

11.3.3 Construction and Decommissioning

Underwater Noise

- 11.3.3.1 The following assessment is in relation to the potential for effect during construction only. The Screening Report ([Appendix A](#)) and subsequent updates to screening ([Appendix B](#)) ([Section 8](#) of the current report) determined that the potential for LSE in relation to underwater noise during decommissioning would be similar to and potentially less than those outlined in the construction phase. Effectively that potential for effect during decommissioning would fall within, and be no worse than, the degree of effect during construction, with any such decommissioning being subject to the relevant licensing requirements at that time.
- 11.3.3.2 The potential for an AEoI as a result of an increase in underwater noise on marine mammals during construction relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE).
- Southern North Sea SAC (harbour porpoise);
 - Wash and North Norfolk Coast SAC (harbour seal);
 - Humber Estuary SAC (grey seal);
 - Humber Estuary Ramsar (grey seal);
 - Berwickshire and North Northumberland Coast SAC (grey seal);
 - Transboundary sites (for harbour seal, specifically Doggersbank (Dutch) SAC and Klaverbank SCI); and
 - Transboundary sites (twelve sites for grey seal, specifically Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres, Vlaamse Banken, SBZ 1, SBZ 2, SBZ 3, Vlakte van de Raan, Westerschelde & Saeftinghe, Voordelta, Noordzeekustzone and Waddenzee).

11.3.3.3 There are a number of sources of underwater noise associated with the project alone during construction, with these identified within [Volume 2, Chapter 4: Marine Mammals](#), with those screened in for potential LSE here (in line with [Section 8](#) of the current report) being:

- Underwater noise from percussive piling;
- Underwater noise during UXO clearance;
- Underwater noise from geophysical and seismic survey; and
- Seabed preparation and cable installation activities (including dredging, drilling, cable laying, rock placement and trenching).

11.3.3.4 The importance of underwater noise for marine mammals (including harbour porpoise, harbour seal and grey seal) is discussed in [Volume 2, Chapter 4: Marine Mammals](#) and [Volume 4, Annex 4.5: Subsea Noise Technical Report](#). That information, together with the underwater noise that may result from the above activities (as discussed within both those reports) and how that may affect marine mammals in the context of the conservation objectives for each relevant designated site, is drawn on here, with each of these effects discussed in turn below, including the relevance for the features identified.

Underwater Noise from Percussive Piling

Project Parameters

- 11.3.3.5 The maximum adverse scenario for marine mammals ([Appendix G](#)) included percussive piling during the installation of the foundation structures, for WTCs (up to 180 WTCs, either monopiles or 3 piles per jacket), the OSS's and HVACs. The OSS's will be large or small, with three large or six small in total. A small OSS will have 6 legs, with 4 piles per leg (24 pin piles), and a large OSS will have 8 legs per jacket, 2 piles per leg (24 pin piles), all located in the array boundary. There will be up to three HVAC booster stations in the export cable corridor (in the HVAC AoS). Each HVAC will have 6 legs per jacket, 4 piles per leg (24 pin piles).
- 11.3.3.6 The duration of piling per monopile is an anticipated most likely 127.5 minutes (including 52.5 minutes of soft start), resulting in total anticipated piling time (for 180 monopile WTC foundations) of 16 days – however to allow for set up time, moving between locations etc, that duration will occur intermittently across an assumed 216 total piling days, within an overall piling window of 12 months. The information presented here provides the most likely scenario first followed by the worst-case, noting that in terms of duration the worst-case is applied.
- 11.3.3.7 Should each WTC foundation be installed on 3 piled jacket foundations, the duration of piling per foundation is most likely to remain the same as per the monopiles, however a slightly longer overall installation time results in a most likely 270 total piling days within an overall piling window of 12 months.

- 11.3.3.8 For installation of the OSS's and HVAC's, the works will occur within an overall window of 12 months (ie potential to occur in the same timeframe as piling at WTC foundations). The actual duration of piling will be intermittent within that timeframe.
- 11.3.3.9 In terms of concurrent piling, ie presence of more than one piling rig on site at any one time, there would be no more than 2 foundation locations being driven simultaneously within the array boundary at any one time.

Project Mitigation

- 11.3.3.10 Project specific mitigation specifically included for pile driving is identified in [Table 3](#) and includes the following:
- Marine Mammal Mitigation Plan (MMMP) – a piling MMMP, secured in the dMLs and approved by the MMO in consultation with Natural England, will be implemented during construction. The MMMP will include robust measures to ensure the risk of PTS to marine mammals is negligible, primarily through minimising the potential that any marine mammal will be within range of the potential for onset of PTS. The details of the MMMP will be agreed with Natural England once the final Project Design is available.; and
 - Soft start – as required by the MMMP, a defined period of time during which the hammer energy will gradually be ramped up to full power applied to all piling activities.
- 11.3.3.11 Following best and established practice, the above measures are primarily focused on managing and mitigating any risk of PTS (injury) in marine mammals. As highlighted in [Section 9.3](#), it is anticipated that a Site Integrity Plan (SIP) will be required, to manage uncertainty in terms of harbour porpoise risk with respect to disturbance going forward. The key points to be addressed within the SIP are identified in Section 9.3, but will address in particular the risk for the project alone (in relation to project parameters and timing) but also in-combination (in relation to uncertainty around non Hornsea Four project parameters and timing). The SIP will be submitted with the application and be provided for in the dMLs.

Project Level Underwater Noise – Most Likely Scenario and PTS

- 11.3.3.12 Underwater noise during construction of Hornsea Four has been studied specifically through the following, including that of direct relevance to marine mammals:
- Volume 2, Chapter 4: Marine Mammals; and
 - Volume 4: Annex 4.5: Subsea Noise Technical Report.
- 11.3.3.13 [Volume 4, Annex 4.5: Subsea Noise Technical Report](#) provides the technical evidence base for underwater noise, with the PEIR chapter providing the context for marine mammals (including for harbour porpoise, harbour seal and grey seal), in relation to the potential for injury. Auditory injury is addressed in the PEIR through consideration of Permanent Threshold Shift (PTS). The threshold values applied for PTS (with the background to the

various thresholds provided in [Section 4.10.3](#) of [Volume 2, Chapter 4: Marine Mammals](#)) in relation to impulsive noise within the PEIR are provided in [Table 13](#) below.

Table 13: Southall et al. (2019) Thresholds for PTS in Harbour Porpoise (VHF: Very High Frequency) and harbour/grey seals (PCW: Phocid Carnivores in Water).

Species	PTS onset	
	weighted SEL_{cum} (dB re 1 μPa^2s)	unweighted SPL_{peak} (dB re 1 μPa)
<i>Impulse Noise</i>		
LF cetacean	183	219
HF cetacean	185	230
VHF cetacean	155	202
PCW	185	218

- 11.3.3.14 Natural England and JNCC advise that a buffer of 26 km around the source location is used to determine the impact area from pile driving with respect to disturbance of harbour porpoise in the Southern North Sea SAC¹⁹, with that approach applied here in the context of the 20% daily/10% seasonal thresholds described in [Appendix E](#). For harbour seals and grey seals, [Volume 2, Chapter 4: Marine Mammals](#) describes the disturbance response in [Section 4.10.4](#). The assessment of harbour seal and grey seal response to disturbance presented here draws on the findings of [Volume 2, Chapter 4: Marine Mammals](#), in the context of the relevant designated sites and their conservation objectives.
- 11.3.3.15 The assessment of potential impact from risk of onset of PTS in harbour porpoise for the most likely scenario is presented in [Section 4.11.1](#) of [Volume 2, Chapter 4: Marine Mammals](#). The assessment draws on results from underwater noise modelling at 4 separate locations (three within the array boundary, the fourth location within the HVAC site). The ranges presented are unmitigated ranges – ie these represent the maximum for the most likely piling scenario in the absence of any mitigation. It is important to note that the project is committed to a piling MMMP (as referenced here in [Table 3](#), and delivered through the dMLs), with [Section 4.11.1](#) of the PEIR finding that the mitigation will reduce the potential for impact with regards PTS in harbour porpoise to negligible.
- 11.3.3.16 As an unmitigated maximum value, the predicted PTS onset impact ranges for the most likely piling scenario presented within PEIR reach a maximum of 3.8 km at the east modelling location for pin piles (SEL_{cum}) and 2.5 km at the north west location for monopiles (SPL_{peak}). The maximum unmitigated number of harbour porpoise predicted to be within the PTS onset impact area, and therefore at risk of auditory injury, is 66 animals (0.02% MU) at the northwest pin pile location and 41 animals (0.01% MU) for monopiles. The SPL_{peak} PTS onset impact ranges at the beginning of the soft start are a maximum of 570 m for monopiles and 170 m for pin piles.
- 11.3.3.17 The effect of the planned mitigation within the piling MMMP (a combination of the soft start approach and use of ADDs) on the potential impact ranges is described in [Section 4.11.1](#) of

¹⁹ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

PEIR. Effectively, the combined mitigation approach would ensure that animals are displaced from the PTS impact zone before the piling commences. It is also considered highly likely that the presence of vessels and associated activity will ensure that the vicinity of the pile is free of harbour porpoise by the time that piling begins.

- 11.3.3.18 The risk of onset of PTS in harbour seal and grey seal is considered in [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#). The modelling locations are the same as those for harbour porpoise, with the ranges similarly being unmitigated – i.e. these represent the maximum for the most likely piling scenario in the absence of any mitigation. It is important to note that the project is committed to a piling MMMP (as referenced here in [Table 3](#), and secured through the dMLs), with [Section 4.11.1](#) of the PEIR finding that the mitigation will reduce the potential for impact with regards PTS in seals to negligible.
- 11.3.3.19 As an unmitigated maximum value, the predicted PTS onset impact ranges for harbour seal and grey seal for the most likely piling scenario presented within PEIR for all instances and at all locations is at most 150m. The maximum number of harbour seal or grey seal predicted to be within the PTS onset impact area, and therefore at risk of auditory injury, is <1 animal. In the context of the predicted range of unmitigated risk of onset of PTS, together with the planned mitigation within the piling MMMP (a combination of the soft start approach and use of ADDs) the conclusion drawn is of negligible adverse significance for both seal species, which is not significant in EIA terms.

Project Level Underwater Noise – Maximum Piling Scenario and PTS

- 11.3.3.20 [Volume 2, Chapter 4: Marine Mammals](#) also considers a maximum piling scenario (in addition to the most likely piling scenario, as discussed above). That information is presented in [Section 4.11.1](#). For harbour seals and grey seals, the maximum design scenario PTS onset impact range remains <100 m and therefore would represent no change in the assessment above.
- 11.3.3.21 For harbour porpoise, the maximum piling scenario has, as a maximum for unmitigated PTS onset impact, a range of some 9.7 km (for the installation of a pin pile at the northwest location). Within this impact area there are a predicted 461 animals (0.13% MU) that may be at risk of auditory injury. While this number is very low when expressed as a proportion of the total MU, the PEIR assessed the impact as a minor magnitude. Further consideration of that range is provided in the context of a recent paper by Hastie et al (2019), which provides evidence for the range at which impulsive noise (such as pile driving) loses its impulsive characteristics. That evidence demonstrates that a range of 9.7km is an overestimate. Depending on the actual range (as noted in [Volume 2, Chapter 4: Marine Mammals](#) predicted to be within 2-5km) the number of animals at risk of onset of PTS from unmitigated pile driving would, at most, actually be between 26 harbour porpoise (based on a 2km range) and 166 harbour porpoise (5km range). In the context of the mitigation contained within the piling MMMP, such an impact is concluded at PEIR to be of negligible adverse significance (not significant in EIA terms).

Project Level Underwater Noise – Most Likely Piling Scenario and Disturbance

- 11.3.3.22 **Volume 2, Chapter 4: Marine Mammals** also considers the potential for behavioural disturbance to occur, and the potential impact on harbour porpoise and harbour and grey seal (**Section 4.11.1**). For the purposes of the RIAA, the assessment presented here for harbour porpoise is based on the 26km EDR (and therefore in a context of habitat availability and not numbers of animals). The absence of such a range for seals for HRA purposes means the assessment here is based on that presented in the PEIR, with a summary of that presented below.
- 11.3.3.23 For harbour seals, the highest disturbance levels were predicted for the south location, where a total of 45 harbour seals are predicted to be disturbed for the installation of a monopile, which represents 0.78% of the reference population. The equivalent number for pin piles at the same location is 27 animals (0.47% of the population), which represents the highest level of disturbance in temporal terms. Such disturbance will be intermittent within an overall 12 month period. In the context of the low density of harbour seals within the area, and an area considered of low importance for foraging for the species, any such short term and temporary disturbance and displacement was found in the PEIR to represent a negligible adverse significance, which is not significant in EIA terms.
- 11.3.3.24 For grey seals, the highest potential disturbance levels on a spatial basis were predicted for the northwest location where up to 839 grey seals have the potential to be disturbed for the installation of a monopile if that monopile was located at the worst possible location for grey seal disturbance, which represents 1.83% of the reference population (ie all other foundation locations would result in a reduced level of effect). The equivalent number for pin piles at the same location is 383 animals (0.84% of the population) which represents the highest level of disturbance in temporal terms.
- 11.3.3.25 The PEIR noted that such disturbance will be intermittent within an overall 12 month period, with evidence indicating that following construction seals return quickly to the area once piling has ceased – indicating that any effect is short lived and temporary. Further, telemetry data have shown that not all grey seals respond to pile driving (Aarts *et al*, 2018), and so may not be disturbed and displaced out of an area that they are motivated to stay in for foraging. Overall, the PEIR found that there is the potential for a risk of a decline in fertility and survival of ‘weaned of the year’ for a very small proportion of the grey seal population if animals are repeatedly displaced from foraging areas over the 12 month construction period. Piling at the OSS’s and HVAC’s may occur within an overall 12month period, but would be of an intermittent and temporary nature in that timeframe.
- 11.3.3.26 Further, the PEIR found that the at-sea usage data suggests that there is a potential foraging area to the northwest of the array area (**Figure 4** below, from **Volume 2, Chapter 4: Marine Mammals**). The dose response curve used in PEIR for grey seal behavioural responses was produced from data obtained from tagged harbour seals only, as there is currently no grey seal dose response curve. The PEIR noted that grey seals are considered to be less sensitive to behavioural disturbance than harbour seals, with recent studies of tagged grey seals showing vast individual variation in responses to pile driving, with some animals not showing any evidence of a behavioural response when within 12 km of the pile

driving location (Aarts et al. 2018). Therefore, the adoption of the harbour seal dose response curve for grey seals is precautionary as it is likely to over-estimate the potential for impact on grey seals.

- 11.3.3.27 This type of short-term, intermittent and temporary behavioural response will affect only a very small proportion of the population and, while energetic requirements may be slightly increased by the need to transit to another foraging location, survival and reproductive rates are very unlikely to be impacted.
- 11.3.3.28 Overall, the PEIR found that for grey seals, the effect from the most likely piling scenario on behavioural disturbance is of minor adverse significance, which is not significant in EIA terms.

Project Level Underwater Noise – Maximum Piling Scenario and Disturbance

- 11.3.3.29 As for risk of onset of PTS, PEIR also considered the significance of the maximum piling scenario in seals in [Section 4.11.1](#). The maximum design scenario is intended to cover the absolute maximum piling parameters that would ever be required to install a foundation (in terms of maximal hammer energies and longest piling durations), and, based on ground investigation work, it is expected that this will only be required at ~30% of the WTG locations (NOTE: The 30% is indicative at this stage and will be updated for the ES and DCO). The results demonstrate that there is only a very small increase in the number of animals predicted to experience behavioural disturbance between the most likely and the maximum design scenarios, with no change in the conclusions of significance for harbour or grey seal.

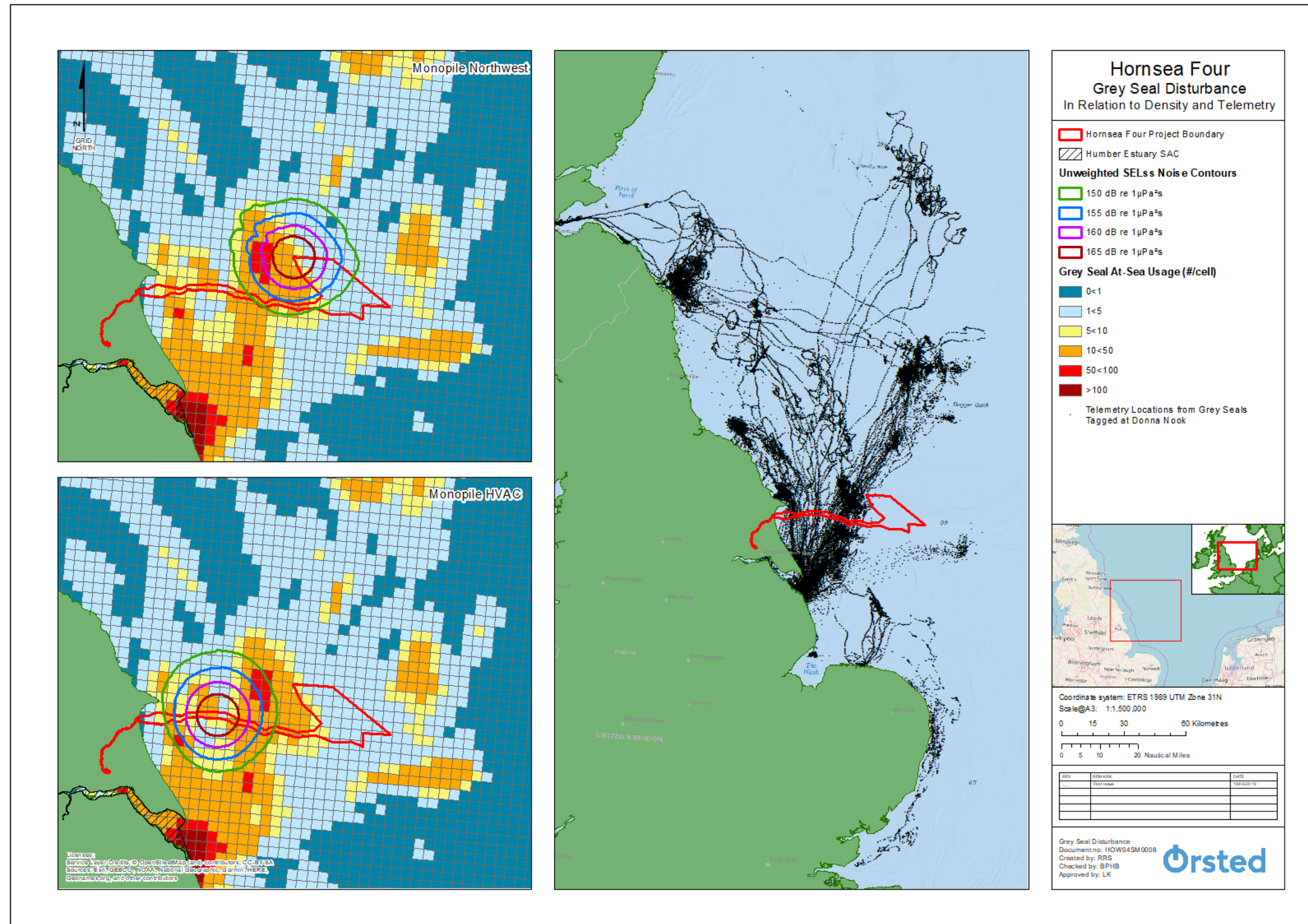


Figure 4: Dose-Response Noise Impact Contours in Relation to Grey Seal at-sea Usage. No grey seals are predicted to respond beyond the 150 dB contour. Within the 150≤155 dB contour 28% of seals are predicted to respond, within the 155≤160 dB contour 49% are predicted to respond, within the 160≤165 dB contour 68% are predicted to respond and within the 165 dB contour all seals are predicted to respond.
 Right: Telemetry locations from 22 grey seals tagged at Donna Nook (not to scale).

Consideration of Harbour Porpoise for RIAA Purposes

- 11.3.3.30 A single site for harbour porpoise has been screened in for assessment – the SNS SAC.
- 11.3.3.31 The consideration of PTS risk for harbour porpoise given above draws on **Volume 2, Chapter 4: Marine Mammals**, which is presented in the context of the total population of animals within the MU. The JNCC Advice²⁰, notes the following relevant points as regards harbour porpoise population, numbers and viability within the site:
- 'The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent deterioration of harbour porpoise presence in the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU)' and
- 'The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.'
- 11.3.3.32 Together with the final point, perhaps most pertinently, made under the description of Conservation Objective 1 (which deals with viability and therefore injury risk):
- 'Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG 2015).'
- 11.3.3.33 Therefore, the number of animals that may be at risk to onset of PTS (as presented above) has not been compared to any population attributed to the SNS SAC, because the number of harbour porpoise using the site naturally varies . Rather, the assessment considers whether any such PTS risk could impact on the FCS of the MU population (which in the context of the first conservation objective refers to measures that '*restrict the survivability and reproductive potential of harbour porpoise using the site*').
- 11.3.3.34 Mitigation for PTS (injury) risk is provided for within the MMMP process, a process that is secured within the dML and requires sign off and regulator agreement and approval prior to works occurring. Mitigation for disturbance risk is provided for separately within the SIP.
- 11.3.3.35 Given that the piling-MMMP (referenced here in **Table 3**) will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour porpoise during pile driving to a level considered not significant in EIA terms even as a maximum (requiring prior approval by the regulator), with that conclusion drawn with respect to the MU population, it is

²⁰ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

concluded that Hornsea Four alone does not have the potential to restrict the survivability and reproductive potential of harbour porpoise using the site. There will not, therefore, be an AEoI on the viability of harbour porpoise as a result of mortality or injury resulting from pile driving at Hornsea Four alone in relation to the SNS SAC and therefore, subject to natural change, harbour porpoise will be maintained as a 'viable component' of the site in the long-term.

- 11.3.3.36 The second conservation objective for the SNS SAC refers to 'no significant disturbance of the species', and as highlighted above that disturbance is assessed here through the application of the 26km EDR.
- 11.3.3.37 The seasonal nature of the SNS SAC is important here, with the array boundary being more than 26km distant from the winter extents of the SNS SAC at its closest point. As such, any pile driving within the array boundary that takes place in the winter season (October-March inclusive) would fall outside the need for assessment here. Any pile driving within the array boundary during the summer season (April-September inclusive) would, however, require consideration through the HRA process. For pile driving at the HVAC booster station, this requires consideration through the HRA process at all times of the year.
- 11.3.3.38 For pile driving within the array boundary for Hornsea Four (for both WTC and OSS), the maximum overlap per foundation location within the summer extents of the SNS SAC would be 2,124 km² (7.87% of the summer extents), or depending on location of the foundation as low as 1,526km² (5.65%)(see [Figure 5](#)). There is therefore capacity within the threshold (20% per 24 hours), when considering the project alone, for piling to occur at more than one foundation location per 24 hours.
- 11.3.3.39 As a 'maximum design scenario for disturbance from piling', piling could occur at up to 2 separate foundation locations per 24 hours, termed concurrent piling. At PEIR, no 'maximum separation distance' has been set, which would place a limit on how far apart two such piling events could take place. In terms of the potential for effect, the greater the separation distance, the greater the potential for effect (as two rigs located closer together would have greater overlap in effect and therefore the reduced net effect would be less compared to two rigs located further apart). Therefore potential for a separation distance to be applied to the project remains a source of mitigation within the SIP.
- 11.3.3.40 As a maximum design scenario, should concurrent pile driving occur at two separate foundation locations in 24 hours, with a separation distance limited only by the array boundary, the maximum area of overlap would be 3,958 km² (14.66%). For installation of foundations by pin piles, the potential for overlap per foundation is the same as that for a monopile, given the close proximity of each pile.
- 11.3.3.41 For pile driving at the HVAC booster station, there is potential for overlap with the summer and winter extents of the SNS SAC. In the summer season, that overlap would be between 357 km² (1.3%) and 641 km² (2.4%) depending on precise HVAC location or between 266 km² (2.1%) and 368 km² (2.9%) with the winter extents (see [Figure 6](#)). It is clear that capacity exists for piling within the array and at the HVAC station to occur in the same 24 hour period

without exceeding the 20% daily threshold (depending on in-combination and other concurrent aspects).

- 11.3.3.42 For the 10% temporal value, the anticipated duration of pile driving is within an overall window of 12 months. For assessment purposes, and as a maximum design scenario for the 10% temporal value, it is therefore assumed that pile driving within the array by a single piling rig each day, which for assessment purposes has been assumed to occur each day of a single summer season. Should concurrent piling be utilised, or more than one foundation installed in a day, the number of days required for piling would fall (and in any case, logistics dictate that there will be non-piling days to account for weather and trips to port etc). The maximum seasonal effect in the summer from piling in the array only, at OSS or WTG locations (assuming the maximum 7.87% per day for every day of the season), would therefore be 7.87%, well within the 10% seasonal threshold.
- 11.3.3.43 For piling at the HVAC location, it is assumed as a maximum design scenario that up to 20 days total would be required for piling, across the overall piling window of a single season. The maximum seasonal effect in the winter from piling at the HVAC location (assuming up to 2.9% per day for up to 20 days of a 182 day winter season) would be 0.32%. The maximum seasonal effect in the summer from piling at the HVAC location (assuming up to 2.34% per day for up to 20 days of a 183 day summer season) would be 0.26%. Both values are precautionary (assuming a maximum-case of effect each time) and well within the 10% seasonal threshold, with capacity within the threshold for additional piling days at the HVAC location if needed.
- 11.3.3.44 Should all piling at the HVAC and within the array (WTG or OSS) occur within the same summer season, the combined effect would be 8%, still within the 10% seasonal threshold.
- 11.3.3.45 Therefore, it is concluded that there will not be an AEol in relation to disturbance on the Conservation Objective for harbour porpoise for the SNS SAC as a result of pile driving from Hornsea Four alone under any pile driving scenario and therefore, subject to natural change, in the long-term, there will be no significant disturbance of harbour porpoise.
- 11.3.3.46 The third conservation objective is focused on maintaining the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC. The Advice on Activities²¹ refers to supporting habitats as 'the characteristics of the seabed and water column' in the context of 'ensuring prey is maintained within the site'. Potential for supporting habitats and processes to be affected are considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**. That chapter has concluded the potential for effect to be minor adverse at most (and therefore not significant in EIA terms).
- 11.3.3.47 There is, therefore, no AEol to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from Hornsea Four alone and therefore, subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.

²¹ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

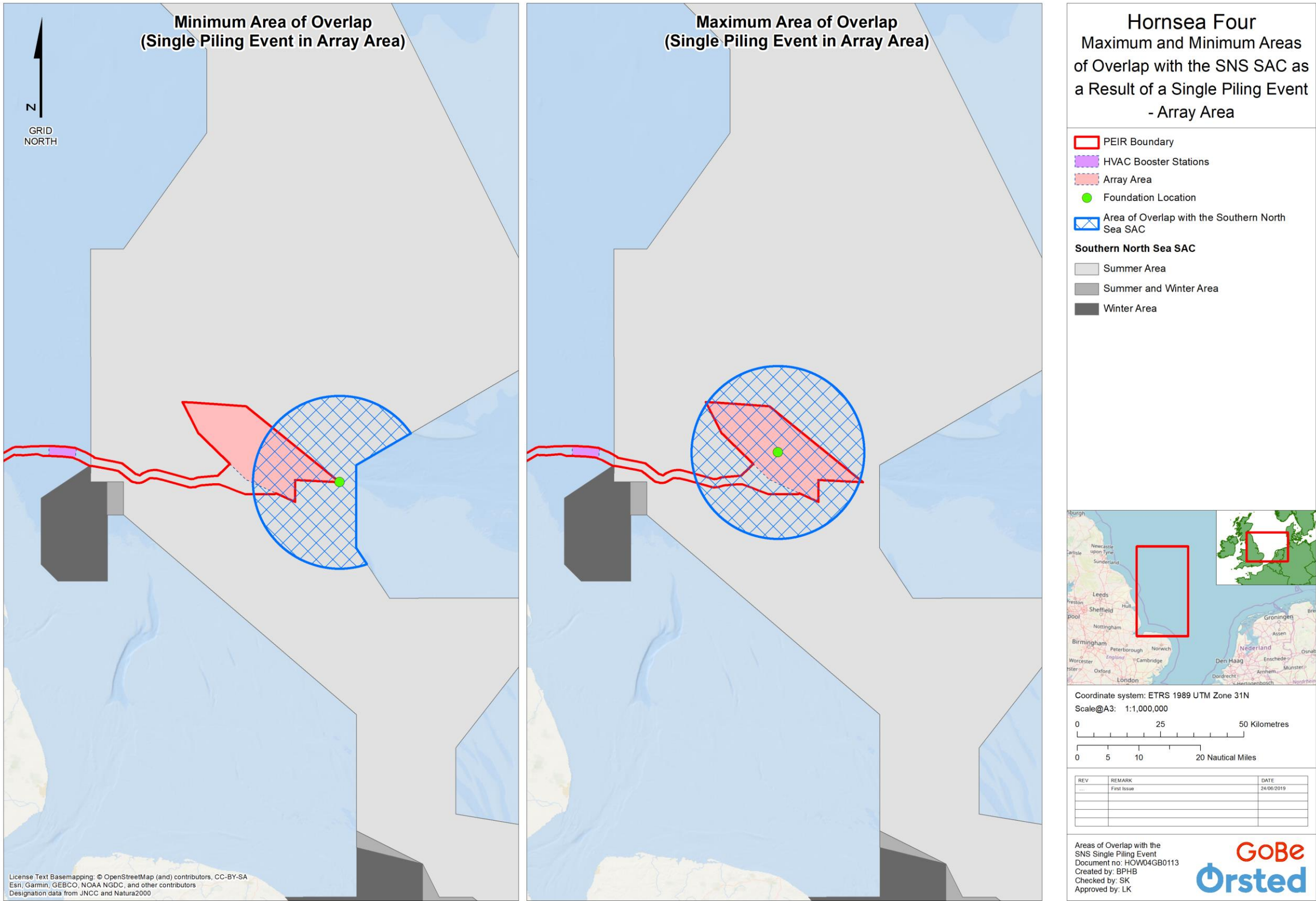


Figure 5: Maximum and Minimum Areas of Overlap with the SNS SAC as a result of a single piling event in the summer season – array area (not to scale).

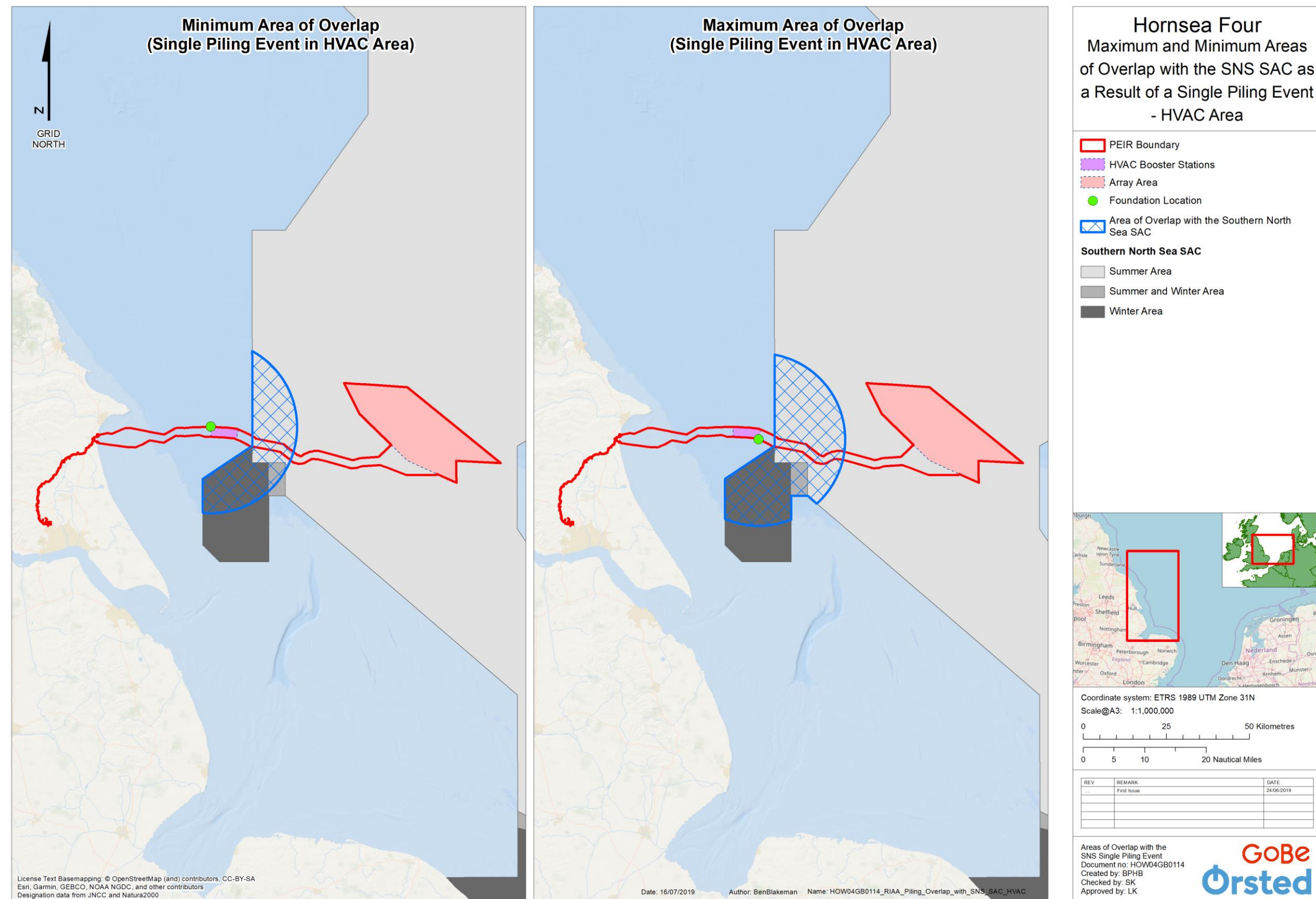


Figure 6: Maximum and Minimum Areas of Overlap with the SNS SAC as a result of a single piling event – HVAC area (not to scale).

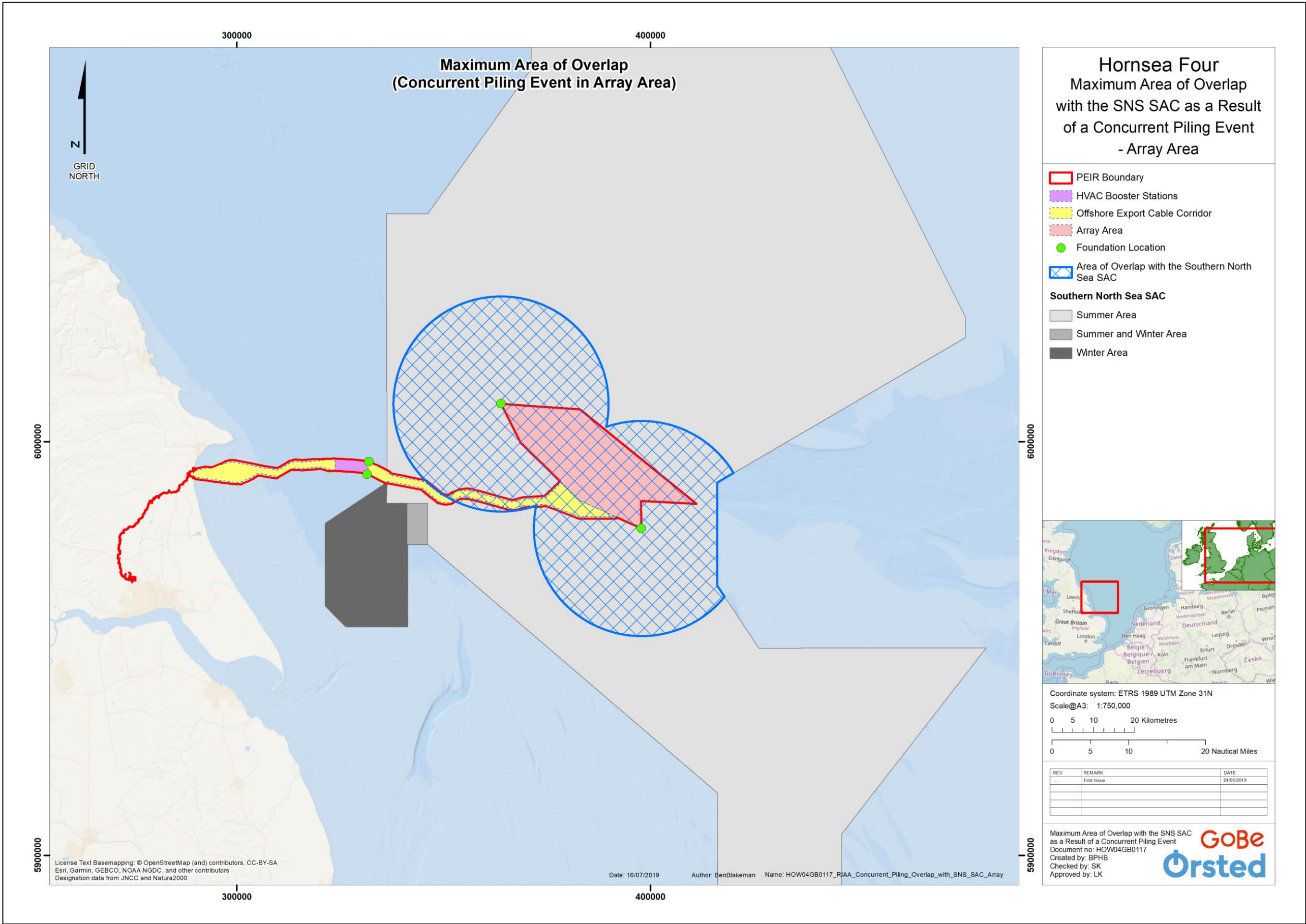


Figure 7: Maximum and Minimum Areas of Overlap with the SNS SAC as a result of a concurrent (two) piling event in the summer season – array area (not to scale).

- 11.3.3.48 The third conservation objective is focused on maintaining the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC. The Advice on Activities²² refers to supporting habitats as 'the characteristics of the seabed and water column' in the context of 'ensuring prey is maintained within the site'. Potential for supporting habitats and processes to be affected are considered within [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#). That chapter has concluded at most a minor adverse effect (which is not considered significant in EIA terms).
- 11.3.3.49 There is, therefore, no AEol to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from Hornsea Four alone and therefore, subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.

Consideration of Harbour Seal for RIAA Purposes

- 11.3.3.50 Harbour seal are screened in for potential LSE with respect to underwater noise during construction and decommissioning for the following sites:
- The Wash and North Norfolk Coast SAC; and
 - Transboundary sites (specifically Doggersbank (Dutch) SAC and Klaverbank SCI).
- 11.3.3.51 Variable information exists on the conservation objectives, with the following drawn from UK sites where, subject to natural change, the following applies:
- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
 - the structure and function (including typical species) of qualifying natural habitats;
 - the structure and function of the habitats of the qualifying species;
 - the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
 - the populations of each of the qualifying species; and
 - the distribution of qualifying species within the site.
- 11.3.3.52 The objectives for transboundary sites are:
- Conserve the area and quality of supporting habitat; and
 - Conserve the population size.
- 11.3.3.53 Of the above conservation objectives, it is clear that the transboundary objectives are contained within those for the UK sites – therefore the assessment that follows is presented following the UK conservation objective requirements to minimise repetition.
- 11.3.3.54 As regards the conservation objectives that address the natural habitats of harbour seal (the first four bullet points for UK site conservation objectives), these are concerned with the physical habitat and the species contained within. The potential for impact on the physical

²² http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

habitat is considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes Chapter**. That chapter has concluded at most a minor adverse effect (which is not significant in EIA terms) and that does not extend to the designated sites themselves. Similarly, **Volume 2, Chapter 4: Marine Mammals** found the potential for effect in relation to harbour seal prey availability to be negligible at most, with the effect therefore not taken forward for further in the assessment, as it will not lead to a significant effect.

- 11.3.3.55 There is, therefore, no AEol to the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI from Hornsea Four alone and therefore, subject to natural change, the supporting habitat for harbour seal and their prey will be maintained in the long-term.
- 11.3.3.56 The potential to affect the population and distribution of harbour seal is considered within **Volume 2, Chapter 4: Marine Mammals** with respect to potential for injury (PTS) and disturbance.
- 11.3.3.57 As for consideration of harbour porpoise above, the risk of PTS in all marine mammal species will be addressed in the piling-MMMP (referenced here in **Table 3**), which will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour seal during percussive piling operations (with prior approval by the regulator). Therefore it is concluded that Hornsea Four alone does not have an AEol on harbour seal as a result of mortality or injury resulting from percussive piling at Hornsea Four alone.
- 11.3.3.58 **Paragraph 4.11.1.38** et seq. of **Volume 2, Chapter 4: Marine Mammals** considers the number of harbour seal potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. The highest unmitigated disturbance levels were predicted for the south location, where a total of 45 harbour seals are predicted to be disturbed for the installation of a monopile, which represents 0.78% of the reference population. The equivalent unmitigated number for pin piles at the same location is 27 animals (0.47% of the reference population), which represents the highest level of disturbance in temporal terms. The numbers potentially disturbed are lowest for the north west location for both monopile and pin pile, being 3 individuals (0.05% of the population) or 1 individual (0.002%) respectively.
- 11.3.3.59 To place the population level numbers in context, the JNCC cites the harbour seal population at the Wash as being 7% of the UK total²³, which is given by the JNCC as 48,000-56,000²⁴. These numbers would indicate that the Wash population stands at around 3,360-3,920. If all the harbour seal disturbed originate from the Wash, that would indicate that in an unmitigated scenario between 0.08 and 0.8% of the Wash SAC population of harbour seal may be temporarily disturbed from pile driving should piling occur at the worst location possible (most likely scenario). All other piling locations would result in a lower percentage of effect. The most recent report from SCOS (SCOS, 2018²⁵) identifies that the harbour seal

²³ <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCODE=UK0017075>

²⁴ <http://jncc.defra.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1365>

²⁵ <http://www.smru.st-andrews.ac.uk/files/2019/05/SCOS-2018.pdf>

population of the Wash has been relatively constant since 2012 (following recovery from phocine distemper). The population during that period is given as being between 3,086 and 3,377 individuals.

- 11.3.3.60 For the Doggersbank and Klaverbank SCIs, there are an estimated 6,000 harbour seal in the Dutch section of the North Sea and Wadden Sea²⁶. No population level for either SCI has been sourced (the standard data forms both read a population of zero).
- 11.3.3.61 The conservation objectives refer to the population of the species and the distribution of that species within the site.
- 11.3.3.62 **Volume 2, Chapter 4: Marine Mammals** found that the area of sea within which noise sufficient to result in disturbance of harbour seal holds a low density of harbour seals, and is not considered an important foraging ground for the species. Therefore, any disturbance and displacement is unlikely to result in a significant reduction in energy intake. In addition, as noted in the PEIR chapter, data collated during windfarm construction has shown that harbour seal density quickly recovers once piling has ceased, and so any disturbance is likely to be short lived and temporary in nature. Further, the number of animals temporarily affected is small in the context of both the overall population and the site level populations (where known).
- 11.3.3.63 There is, therefore, no AEoI for the harbour seal population and distribution with respect to the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI from Hornsea Four alone and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.

Consideration of grey seal for RIAA purposes

- 11.3.3.64 Grey seal are screened in for potential LSE with respect to underwater noise during construction and decommissioning for the following sites:
- Humber Estuary SAC;
 - Humber Estuary Ramsar (grey seal);
 - Berwickshire and North Northumberland Coast SAC (grey seal); and
 - Transboundary sites (twelve sites for grey seal, specifically Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres, Vlaamse Banken, SBZ 1, SBZ 2, SBZ 3, Vlake van de Raan, Westerschelde & Saeftinghe, Voordelta, Noordzeekustzone and Waddenzee).
- 11.3.3.65 Variable information exists on the conservation objectives, with the following drawn from UK sites (noting that no conservation objectives exist for the Humber Estuary Ramsar, with those for the Humber Estuary SAC applying instead) where, subject to natural change, the following applies:

²⁶ <https://www.noordzeeloket.nl/en/policy/noordzee-natura-2000/gebieden/doggersbank/dogger-bank/beschermde-soorten/mammals/kopie-harbour-seal/>

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of the qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of each of the qualifying species; and
- the distribution of qualifying species within the site.

11.3.3.66 The objectives for transboundary sites (where available) are:

- Conserve the area and quality of supporting habitat; and
- Conserve the population size.

11.3.3.67 With the following also highlighted for the Voordelta SCI, Noordseekustzone SCI and Waddenzee SCI:

- Conservation of intertidal areas for resting grey seal.

11.3.3.68 Together with the following additional objective for the Noordseekustzone SCI (the second point also for the Waddenzee SCI):

- Improving the quality of habitat for marine mammals; and
- Maintain undisturbed resting places and optimal breeding habitat for grey seal.

11.3.3.69 Of the above conservation objectives, it is clear that the transboundary objectives are contained within those for the UK sites – therefore the assessment that follows is presented following the UK conservation objective requirements to minimise repetition.

11.3.3.70 As regards the conservation objectives that address the natural habitats of grey seal (the first four bullet points for UK site conservation objectives), these are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#). That chapter has concluded minor adverse significance at most in all cases (which is not significant in EIA terms), in any case insufficient to reach any designated site for seals. Similarly, [Volume 2, Chapter 4: Marine Mammals](#) found the potential for effect in relation to grey seal prey availability to be negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.

11.3.3.71 There is, therefore, no AEoI to the supporting habitats relevant to grey seal and their prey for the Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordseekustzone SCI and Waddenzee SCI from Hornsea Four alone

and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.

- 11.3.3.72 The potential to affect the population and distribution of grey seal is considered within **Volume 2, Chapter 4: Marine Mammals** with respect to potential for injury (PTS) and disturbance.
- 11.3.3.73 As for consideration of harbour porpoise and harbour seal above, the risk of PTS in all marine mammal species will be addressed in the piling-MMMP (referenced here in **Table 3**), which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during percussive piling (requiring prior approval by the regulator). Therefore, it is concluded that Hornsea Four alone does not have an AEol on grey seal as a result of mortality or injury resulting from percussive piling at Hornsea Four alone.
- 11.3.3.74 **Section 4.11.1** of **Volume 2, Chapter 4: Marine Mammals** considers the number of grey seal potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. The highest disturbance levels were predicted for the north west location, where a total of 839 grey seals are predicted to be disturbed during the installation of a monopile, which represents 1.83% of the reference population. The equivalent number for pin piles at the same location is 383 animals (0.84% of the population) which represents the highest level of disturbance in temporal terms. The numbers potentially disturbed are lowest for the southerly location for both monopile and pin pile, being 107 individuals (0.23% of the population) or 56 individuals (0.12%) respectively. As noted above, it is clear that the PEIR Marine Mammal chapter identifies that survival of individuals and reproductive rates are very unlikely to be impacted.
- 11.3.3.75 To place the population level numbers in context, the Humber Estuary SAC citation²⁷ gives the grey seal population at the Humber as being 1,800 individuals (no population number is given in the Humber Estuary RIS²⁸), with the citation for the Berwickshire and North Northumberland Coast SAC²⁹ giving the population as 501-1,000. The most recent report from SCOS (SCOS, 2018³⁰) identifies that the grey seal population of the Humber Estuary (counted at Donna Nook) has increased in recent years, from below 1,000 in 2005 to some 6,526 in 2017. Similarly, the same report identifies an increase in the grey seal population in north east England (the 'Tees data', which covers Coquet Island to Berwick), increasing from 1,100 individuals in 2000-2006 to 7,004 in 2008-2017.
- 11.3.3.76 For the transboundary grey seal sites, population estimates have been sourced where available (from the standard data forms³¹) for sites in Dutch waters (Doggersbank (Dutch) SAC (gives a population of 0), Klaverbank SCI (gives a population of 0), Westerschelde & Saeftinghe SCI (1-20), Voordelta SCI (50-200), Noordzeekustzone SCI (2,040) and Waddenzee SCI (1,800)). For the site in French waters (Bancs des Flandres SCI (none given)) and those in Belgian waters (Vlaamse Banken SCI (gives a population of 0), SBZ 1 SCI (gives

²⁷ <http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030170.pdf>

²⁸ <http://jncc.defra.gov.uk/pdf/RIS/UK11031.pdf>

²⁹ <http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0017072.pdf>

³⁰ <http://www.smru.st-andrews.ac.uk/files/2019/05/SCOS-2018.pdf>

³¹ <http://natura2000.eea.europa.eu>

a population of 0), SBZ 2 SCI (gives a population of 0), SBZ 3 SCI (gives a population of 0 and Vlake van de Raan SCI (0-400))

- 11.3.3.77 There is a significant variation in the population numbers for grey seal recorded at both UK SACs screened in (1,800-6,526 for the Humber and 501-7,004 at Berwickshire and North Northumberland SAC, for both the largest numbers are the most recent). For transboundary sites, many do not have a population given in the standard data forms and those that do, population levels vary between 1 and >2,000. Similarly, there is significant variation in the number of grey seal that may be temporarily disturbed during piling, depending on the foundation type and location (56-839 individuals). Further, it is clear from grey seal tracking data (see [Figure 4](#)) that the proportion of grey seals using the area from Berwickshire and North Northumberland SAC and the transboundary SCIs is likely to be low. Further, as noted in [Volume 2, Chapter 4: Marine Mammals](#), for grey seal from the Humber Estuary SAC and Ramsar, individuals are likely to disperse more widely (i.e. over a wider area than purely the area to the west of Hornsea Four). In other words, the grey seals that may be disturbed are unlikely to solely 'belong' to a particular SAC, alternative feeding grounds are available, and are used, by grey seals from each of the sites being considered.
- 11.3.3.78 As noted above, the assessment method applied for grey seal in [Volume 2, Chapter 4: Marine Mammals](#) is considered likely to over-estimate the number of seals that show a disturbance response to underwater noise, with some individuals expected to show no response at all. Further, not all seal disturbed will come from a single SAC, with more than one feeding ground available to each SAC. Given the potential for an over estimate to be made, combined with the findings of the marine mammal assessment presented at PEIR (of not significant) and the number and location of sites screened in for potential LSE with respect to grey seals, further consideration of this issue will be made following PEIR and reported on within the RIAA submitted at Application.
- 11.3.3.79 The measure to be considered here is whether or not the above potential for disturbance would result in a potential effect on the population and distribution of grey seal. That question is addressed in [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.1](#) and summarised below.
- 11.3.3.80 All piling related disturbance will occur intermittently over a maximum period of 12 months (, with monopiles requiring fewer total piling days than pin piles. Given the results of the recent expert elicitation on the likely effects of behavioural disturbance on vital rates (Booth *et al*, 2019 (see [Section 4.10.4](#) of [Volume 2, Chapter 4: Marine Mammals](#)), there is the potential for this level of disturbance to cause an effect on fertility rates and survival of 'weaned of the year' animals if repeated disturbance were to result in a significant reduction in foraging and therefore energy intake; however expert opinions varied on the number of days of repeated disturbance that this would require. Data collated during windfarm construction has shown that seals quickly return to the area once piling has ceased, and so any disturbance is likely to be short lived and temporary in nature. In addition, telemetry data have shown that not all grey seals respond to pile driving (Aarts *et al*, 2018), and so

may not be disturbed and displaced out of an area that that are motivated to stay in for foraging.

- 11.3.3.81 Overall, and drawing on the expert elicitation workshop in Amsterdam in 2018, (Booth *et al.* 2019), it was concluded at PEIR that there is the potential for a risk of a decline in fertility and survival of 'weaned of the year' for a very small proportion of the population if animals are repeatedly displaced from foraging areas over the 12 month construction period.
- 11.3.3.82 The at-sea usage data (see [Figure 4](#)) suggest that there is a potential foraging area to the northwest of the array area, as shown by the higher predicted densities in the grid cells. The dose response curve used for grey seal behavioural responses was produced from data obtained from tagged harbour seals only, and there is currently no grey seal dose response curve available. Grey seals are considered to be less sensitive to behavioural disturbance than harbour seals (see [Section 4.10.4](#) of [Volume 2, Chapter 4: Marine Mammals](#)), and recent studies of tagged grey seals have shown that there is vast individual variation in responses to pile driving, with some animals not showing any evidence of a behavioural response when within 12 km of the pile driving location (Aarts *et al.*, 2018). Therefore the adoption of the harbour seal dose response curve for grey seals is likely to over-estimate the potential for impact on grey seals.
- 11.3.3.83 The highest density grid cells (red grid cells in [Figure 4](#)) are located between 10 and 22 km from the northwest piling location and are situated within the SELss contours $155 \leq 160$ and $160 \leq 165$ dB. It is important to note that not all grey seals within these noise level contours are expected to respond during pile driving. Given the distance of the highest density areas from the northwest pile location, based on the data presented in Aarts *et al.* (2018), it is possible that grey seals may show no behavioural response at all, given their motivation to remain in the area for foraging. Given the wide ranging behaviour of grey seals, travelling over 100 km between haul-out sites and with foraging trips lasting up to 30 days (SCOS 2017), it is highly likely that any grey seals displaced from this foraging area will be able to compensate by travelling to a different foraging patch. Telemetry data obtained from grey seals tagged at Donna Nook in the Humber Estuary SAC/ Ramsar (depicted above in [Figure 4](#)) show that the foraging area to the northwest of the array area is not the only foraging location that these seals utilise (characterised by high densities of location fixes with tight turning angles in tracks).
- 11.3.3.84 Similarly it is expected that some grey seals may be displaced around the HVAC location at the time of piling, however pile driving at this site will be temporary in nature and since not all seals are predicted to respond they will still be expected to transit through and around this area from the Humber Estuary SAC and Ramsar in order to reach foraging sites.
- 11.3.3.85 This type of short-term, intermittent and temporary behavioural response will affect only a very small proportion of the overall population for short , intermittent periods for up to 12 months and, while energetic requirements may be slightly increased by the need to transit to another foraging location, survival and reproductive rates are very unlikely to be impacted. It should also be noted that the potential for effect is based on a worst-case location – all other piling locations would result in a reduced level of effect. The test that

needs to be met is the conservation objectives for the SACs or Ramsar (as raised above), which is concerned about 'a potential effect on the population and distribution of grey seal'. In the context of the above, it can therefore be concluded that the proposed works would not result in an effect at population level or (other than in the short term) on the distribution of grey seal.

- 11.3.3.86 There is, therefore, no AEol for grey seal population and distribution with respect to the Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI from Hornsea Four alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.

Underwater Noise from UXO Clearance

- 11.3.3.87 Experience from other OWF projects in the southern North Sea, together with specific and recent experience from other Hornsea projects, suggests that there is the potential for UXO to occur within the array and export cable corridor for Hornsea Four and that it is likely that UXO clearance work may be required in some cases; this would need to be confirmed by site-specific pre-construction surveys and a separate Marine Licence (with associated EPS Licence application) will be applied for pre-construction for the detonation of any UXO, if required.
- 11.3.3.88 It should be noted that the preferred action for the Applicant is for no UXO clearance to occur; however, should UXO be detected during the pre-construction geophysical survey, clearance (including a detonation option) may be required prior to construction as a safety measure. Any required UXO clearance would take place before construction piling commences, with the proposed date for piling being the period 2025-2028. Therefore, the earliest any such clearance may occur is anticipated to be in 2024.
- 11.3.3.89 As there is no certainty regarding the number, location or nature of any UXO found (and requiring clearance) precautionary assumptions are made here for assessment purposes, based on experience at other Hornsea projects. That assumption is for a total of 86 targets that will require detonation over a period of 150 to 324 days (depending on the number of targets cleared per day). On a precautionary basis, UXO clearance for the purposes of this assessment is considered to involve the high-order detonation of the UXO in situ to make it safe to undertake construction works in the surrounding area.
- 11.3.3.90 Consideration of impact from UXO is made on a risk of injury basis (defined as PTS) and a disturbance element. [Volume 2, Chapter 4: Marine Mammals](#) considers how PTS is defined and predicted in [Section 4.11.1](#), with that information not repeated here. Depending on the charge weight of the UXO, it is clear (based on Table 4.40 of that Chapter) that the potential range of PTS for an unmitigated high order detonation is potentially high, although the number of animals affected and the percentage of the Management Unit

population impacted is primarily found to be negligible (rising to minor for harbour porpoise for larger charge weights).

- 11.3.3.91 However, the potential for impact with respect to PTS means that Hornsea Four will be required to implement a UXO specific MMMP to ensure that the risk of PTS is reduced to negligible. The exact mitigation measures contained with the UXO MMMP are yet to be determined and will be agreed with Natural England and the MMO. Further, although not currently proposed, the Project is aware of the potential option for UXO clearance using low-order detonation (small shape charge to penetrate the casing and vaporize the explosive material) as opposed to the commonly used high-order detonation where the explosive material is detonated. It is understood that the potential for this approach and evidence of its noise impact ranges are currently being investigated further within a project under BEIS and through the SEA process, though it is expected that since the detonation is much smaller, impact ranges will be significantly reduced.
- 11.3.3.92 Natural England and JNCC advise that a buffer of 26 km around the source location is used to determine the impact area from UXO clearance with respect to disturbance of harbour porpoise in the Southern North Sea SAC. In the absence of agreed metrics for the use of other marine mammal species for disturbance and given a lack of empirical data on the likelihood of response to explosives, this 26 km radius has been applied for all species. This approach is consistent with [Volume 2, Chapter 4: Marine Mammals](#).
- 11.3.3.93 [Section 4.11.1](#) of [Volume 2, Chapter 4: Marine Mammals](#) concluded the significance of impact for all marine mammal species (for risk of PTS and disturbance respectively) from UXO detonation to be 'not significant in EIA terms'.
- 11.3.3.94 In HRA terms, the potential for impact will further depend on the location(s) of any UXO relative to a designated site, particularly for harbour porpoise and the SNS SAC. The assessment below is made for each of the designated sites and marine mammal species screened in for potential LSE for underwater noise during construction and decommissioning.

Consideration of Harbour Porpoise for RIAA Purposes

- 11.3.3.95 Designated sites screened in for harbour porpoise are limited to the SNS SAC. The conservation objectives for that site are given above in [Appendix E](#).
- 11.3.3.96 Given that the anticipated requirement for a UXO-MMMP will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour porpoise during UXO clearance (with prior approval by the regulator), it is concluded that Hornsea Four alone does not have an AEol on the viability of harbour porpoise as a result of mortality or injury resulting from UXO clearance at Hornsea Four alone in relation to the SNS SAC and therefore ensures that, subject to natural change, harbour porpoise will be maintained as a 'viable component' of the site in the long-term.

- 11.3.3.97 There is, therefore, no AEol with respect to the first conservation objective, which deals with species viability, for harbour porpoise within the SNS SAC from Hornsea Four alone and therefore, subject to natural change, the viability of harbour porpoise will be maintained in the long-term.
- 11.3.3.98 The second conservation objective for the SNS SAC refers to 'no significant disturbance of the species', and as highlighted above that disturbance is assessed here through the application of the 26km EDR.
- 11.3.3.99 The seasonal nature of the SNS SAC is important here, with the array boundary being more than 26km distant from the winter extents of the SNS SAC at its closest point. As such, any UXO clearance within the array boundary that takes place in the winter season (October-March inclusive) would fall outside the need for assessment here. Any UXO clearance within the array boundary during the summer season (April-September inclusive) would, however require consideration through the HRA process. For UXO clearance within the export cable corridor, any that fall within 26km of the SNS SAC boundary would require consideration through the HRA process – with seasonal variability depending on UXO location relative to the seasonal extents of the SNS SAC (see [Figure 8](#)). Towards the western end of the export cable corridor, provided any UXO are more than 26km distant from the SNS SAC boundary (summer and/or winter seasonal extents), there would similarly be areas where HRA considerations would not apply or only apply in the summer season (see [Figure 8](#) and [Figure 10](#)). The assessment below is made based on maximum design scenario assumptions.
- 11.3.3.100 For UXO clearance within the array boundary for Hornsea Four, the maximum overlap per individual UXO clearance with the summer extents of the SNS SAC would be 2,124 km² (7.87% of the summer extents), or depending on location of the UXO as low as 1,526km² (5.65%) (see [Figure 8](#)). There is therefore capacity within the threshold (20% per 24 hours) for more than one UXO detonation to occur within the array boundary, the maximum number of potential detonations being dependant on location and in-combination risk.
- 11.3.3.101 For a UXO detonation within the export cable corridor, the potential for overlap with the summer or winter extents of the SNS SAC varies with proximity (the further west the UXO is located, the smaller the potential for overlap). The potential for overlap for a UXO detonated within the HVAC location would result in an overlap of 357 km² (1.3%) to 641 km² (2.4%) with the summer extents or 266 km² (2.1%) to 368 km² (2.9%) with the winter extents. For UXO clearance in the overall export cable corridor, the values in the summer season vary (depending on location) between 0km² (0%) and 2,124km² (7.87%). In the winter season, UXO clearance in the cable corridor similarly varies, also being as a minimum 0km² (0%) and as a maximum 453km² (3.57%). As noted above, it is clear that capacity exists for clearance of more than UXO within the RLB per 24 hours without exceeding the 20% daily threshold (dependant on location and in-combination risk).
- 11.3.3.102 For the 10% temporal value, it is pertinent to note that on any given day the 10% value could only be exceeded if multiple UXO were detonated within that timeframe (a single UXO as a maximum would result in 7.87% of effect). The anticipated duration of UXO clearance would occur within an overall window of 150 to 324 days, depending on the rate

of clearance, with a maximum number of 86 targets anticipated for clearance. For assessment purposes, and as a maximum design scenario for the 10% temporal value, it is therefore assumed that up to 86 days of UXO clearance within the overall window would be required, wholly within a winter season or wholly within a summer season. The maximum seasonal effect in the summer (assuming up to 7.87% per day for up to 86 days of a 183 day season) would be 3.7%, with the maximum seasonal effect in the winter (assuming up to 3.57% per day for up to 86 days of a 182 day season) would be 1.68%. Both values are precautionary (assuming a worst-case of effect each time) and well within the 10% seasonal threshold.

- 11.3.3.103 Therefore, it is concluded that there will not be an AEol in relation to disturbance on the Conservation Objective for harbour porpoise for the SNS SAC as a result of UXO clearance from Hornsea Four alone and therefore, subject to natural change, in the long-term, there will be no significant disturbance of harbour porpoise.

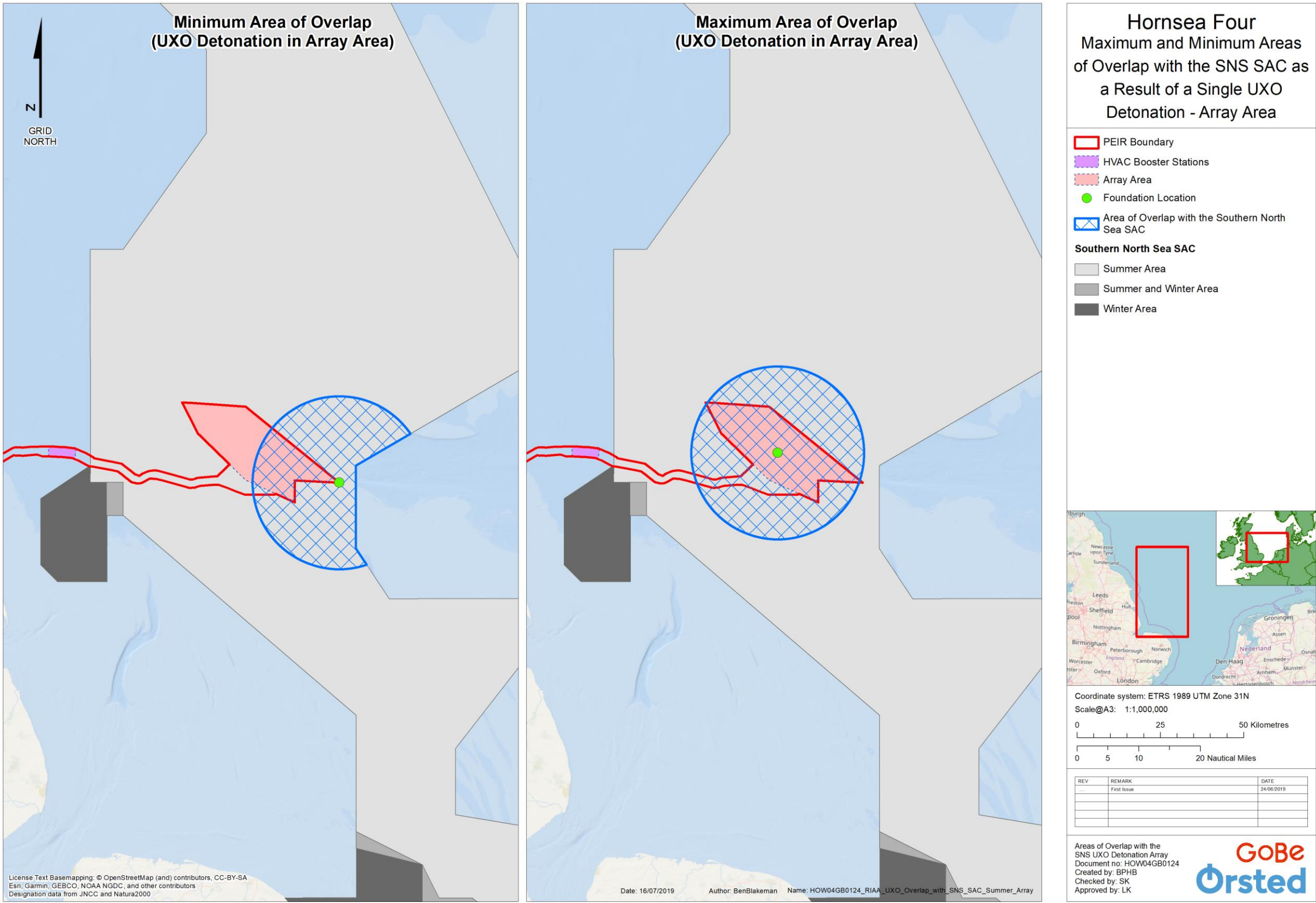


Figure 8: Maximum and Minimum areas of overlap with the SNS SAC as a result of a single UXO detonation – array area (not to scale).



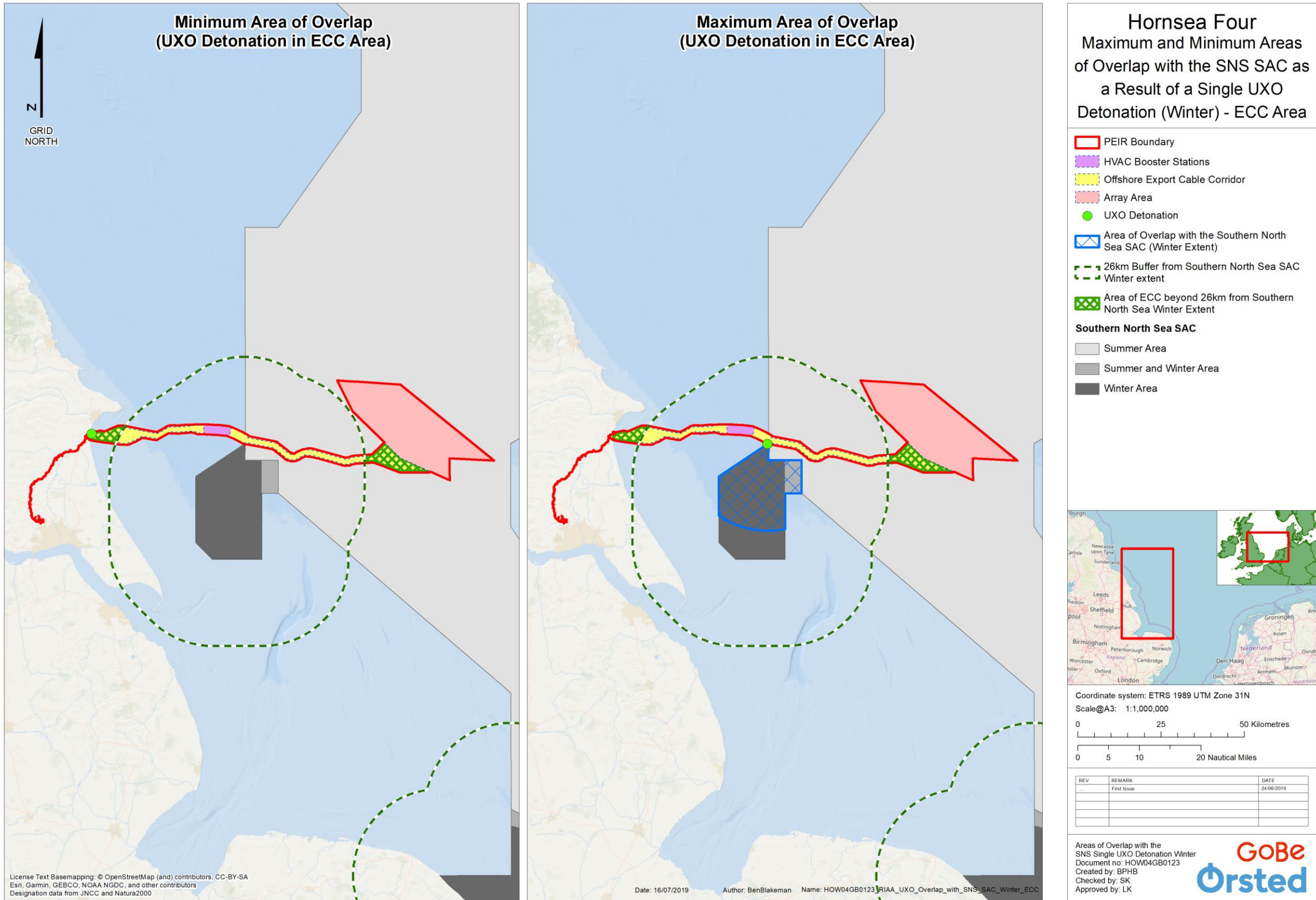


Figure 10: Maximum and Minimum areas of overlap with the SNS SAC as a result of a single UXO detonation (winter) – ECC (not to scale).

- 11.3.3.104 The third conservation objective is focused on maintaining the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC. The Advice on Activities³² refers to supporting habitats as 'the characteristics of the seabed and water column' in the context of 'ensuring prey is maintained within the site'. Potential for supporting habitats and processes to be affected are considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**. That chapter has concluded at most a minor adverse effect (which is not considered significant in EIA terms).
- 11.3.3.105 There is, therefore, no AEol to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from Hornsea Four alone and therefore, subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.

Consideration of harbour seal for RIAA purposes

- 11.3.3.106 The sites for which harbour seal are screened in for potential LSE with respect to underwater noise are highlighted under the assessment for piling above, including confirmation that the conservation objectives as applied to UK sites encompass the relevant measures for transboundary sites. Therefore, the assessment that follows is presented following the UK conservation objective requirements to minimise repetition.
- 11.3.3.107 As regards the conservation objectives that address the natural habitats of harbour seal, these are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**. That chapter has concluded minor adverse significance in all cases (which is not significant in EIA terms). Similarly, **Volume 2, Chapter 4: Marine Mammals** found the potential for effect in relation to harbour seal prey availability to be negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.
- 11.3.3.108 There is, therefore, no AEol to the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI from Hornsea Four alone and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.
- 11.3.3.109 The potential to affect the population and distribution of harbour seal is considered within **Volume 2, Chapter 4: Marine Mammals** with respect to potential for injury (PTS) and disturbance.
- 11.3.3.110 As for consideration of harbour porpoise above, the risk of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP, which will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour seal during UXO clearance (requiring prior approval by the regulator). Therefore, it is concluded that Hornsea

³² http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

Four alone does not have an AEol on harbour seal as a result of mortality or injury resulting from UXO clearance at Hornsea Four alone.

- 11.3.3.111 **Volume 2, Chapter 4: Marine Mammals** applies the 26km EDR for disturbance from UXO detonation for all marine mammal species; the chapter provides counts of individual animals that may be subject to disturbance and places this in the context of the overall population. Such counts will vary with size of UXO, however given the very short duration, intermittent nature and high reversibility of the effect, the significance was concluded to be negligible, which is not significant in EIA terms.
- 11.3.3.112 There is, therefore, no AEol for the harbour seal population and distribution with respect to the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI from Hornsea Four alone and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.

Consideration of grey seal for RIAA purposes

- 11.3.3.113 The sites for which grey seal are screened in for potential LSE with respect to underwater noise are highlighted under the assessment for piling above, including confirmation that the conservation objectives as applied to UK sites encompass the relevant measures for transboundary sites. Therefore, the assessment that follows is presented following the UK conservation objective requirements to minimise repetition.
- 11.3.3.114 As regards the conservation objectives that address the natural habitats of grey seal (the first four bullet points for UK site conservation objectives), these are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**. That chapter has concluded minor adverse significance in all cases (which is not significant in EIA terms). Similarly, **Volume 2, Chapter 4: Marine Mammals** found the potential for effect in relation to grey seal prey availability to be negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.
- 11.3.3.115 There is, therefore, no AEol to the supporting habitats relevant to grey seal and their prey for the Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI from Hornsea Four alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.
- 11.3.3.116 The potential to affect the population and distribution of grey seal is considered within **Volume 2, Chapter 4: Marine Mammals** with respect to potential for injury (PTS) and disturbance.

- 11.3.3.117 As for consideration of harbour porpoise and harbour seal above, the risk of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP, which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during UXO clearance (requiring prior approval by the regulator). Therefore, it is concluded that Hornsea Four alone does not have an AEol on grey seal as a result of mortality or injury resulting from UXO clearance at Hornsea Four alone.
- 11.3.3.118 **Volume 2, Chapter 4: Marine Mammals** applies the 26km EDR for disturbance from UXO detonation for all marine mammal species; the chapter provides counts of individual animals that may be subject to disturbance and places this in the context of the overall population. Such counts will vary with size of UXO, however given the very short duration, intermittent nature and high reversibility of the effect, the significance was concluded to be negligible, which is not significant in EIA terms.
- 11.3.3.119 There is, therefore, no AEol for grey seal population and distribution with respect to the Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI from Hornsea Four alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.

Underwater Noise from Geophysical & Seismic Survey

- 11.3.3.120 Geophysical survey, by definition, results in the emission of underwater noise. The pre-construction geophysical survey for Hornsea Four is likely to occur prior to the UXO clearance and piling, however no specific information is yet available (in terms of timing, nature, extent or duration). As noted above, the use of a SIP will ensure that the assessment for the SNS SAC will be revisited for Hornsea Four according to the timeframe set out within the SIP and will therefore include any geophysical survey known at that time.
- 11.3.3.121 The type of geophysical survey carried out for OWF is not typically considered likely to result in PTS in marine mammals, as the risk is mainly derived from surveys in water >200m and/or using airguns³³. If a risk were deemed to be present (which would be related to the type and nature of any seismic survey eventually proposed) that risk would be addressed through appropriate licensing measures at that time. With respect to PTS risk for all marine mammal species, a conclusion of no AEol for all sites and marine mammal features screened in can therefore be drawn.
- 11.3.3.122 The JNCC advice on activities for the SNS SAC³⁴ found that the need for an individual geophysical survey to be subject to HRA would need to be assessed on a case by case basis (to be addressed for Hornsea Four through the SIP process, as noted above). Cumulative impacts however 'will need to be considered'.

³³ http://archive.jncc.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf

³⁴ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

- 11.3.3.123 To that end, the potential for disturbance in marine mammals from geophysical surveys (given that any such surveys for Hornsea Four are as yet unknown) are addressed further in the in-combination section only (where plans for such surveys are known). Should the requirement for surveys become clear in time for the application, this assessment will be updated to reflect that. If not, the need for such surveys will be known and addressed within the SIP process.

Underwater Noise from Seabed Preparation and Cable Installation

- 11.3.3.124 While percussive piling and UXO clearance will be the worst-case noise source during the construction phase, there will also be several other construction activities that will produce underwater noise. These include dredging, drilling, cable laying, rock placement and trenching (vessel disturbance is assessed separately).
- 11.3.3.125 A simple assessment of the noise impacts from non-piling noise is presented in [Volume 4, Annex 4.5: Subsea Noise Technical Report](#). Using the non-impulsive weighted SEL_{cum} PTS and TTS thresholds from Southall *et al.* (2019) resulted in estimated PTS and TTS impact ranges of <100 m for all marine mammals species for each non-piling construction activity. These values mean that animals would have to stay within these very small ranges for 24 hours before they experienced injury, which is an extremely unlikely scenario as it is far more likely that any marine mammal within the injury zone would move away from the vicinity of the vessel and the construction activity.
- 11.3.3.126 The potential effects of cabling techniques used in the offshore wind farm industry was reviewed in a report by BERR in association with DEFRA (BERR and DEFRA 2008). The report reviewed various cable types and installation methods including burial ploughs, machines, ROVs and sleds and the burial methods themselves including jetting, rock ripping, and dredging. The review concluded that it would be “highly unlikely that cable installation would produce noise at a level that would cause a behavioural reaction in marine mammals”. It is also highly likely that the presence of vessels will act as a deterrent and disturb marine mammals out of the area before any non-piling construction activity begins (as has been documented for harbour porpoise, Brandt *et al.* 2018).
- 11.3.3.127 Given the conclusion in [Section 4.11.1](#) of [Volume 2, Chapter 4: Marine Mammals](#), effectively that the potential for impact is considered negligible and therefore not taken forward further in the assessment, enables a conclusion of no AEol to all marine mammals in relation to underwater noise during seabed preparation and cable laying from Hornsea Four alone and therefore, subject to natural change, the marine mammal features will be maintained in the long term.

All sources of Underwater Noise from Hornsea Four Alone

- 11.3.3.128 It is clear that the proposed works resulting in underwater noise would, independently of each other, not result in an AEol with respect to the sites and features screened in for marine mammals, as even as a worst-case there would be no exceedance of the 20% daily or 10% seasonal thresholds. For clarity, it can be confirmed that such activity (in terms of percussive

piling and UXO activity) will not overlap temporally and will therefore not lead to a 'project alone in-combination effect'; even though (with respect to the SNS SAC) capacity exists in the thresholds for such overlap to occur (based on values for the project alone only). Such an effect could occur, should for example UXO clearance occur in the same timeframe as percussive piling. Confirmation of this conclusion (or if necessary appropriate management measures) will be provided for within the SIP at the time of application.

Vessel Disturbance

- 11.3.3.129 The potential for an AEol as a result of vessel disturbance on marine mammals during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase.
- Southern North Sea SAC (harbour porpoise);
 - The Wash and North Norfolk Coast SAC (harbour seal);
 - Humber Estuary SAC (grey seal);
 - Humber Estuary Ramsar (grey seal);
 - Berwickshire and North Northumberland Coast SAC (grey seal);
 - Transboundary sites (two sites for harbour seal); and
 - Transboundary sites (twelve sites for grey seal).
- 11.3.3.130 The potential for vessel related disturbance on marine mammals alone has been assessed within the existing project literature (see [Volume 2, Chapter 4: Marine Mammals](#)), with a summary of that provided here.
- 11.3.3.131 The area surrounding Hornsea Four already experiences a reasonable amount of vessel traffic throughout the year, with an average of 16 vessels per day passing through the array area (see [Volume 2, Chapter 8: Shipping and Navigation](#)). Therefore, the introduction of vessels during construction is not a novel impact for marine mammals present in the area.
- 11.3.3.132 Increased vessel traffic during construction has the potential to result in disturbance of marine mammals. Disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. The busiest period during construction in terms of vessel traffic would be when up to eight vessels are present in a given 5 km² block. This level of activity is unlikely to occur across the entire Hornsea Four array area at any one time, rather this intensity is expected across approximately three or four 5 km² blocks. The total duration of the piling campaign is expected to be a maximum of 12 months. During the period of piling operations, it is considered unlikely that vessel noise will impact marine mammal receptors at levels additional to the piling activity itself.
- 11.3.3.133 The magnitude and characteristics of vessel noise varies depending on ship type, ship size, mode of propulsion, operational factors and speed. Vessels of varying size produce different frequencies, generally becoming lower frequency with increasing size. The distance at

which animals may react is difficult to predict and behavioural responses can vary a great deal depending on context.

- 11.3.3.134 There are very few studies that indicate a critical level of activity in relation to harbour porpoise density, but an analysis presented in Heinänen and Skov (2015) suggested that harbour porpoise density was significantly lower in areas with vessel transit rates of greater than 80 per day. Vessel traffic in the Hornsea Four area, even considering the addition of construction traffic, will still be below this figure.
- 11.3.3.135 It is therefore not expected that the level of vessel activity during the construction of Hornsea Four would cause a significant increase in the risk of disturbance by vessels or collision risk with vessels. The adoption of a vessel management plan (Commitment Co108) that includes preferred transit routes and guidance for vessel operations in the vicinity of marine mammals and around seal haul-outs will minimise the potential for any impact. The impact is predicted to be of local, short term duration and intermittent. It is expected that any marine mammals that are disturbed as a result of vessel presence will return to the area once the vessel disturbance has ended.
- 11.3.3.136 Overall, **Volume 2, Chapter 4: Marine Mammals** found that the effect (in terms of disturbance) is of Minor adverse significance, which is not significant in EIA terms.

Consideration of Harbour Porpoise for RIAA Purposes

- 11.3.3.137 The existing vessel traffic movements within the array boundary (an average of 16 per day), combined with up to 8 vessels per 5km² block during construction, remains below the approximately 80 movements per day cited in Heinänen and Skov (2015) as having potential to lead to a negative effect on harbour porpoise density.
- 11.3.3.138 The relevant conservation objectives for harbour porpoise are cited in **Appendix E**.
- 11.3.3.139 The first two conservation objectives address risk of injury and disturbance. **Volume 2, Chapter 4: Marine Mammals** found (in the context of existing shipping levels, the increase in those levels proposed during construction at Hornsea Four and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of Hornsea Four is insufficient to result in mortality, injury or significant disturbance in marine mammals.
- 11.3.3.140 The third conservation objective is focused on maintaining the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC. The Advice on Activities³⁵ refers to supporting habitats as 'the characteristics of the seabed and water column' in the context of 'ensuring prey is maintained within the site'. Potential for supporting habitats and processes to be affected are considered within **Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes**. That chapter has concluded the potential for effect to be minor adverse at most (and therefore not significant in EIA terms).

³⁵ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

- 11.3.3.141 There is, therefore, no AEol relevant to harbour porpoise for the SNS SAC from Hornsea Four alone and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.

Consideration of Harbour Seal and Grey Seal for RIAA Purposes

- 11.3.3.142 Harbour seal and grey seal are screened in for potential LSE with respect to vessel disturbance during construction and decommissioning for the following sites:
- The Wash and North Norfolk Coast SAC (harbour seal);
 - Humber Estuary SAC (grey seal);
 - Humber Estuary Ramsar (grey seal);
 - Berwickshire and North Northumberland Coast SAC (grey seal);
 - Transboundary harbour seal sites (Doggersbank (Dutch) SAC and Klaverbank SCI); and
 - Transboundary grey seal sites (Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, Waddenzee SCI).
- 11.3.3.143 The relevant conservation objectives for harbour seal and grey seal are cited in [Appendix E](#).
- 11.3.3.144 As regards the conservation objectives that address the natural habitats of harbour seal and grey seal, these are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#). That chapter has concluded minor adverse significance in all cases (which is not significant in EIA terms). Similarly, [Volume 2, Chapter 4: Marine Mammals](#) found the potential for effect in relation to harbour seal and grey seal prey availability to be negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.
- 11.3.3.145 There is, therefore, no AEol to the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI or for grey seal and their prey for Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI from Hornsea Four alone and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.
- 11.3.3.146 The potential to affect the population and distribution of harbour seal and grey seal is considered within [Volume 2, Chapter 4: Marine Mammals](#) with respect to potential for mortality, injury (PTS) and disturbance. No indication was found that disturbance from

shipping can result in PTS in marine mammals, with consideration given to the risk of disturbance below.

- 11.3.3.147 As regards the risk of disturbance, it is clear from the summary presented above (which draws on [Volume 2, Chapter 4: Marine Mammals](#)) that (in the context of existing shipping levels, the increase in those levels proposed during construction at Hornsea Four and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of Hornsea Four is insufficient to result in mortality, injury or significant disturbance in marine mammals.
- 11.3.3.148 There is, therefore, no AEol relevant to harbour seal for the Wash and North Norfolk Coast SAC, Doggersbank (Dutch) SAC or Klaverbank SCI or for grey seal for Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI from Hornsea Four alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.

11.3.4 Operation and Maintenance

Underwater Noise

- 11.3.4.1 The potential for an AEol as a result of an increase in underwater noise (operational noise) on marine mammals during operation & maintenance relates to the following designated site and the relevant feature (i.e. those features screened in for potential LSE).
- Southern North Sea SAC (harbour porpoise).
- 11.3.4.2 The relevant conservation objectives for harbour porpoise are cited in [Appendix E](#).
- 11.3.4.3 The potential for operational noise to affect marine mammals is discussed in [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.2](#). A summary of that information is presented below.
- 11.3.4.4 Operational WTGs will produce underwater noise a result of vibration from the rotating machinery in the turbines, which is transmitted through the structure of the pile and foundations. An assessment was made based on an extrapolation from measured data from operational offshore wind farms sites with smaller sizes rotors (see [Volume 4, Annex 4.5: Subsea Noise Technical Report](#)). Using the non-impulsive weighted SEL_{cum} PTS and TTS thresholds from Southall et al. (2019) (as the most sensitive measures contained within that document) resulted in estimated PTS and TTS impact ranges of <100 m for all marine mammals species (being the minimum range feasible when producing modelled outputs for the SEL_{cum} values – in other words the potential range of effect is within that distance, not necessarily out to that distance).

- 11.3.4.5 The MMO (2014) review of post-consent monitoring at OWFs found that available data on the operational WTC noise, from the UK and abroad, in general showed that noise levels from operational WTCs are low and the spatial extent of the potential impact of the operational WTC noise on marine receptors is generally estimated to be small, with behavioural response only likely at ranges close to the WTC. This is supported by several published studies which provide evidence that marine mammals are not displaced from operational wind farms. For example, a number of reviews have concluded that operational wind farm noise will have negligible effects (Madsen *et al.* 2006, Teilmann *et al.* 2006, CEFAS 2010, Brasseur *et al.* 2012). In addition, studies have shown that porpoise are detected regularly within operational offshore wind farms (Diederichs *et al.* 2008, Scheidat *et al.* 2011) and may be attracted to offshore wind farms for increased foraging opportunities (Lindeboom *et al.* 2011).
- 11.3.4.6 As regards the conservation objectives for the SNS SAC, it is considered that there is no risk of injury resulting from PTS in harbour porpoise. The risk of injury (defined as onset of PTS) as well as the risk of TTS is given as occurring in a range of <100m, a highly precautionary range, and within which the animal would need to stay for a 24 hour period for sufficient noise exposure to result in an effect. It should be noted that as the range of risk of onset of TTS is also <100m, the range of onset of PTS would be well within that limit (although the models are not sensitive enough to enable such differentiation at such close range to source). Given existing evidence, which demonstrates that harbour porpoise are not displaced from offshore wind farms in general following construction, it is therefore anticipated that, in line with a number of studies conducted to date, any such disturbance response would be in close proximity to turbines only.
- 11.3.4.7 The final consideration is that of risk to habitat and prey from operational noise. Underwater noise is not considered a risk to the habitat of harbour porpoise. The risk to harbour porpoise prey, in terms of fish, is also considered (see [Volume 4, Annex 4.5: Subsea Noise Technical Report](#)), finding that the risk of TTS (over a period of 12 hours) is <50m. Further consideration is given to fish in [Volume 2, Chapter 3: Fish and Shellfish Ecology](#), including during operation, with a behavioural response only expected at very close range. The effect was considered negligible and therefore not significant in EIA terms.
- 11.3.4.8 It can therefore be concluded that there is no AEol to harbour porpoise in relation to operational noise from Hornsea Four alone and therefore, subject to natural change, the marine mammal feature will be maintained in the long term.

Vessel Disturbance

- 11.3.4.9 The potential for an AEol as a result of vessel disturbance on marine mammals during operation & maintenance relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE).
- Southern North Sea SAC (harbour porpoise);
 - The Wash and North Norfolk SAC (harbour seal);
 - Humber Estuary SAC (grey seal);

- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (two sites for harbour seal); and
- Transboundary sites (twelve sites for grey seal).

11.3.4.10 The relevant conservation objectives for harbour porpoise, harbour seal and grey seal are cited in [Appendix E](#).

11.3.4.11 The potential for vessel disturbance (and any associated collision risk) in marine mammals during operation and maintenance is considered in [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.11.2](#). The assessment considered the potential for an effect on marine mammals from vessel movements, in the context of the vessel management plan, with no significant change on existing levels predicted. The impact is predicted to be of local, short term duration and intermittent. It is expected that any marine mammals that are disturbed as a result of vessel presence will return to the area once the vessel disturbance has ended. The effect was concluded to be of minor adverse significance, which is not significant in EIA terms. As such, the conclusions drawn here with respect to vessel disturbance during construction, of no AEol for all marine species screened in, applies equally during the operation & maintenance phase of works.

11.4 Offshore Ornithology

11.4.1 Assessment Criteria

11.4.1.1 The assessment has been based on the relevant guidance for conducting HRA and assessing offshore wind farms (e.g. European Commission, 2011; Maclean *et al*, 2009; Natural England, 2010; PINS Advice Note Ten) and applied the criteria contained in that guidance where relevant to the interest features under consideration.

11.4.1.2 The screening criteria applied are precautionary and are:

- The occurrence of the species, as shown by the baseline surveys, in more than trivial numbers (where 'trivial' was single figures over the duration of the surveys) within the Hornsea Four array area and 4 km buffer, ECC and Cable Landfall area; and / or
- The species has been identified as sensitive to disturbance and displacement in relevant guidance (Bradbury *et al*, 2014; Furness and Wade 2012; Furness *et al*, 2013); and / or
- The species has been identified as sensitive to collision risk in relevant guidance (Bradbury *et al*, 2014; Furness and Wade 2012; Furness *et al*, 2013).

11.4.1.3 The determination of AEol is based on the factors that contribute to the definition of maintaining integrity, namely that the ecological structure and function of the site is not adversely affected, that the ability of the habitat to sustain the bird species that are interest features is not adversely affected (i.e. that breeding, roosting and foraging locations are maintained and that food sources are maintained) and that the population of the interest

feature is maintained both in numbers and across the area of the site. Where relevant, the long-term viability of the population has been assessed using population modelling.

11.4.2 Description of Significance

- 11.4.2.1 A description of the significance of project level effects upon the receptors grouped under 'offshore ornithology', as relevant to the designated sites and their associated features screened in for LSE is provided below.

11.4.3 Construction and Decommissioning

Disturbance and Displacement

- 11.4.3.1 The potential for disturbance and displacement to result in an AEol relates to the following designated sites and the relevant features:
- Greater Wash SPA; red-throated diver and common scoter during the non-breeding bio-season;
 - Flamborough and Filey Coast SPA; guillemot, razorbill and puffin during the breeding and non-breeding bio-seasons;
 - Coquet Island SPA; puffin during the breeding and non-breeding bio-seasons;
 - Farne Islands SPA; guillemot and puffin during non-breeding bio-season;
- 11.4.3.2 The construction phase has the potential to affect birds in the marine environment through disturbance due to construction activities, including the installation of foundations, towers, blades, export cables and other infrastructure and the movement of vessels and helicopters. The disturbance created has the potential to result in displacement of birds from the site of construction, from an area around it and from routes used by vessels to access the construction site. This displacement would effectively result in temporary habitat loss through a reduction in the area available to birds for feeding, resting and moulting.
- 11.4.3.3 Any impacts resulting from disturbance and displacement from these activities are considered to be short-term, temporary and reversible in nature, lasting only for the duration of construction activity, as birds would return to the area once construction activities have ceased. Disturbance and displacement of birds during the construction phase is most likely to affect birds foraging in and around the construction area. The level of disturbance at each work location would differ dependent on the activities taking place, but there could be vessel movements at any time of day or night over the entire construction period.
- 11.4.3.4 There are a number of different measures used to assess bird disturbance and displacement from areas of sea in response to activities associated with an offshore wind farm. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which is used widely in OWF EIAs. Furness and Wade (2012) developed disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance in Scottish

waters. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. As many of these references relate to disturbance from helicopter and vessel activities, these are considered relevant to this assessment. Bradbury *et al.* (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters. More recently a joint SNCB interim displacement advice note (SNCBs, 2017) provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs.

11.4.3.5 Some species are more susceptible than others to disturbance from construction activities which may lead to subsequent displacement. Dierschke *et al.* (2016) noted both displacement and avoidance to varying degrees by some seabird species while others were attracted to offshore wind farms. Species such as divers have been noted to avoid shipping with one study identifying red-throated diver flushing at a median value of 400 m and a maximum value of 2 km (Bellebaum *et al.*, 2006). Therefore, this species is considered further for the potential impact of displacement from cable laying vessels within the ECC during the construction phase of Hornsea Four. Auk species, in this instance guillemot, razorbill and puffin, have been noted to respond to OWF construction activities and be displaced as a consequence. Therefore, these species are considered further for the potential impact of displacement from the array area and species dependent differing degrees of buffers surrounding activities are applied in the assessment of the proposed construction phase of Hornsea Four.

11.4.3.6 The process for assessing displacement has been carried out for Hornsea Four based on a set of methods and results following a set of scenarios that recognise construction activities being restricted both temporally and spatially;

- Export cable laying activities being undertaken by only three vessels across the entire ECC between cable landfall and the array area (approx. 94 km);
- Construction activities being undertaken within only three to four blocks of 5 km² at any one time across the entire 600 km² array area;
- Any potential displacement is likely to only occur within the array area, where vessels and construction activities are present;
- Construction activities are restricted both temporally and spatially to approximately 24 months for the ECC and 36 months for the array area; and
- Large parts of the array area not being influenced by construction activities.

11.4.3.7 For each of the species assessed in this RIAA an evidence led approach to quantifying the level of displacement led to the following rates of displacement being used at this stage to determine the overall number of birds within the areas defined as most appropriate for each species. In recognition of the potential disturbance activities being of a lesser extent to that of an active offshore wind farm then the levels of displacement are also of lesser extent. Evidence from recent seabird monitoring during the construction period of Thanet OWF (Royal HaskoningDHV, 2013) presented displacement rates of the following for guillemot and razorbill;

- Up to 63% of guillemots were displaced within the Thanet array area and 25% from a buffer out to 1 km (but not beyond); and
- Up to 89% of razorbills were displaced within the Thanet array area and 25% from a buffer out to 500 m (but not beyond).

- 11.4.3.8 For the purpose of this assessment an assumption of puffin being displaced by 50% within the array area only has been selected. This is based on puffin being less likely to be displaced by construction activities (Furness and Wade, 2012). For all three species of auks (guillemot, razorbill and puffin) the level of mortality applied for this assessment is 1% of those displaced.
- 11.4.3.9 For the purpose of assessing the potential impact on red-throated diver it was agreed with Natural England that a 2 km buffer surrounding cable laying vessels would be assumed to be the extent of any displacement (at Technical Panel Meeting 4 on 11.06.19).
- 11.4.3.10 The assessments provided within this RIAA include a number of assumptions that contribute to the predicted impacts and potential effects being considered overly precautionary, including;
- The population within each bio-season being the mean of the peaks from each survey year. This makes the assumption that such a high population is maintained for each of the months within the bio-season, whilst the actual abundance of each species is likely to be less than this for much of the bio-season;
 - The maximum extent of displacement considered for each species is likely to be greater than actually experienced within the array area and buffer;
 - The 1% mortality of birds displaced during the migratory breeding bio-season is highly unlikely, as the species assessed in this RIAA are not solely dependant upon the area within the Hornsea Four array area and buffer for all their foraging needs;
 - That adult birds that are actively breeding will respond to displacement by putting themselves to further stress to the extent of dying rather than ceasing to breed (i.e. abandoning eggs or young) and surviving to breed in a later year;
 - Not all adult birds within the Hornsea Four array area and / or buffer will be from Flamborough and Filey Coast SPA; and
 - Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the Hornsea Four array area throughout the year.
- 11.4.3.11 For the purpose of this assessment the impacts from decommissioning are similar to and potentially less than those outlined in the construction phase. Therefore, they are not assessed in detail in this document, however the outcomes of the assessment are summarised in [Table 34](#).

Greater Wash SPA – red-throated diver

- 11.4.3.12 Red-throated diver has been screened in to the assessment of the construction phase on the basis of its sensitivity to vessel presence during the process of the export cable laying

and in relation to those parts of the ECC in shallower water, closer to the coast, where red-throated diver are most likely to be found.

- 11.4.3.13 The laying of the export cable between the array area and the cable landfall area for Hornsea Four would involve cable laying vessels being in situ for the entire construction period of up to 24 months, potentially occurring in two consecutive non-breeding periods.
- 11.4.3.14 In order to assess the potential impact on red-throated diver a displacement effect distance was determined, consulted on and it was agreed with Natural England that a 2 km buffer surrounding any cable laying vessel would be used to assess the extent of any displacement (Technical Panel Meeting 4 on 11.06.19).
- 11.4.3.15 The ECC route was selected so that it does not run directly through the Greater Wash SPA and as a result it avoids the areas known to hold the highest densities of this species (derived from an evaluation of the SeaMaST data set: Bradbury *et al*, 2014). An evaluation of the SeaMaST data confirmed that for the majority of the ECC that red-throated diver occur in very low to low densities of between 0.000 and 0.007-0.064 birds per km². The SeaMaST data identified that the ECC may run through a small area where densities are higher, between 0.065 and 0.641 birds per km².
- 11.4.3.16 Based on the above densities it was estimated that for the majority of the ECC there would be less than one red-throated diver present within a 2 km buffer of the cable laying vessel. In the ECC areas of higher density it was estimated that for the minority of the ECC there would be between under one and eight red-throated diver present within a 2 km buffer of the cable laying vessel.
- 11.4.3.17 If on a precautionary assessment is made assuming 100% displacement within the 2 km buffer area surrounding the cable laying vessel then between under one and eight red-throated diver would be displaced. With an assumed resultant mortality of 1% of displaced birds this would mean a maximum of less than a tenth of one bird. The Greater Wash SPA population is 1,407 individuals. Background annual survival of red-throated diver has been estimated as 0.84 (Robinson, 2017). On this basis 225 individuals out of the population of the Greater Wash SPA might be expected to die each year. The less than one individual identified above is a 0.04% increase in background mortality. This very small increase in mortality, that would be temporary given that it relates to the construction phase, would make no material difference to the long-term maintenance of the red-throated diver population of the Greater Wash SPA.
- 11.4.3.18 There is, therefore, no potential for an AEol to the conservation objectives of the red-throated diver feature of Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, red-throated diver will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Greater Wash SPA – common scoter

- 11.4.3.19 Common scoter has been screened in to the assessment of the construction phase on the basis of its sensitivity to vessel presence during the process of the export cable laying and in relation to those parts of the ECC in shallower water, closer to the coast, where common scoter are most likely to be found.
- 11.4.3.20 The laying of the export cable between the array area and the cable landfall area for Hornsea Four would involve cable laying vessels being in situ for the entire construction period of up to 24 months, potentially occurring in two consecutive non-breeding periods.
- 11.4.3.21 In order to assess the potential impact on common scoter a displacement effect distance has to be determined. A 2 km buffer surrounding any cable laying vessel will be used to assess the extent of any displacement based on that being the agreed distance for red-throated diver and that common scoter is also known to be sensitive to disturbance by vessels.
- 11.4.3.22 The ECC does not run directly through the Greater Wash SPA and as a result it avoids the areas known to hold the highest densities of this species (derived from a visual evaluation of the common scoter density data that supported the classification of the Greater Wash SPA published in Lawson *et al.* 2016). An evaluation of that data confirmed that across the ECC that common scoter occur in very low densities of between 0.00 and 0.70 birds per km².
- 11.4.3.23 Based on the above densities it was estimated that in the ECC there would be between zero and nine common scoter present within a 2 km buffer of the cable laying vessel.
- 11.4.3.24 If on a worst-case basis the assessment is made assuming 100% displacement within the 2 km buffer area surrounding the cable laying vessel then between zero and nine common scoter would be displaced. With an assumed resultant mortality of 1% of displaced birds this would mean a maximum less than a tenth of one bird. The Greater Wash SPA population is 3,449 individuals. Background annual survival of common scoter has been estimated as 0.783 (Robinson, 2017). On this basis 748 individuals out of the population of the Greater Wash SPA might be expected to die each year. The less than one tenth of an individual identified above is a 0.01% increase in background mortality. This level of potential mortality is beyond the limits of detection, would be temporary given that it relates to the construction phase and would make no material difference to the long-term maintenance of the common scoter population of the Greater Wash SPA.
- 11.4.3.25 There is, therefore, no potential for an AEol to the conservation objectives of the common scoter feature of Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, common scoter will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - guillemot

- 11.4.3.26 Guillemot has been screened in to the assessment of the construction phase on the basis of its sensitivity to the activities which will take place within the array area.
- 11.4.3.27 The construction activities within the array area will be undertaken within only three to four blocks of 5 km² at any one time across the entire 600 km² array area and hence large parts of the array area will not be influenced by construction activities over the approximately 36 month period.
- 11.4.3.28 In order to assess the potential impact on guillemot a displacement effect distance was determined of the array and 1 km surrounding the array area. Within that displacement effect area the percentage of birds displaced from the array area was set at 63% and from within the 1 km buffer around the array area the percentage of birds displaced was set at 25%. Further details on the derivation of the buffer distance and the percentage displaced is given in [Volume 2, Part B Chapter 5, Section 5.11](#).
- 11.4.3.29 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied.
- 11.4.3.30 In the migration-free breeding bio-season the number of guillemots estimated to occur in the array area and a 1 km buffer is 8,493 individuals (all abundance data is drawn from [Table 2 of Annex 5.2 of Volume 2, Part B, Chapter 5 of the Hornsea Four PEIR](#)) and the number predicted to be displaced is 4,571 individuals. Of these individuals, the predicted consequent mortality from being displaced is estimated at 46 individuals. The Hornsea Four array area is within the mean maximum foraging distance of 84.2 km to the Flamborough and Filey Coast SPA at 63 km and within the maximum foraging distance of 135 km. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (classified guillemot population of 83,214 individuals, with an annual background mortality of this number of birds being 4,494 individuals) then this prediction of 46 birds suffering displacement consequent mortality would represent a 1.0% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age.
- 11.4.3.31 Outside of the breeding season the number of guillemots estimated to occur in the array area and a 1 km buffer in the return migration bio-season is 6,935 individuals, in the post-breeding migration bio-season is 50,296 individuals and in the migration free winter bio-

season is 11,883 individuals (all abundance data is drawn from Table 2 of Annex 5.2 of the Offshore Ornithology Displacement Analysis in [Hornsea Four EIA PEIR Volume 2 Part B Chapter 5](#)). The number predicted to be displaced in the return migration bio-season is 3,869 individuals, in the post-breeding migration bio-season is 27,645 individuals and in the migration free winter bio-season is 6,373 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 379 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 74,893 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.6%. On that basis 18 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.4% increase in baseline mortality.

- 11.4.3.32 The impact of displacement from the array area and a buffer around it, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of 46 birds from the SPA in the breeding season and 18 birds from the SPA in the non-breeding season. As noted above, the assessment method applied for guillemot during the breeding season is considered likely to over-estimate the number of adult birds that show a disturbance response to Hornsea Four during the operational maintenance phase, with some individuals expected to show no response at all. Further, it is unlikely that the population within the Hornsea Four array area and buffer is as high as the mean peak throughout the entire breeding bio-season, 1% of all guillemots displaced are highly unlikely to be subject to mortality and 100% of those adults potentially displaced are not likely to come from a single SPA (in this case the FFC SPA). Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.
- 11.4.3.33 There is, therefore, no potential for an AEol to the conservation objectives of the guillemot feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - razorbill

- 11.4.3.34 Razorbill has been screened into the assessment of the construction phase on the basis of its sensitivity to the activities which will take place within the array area.

- 11.4.3.35 The construction activities within the array area will be undertaken within only three to four blocks of 5 km² at any one time across the entire 600 km² array area and hence large parts of the array area will not be influenced by construction activities over the approximately 36 month period.
- 11.4.3.36 In order to assess the potential impact on razorbill a displacement effect distance was determined of the array and 0.5 km surrounding the array area. Within that displacement effect area the percentage of birds displaced from the array area was set at 89% and from within the 0.5 km buffer around the array area the percentage of birds displaced was set at 25%. Further details on the derivation of the buffer distance and the percentage displaced is given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.3.37 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied.
- 11.4.3.38 In the migration-free breeding bio-season the number of razorbills estimated to occur in the array area and a 1 km buffer is 421 individuals (all abundance data is drawn from Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of [Volume 2 Part B Chapter 5](#)) and the number predicted to be displaced is 329 individuals. Of these individuals, the predicted consequent mortality from being displaced is estimated at 3 individuals. The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Flamborough and Filey Coast SPA at 63 km and within the maximum foraging distance of 95 km. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (classified razorbill population of 21,140 individuals, with an annual background mortality of this number of birds being 2,114 individuals) then this prediction of 3 birds suffering displacement consequent mortality would represent a 0.2% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age.
- 11.4.3.39 Outside of the breeding season the number of razorbills estimated to occur in the array area and a 1 km buffer in the return migration bio-season is 833 individuals, in the post-breeding migration bio-season is 5,034 individuals and in the migration free winter bio-season is 494 individuals (all abundance data is drawn from [Table 2 of Annex 5.2 of Volume 2 Part B Chapter 5](#)). The number predicted to be displaced in the return migration bio-season is 487 individuals, in the post-breeding migration bio-season is 4,073 individuals and in the migration free winter bio-season is 379 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is

estimated at 49 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 21,140 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.6%. On that basis 2 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.

- 11.4.3.40 The impact of displacement from the array area and a buffer around it, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of 3 birds from the SPA in the breeding season and 2 birds from the SPA in the non-breeding season. The temporary increase in baseline mortality of 0.2% in the breeding season and 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.3.41 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - puffin

- 11.4.3.42 Puffin has been screened into the assessment of the construction phase on the basis of its sensitivity to the activities which will take place within the array area.
- 11.4.3.43 The construction activities within the array area will be undertaken within only three to four blocks of 5 km² at any one time across the entire 600 km² array area and hence large parts of the array area will not be influenced by construction activities over the approximately 36 month period.
- 11.4.3.44 In order to assess the potential impact on puffin a displacement effect distance was determined of the array only and no buffer surrounding the array area. Within that displacement effect area the percentage of birds displaced from the array area was set at 50%. Further details on the derivation of the absence of a buffer distance and the percentage displaced is given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.3.45 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population

contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied.

- 11.4.3.46 In the migration-free breeding bio-season the number of puffins estimated to occur in the array area is 77 individuals (all abundance data is drawn from Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of [Volume 2 Part B Chapter 5](#)) and the number predicted to be displaced is 39 individuals. Of these individuals, the predicted consequent mortality from being displaced is estimated at less than one individual. The Hornsea Four array area is within the mean maximum foraging distance of 105.4 km to the Flamborough and Filey Coast SPA at 63 km and within the maximum foraging distance of 200 km. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (classified puffin population of 980 individuals, with an annual background mortality of this number of birds being 74 individuals) then this prediction of less than one bird (0.4) suffering displacement consequent mortality would represent a 0.5% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age.
- 11.4.3.47 Outside of the breeding season the number of puffins estimated to occur in the array area in the return migration bio-season is 174 individuals, in the post-breeding migration bio-season is 313 individuals and in the migration free winter bio-season is 188 individuals (all abundance data is drawn from Table 2 of Annex 5.2 of [Volume 2 Part B Chapter 5](#)). The number predicted to be displaced in the return migration bio-season is 87 individuals, in the post-breeding migration bio-season is 157 individuals and in the migration free winter bio-season is 94 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 3.4 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 490 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.2%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.
- 11.4.3.48 The impact of displacement from the array area, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of less than one bird from the SPA in the breeding season and no birds from the SPA in the non-breeding season. The temporary increase in baseline mortality of 0.5% in the breeding season and none in the non-breeding season will not affect the achievement of the conservation

objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.3.49 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Coquet Island SPA - puffin

- 11.4.3.50 Contextual information on the assessment of displacement effects on puffin are provided above in the account on the Flamborough and Filey Coast SPA and for conciseness are not repeated here.
- 11.4.3.51 In the migration-free breeding bio-season the number of puffins estimated to occur in the array area is 77 individuals and the number predicted to be displaced is 39 individuals. Of these individuals, the predicted consequent mortality from being displaced is estimated at less than one individual. The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Coquet Island SPA at 167 km and within the maximum foraging distance of 200 km. On a worst-case basis (which is highly unlikely given the presence of breeding birds from the closer Flamborough and Filey Coast SPA) if all the birds predicted to be displaced were breeding adult birds from the Coquet Island SPA (classified puffin population of 31,686 individuals, with an annual background mortality of this number of birds being 2,408 individuals) then a prediction of less than one bird (0.4) suffering displacement consequent mortality would represent a 0.02% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age and not all would come from the Coquet Island SPA.
- 11.4.3.52 Outside of the breeding season the number of puffins estimated to occur in the array area in the return migration bio-season is 174 individuals, in the post-breeding migration bio-season is 313 individuals and in the migration free winter bio-season is 188 individuals. The number predicted to be displaced in the return migration bio-season is 87 individuals, in the post-breeding migration bio-season is 157 individuals and in the migration free winter bio-season is 94 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 3.4 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Coquet Island SPA has to be calculated. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 15,843 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 6.8%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

- 11.4.3.53 The impact of displacement from the array area, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of less than one bird from the SPA in the breeding season and no birds from the SPA in the non-breeding season. The temporary increase in baseline mortality of 0.02% in the breeding season and none in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.3.54 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Coquet Island SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Farne Islands SPA - guillemot

- 11.4.3.55 Contextual information on the assessment of displacement effects on guillemot are provided above in the account on the Flamborough and Filey Coast SPA and for conciseness are not repeated here.
- 11.4.3.56 This SPA at 198 km from Hornsea Four is outside both the mean maximum and maximum foraging range for this species when attending a breeding colony and as a result no breeding bio-season assessment is required.
- 11.4.3.57 Outside of the breeding season the number of guillemots estimated to occur in the array area and a 1 km buffer in the return migration bio-season is 6,935 individuals, in the post-breeding migration bio-season is 50,296 individuals and in the migration free winter bio-season is 11,883 individuals. The number predicted to be displaced in the return migration bio-season is 3,869 individuals, in the post-breeding migration bio-season is 27,645 individuals and in the migration free winter bio-season is 6,373 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 379 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 59,175 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.7%. On that basis 14 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.4% increase in baseline mortality.
- 11.4.3.58 The impact of displacement from the array area and a buffer around it, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of 14 birds from the SPA in the non-breeding season (breeding season effects have

been screened out due to distance). The temporary increase in baseline mortality of 0.4% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.3.59 There is, therefore, no potential for an AEol to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to disturbance and displacement effects in the construction phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Farne Islands SPA - puffin

- 11.4.3.60 Contextual information on the assessment of displacement effects on puffin are provided above in the account on the Flamborough and Filey Coast SPA and for conciseness are not repeated here.
- 11.4.3.61 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Farne Islands SPA at 225 km distant and also beyond the maximum foraging distance of 200 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.3.62 Outside of the breeding season the number of puffins estimated to occur in the array area in the return migration bio-season is 174 individuals, in the post-breeding migration bio-season is 313 individuals and in the migration free winter bio-season is 188 individuals. The number predicted to be displaced in the return migration bio-season is 87 individuals, in the post-breeding migration bio-season is 157 individuals and in the migration free winter bio-season is 94 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 3.4 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 38,399 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 16.6%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.01% increase in baseline mortality.
- 11.4.3.63 The impact of displacement from the array area, that is a temporary effect during the period of the construction of the array, is a prediction of consequent mortality of less than one bird from the SPA in the breeding season and one bird from the SPA in the non-breeding season. The temporary increase in baseline mortality of 0.01% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.3.64 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Farne Islands SPA in relation to disturbance and displacement effects in the

construction phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

11.4.4 Operation and Maintenance

Disturbance and Displacement

- 11.4.4.1 The potential for disturbance and displacement to result in an AEol relates to the following designated sites and the relevant features:
- Greater Wash SPA; red-throated diver and common scoter during the non-breeding bio-season;
 - Flamborough and Filey Coast SPA; gannet, guillemot, razorbill and puffin during the breeding and non-breeding bio-seasons;
 - Coquet Island SPA; puffin during the breeding and non-breeding bio-seasons;
 - Farne Islands SPA; guillemot and puffin during the non-breeding bio-season;
 - Forth Islands (UK) SPA; guillemot, razorbill and puffin during the non-breeding bio-season;
 - Outer Firth of Forth and St Andrew's Complex pSPA; guillemot, razorbill and puffin during the non-breeding bio-season;
 - Buchan Ness to Collieston Coast SPA; guillemot during the non-breeding bio-season;
 - Fowlsheugh SPA; guillemot and razorbill during the non-breeding bio-season;
 - Troup, Pennan and Lion's Heads SPA; guillemot and razorbill during the non-breeding bio-season;
 - East Caithness Cliffs SPA; guillemot and razorbill during the non-breeding bio-season;
 - North Caithness Cliffs SPA; guillemot, razorbill and puffin during the non-breeding bio-season;
- 11.4.4.2 The presence of WTCs has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where Hornsea Four is proposed to be developed. This in effect represents indirect habitat loss, which would potentially reduce the area available to those seabirds to forage, loaf and / or moult that currently occur within and around Hornsea Four and may be susceptible to displacement from such a development. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.
- 11.4.4.3 Seabird species vary in their response to the presence of operational infrastructure associated with offshore wind farms, such as WTCs and shipping activity related to maintenance activities. Offshore wind farms are a relatively new feature in the marine environment and as a result there is limited evidence as to the effects of disturbance and displacement by operational infrastructure in the long-term.
- 11.4.4.4 Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which has been widely applied in offshore wind farm HRAs. Furness and Wade (2012) developed a similar system with disturbance ratings for particular species that was applied alongside

scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity of each species to disturbance and displacement.

- 11.4.4.5 Natural England and JNCC issued a joint Interim Displacement Guidance Note (Natural England and JNCC 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to offshore wind farm developments. This has been superseded recently by a joint SNCB interim displacement advice note (SNCBs, 2017), which provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from offshore wind farms. These guidance notes have shaped the assessment provided for each site and their interest features presented below.
- 11.4.4.6 The detailed methods and results of the displacement assessment are presented in [Volume 2, Chapter 5, Annex 5.2: Offshore Ornithology Displacement Analysis](#).
- 11.4.4.7 The four species that were agreed, in principle, as the species of focus for displacement through the evidence plan process (at Technical Panel Meeting 3 on 10.04.19) were; gannet, guillemot, razorbill and puffin. For each of the four species an evidence led approach to quantifying the level of displacement led to the following rates of displacement being used at this stage to determine the overall number of birds within the areas defined as most appropriate for each species;
- 11.4.4.8 Gannets - Between 60-70% displacement during the non-migratory breeding bio-season within the array area and 0% displacement beyond the array area. During the non-breeding bio-seasons 100% displacement from within the array area and 0% displacement beyond the array area;
- Gannets show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004 and Furness & Wade, 2012). A study by Krijgsveld *et al.* (2011) using radar and visual observations to monitor the post-construction effects of the OWEZ established that 64% of gannets avoided entering the wind farm (macro-avoidance). The results of the post-consent monitoring surveys for Thanet OWF found that gannet densities reduced within the site in the third year, but the report did not quantify this (Royal HaskoningDHV, 2013). For the purpose of this assessment the level of displacement considered during the non-migratory breeding bio-season is between 60-70% within the Hornsea Four array area only, as there is no evidence that gannets are displaced beyond OWF site boundaries. A more recent study by APEM (APEM, 2014) provided evidence that during their migration most gannets would avoid flying into areas with operational WTGs (macro-avoidance), with the estimated macro avoidance being 95%. For the purpose of this assessment for Hornsea Four the level of displacement for the return migration and post-breeding migration bio-seasons considers a precautionary 100% displacement within the Hornsea Four array area only, as there is no evidence that gannets are displaced beyond OWF site boundaries.

11.4.4.9 Guillemots - Between 30-80% displacement during all bio-seasons within the array area and 30% displacement out to a 2 km buffer;

- Guillemots show a medium level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; and Bradbury *et al*, 2014). However, a number of detailed studies (including Krijgsveld *et al*, 2011, Walls *et al*, 2013 and Royal HaskoningDHV, 2013) monitoring the post-construction effects of offshore wind farms on guillemots suggest that the range may be between approximately 30-80% within array areas, whilst lower rates of approximately 30% may be apparent out to a maximum of 1-2 km. For the purpose of this assessment for Hornsea Four the level of displacement for each bio-season will be based on these values derived from an evaluation of the published literature.

11.4.4.10 Razorbills - Between 30-95% displacement during all bio-seasons within the array area and 25% displacement out to a 2 km buffer;

- Razorbills show a medium level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; and Bradbury *et al*, 2014). However, a number of detailed studies (including Krijgsveld *et al*, 2011, Walls *et al*, 2013 and Royal HaskoningDHV, 2013) monitoring the post-construction effects of offshore wind farms on razorbills suggest that the range may be between approximately 30-95% within array areas, whilst lower rates of approximately 25% may be apparent out to a maximum of 1-2 km. For the purpose of this assessment for Hornsea Four the level of displacement for each bio-season will be based on these values derived from an evaluation of the published literature.

11.4.4.11 Puffins - Between 50-70% displacement during all bio-seasons within the array area and 40% displacement out to a 2 km buffer;

- Puffins show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; and Bradbury *et al*, 2014). However, a number of detailed studies (including Krijgsveld *et al*, 2011 and Walls *et al*, 2013) monitoring the post-construction effects of offshore wind farms on puffins suggest that the range may be between approximately 50-70% within OWF arrays, whilst lower rates occur out to a maximum of 1-2 km. For the purpose of this assessment for Hornsea Four the level of displacement for each bio-season will be based on 40% within the array area and out to 2 km derived from an evaluation of the published literature, which provides a sufficiently precautionary approach to a species that is less sensitive than other auk species.

11.4.4.12 For the purpose of this assessment a precautionary approach has been taken to estimating the potential mortality rates for the seabird species, dependent upon the bio-season being assessed. This includes a level of mortality applied for this assessment of 1% during all non-breeding bio-seasons for each species. An even more precautionary set of mortality rates

have been applied when considering potential impacts during the non-migratory breeding bio-season of 1-2% for gannet and 2-10% for guillemot, razorbill and puffin.

11.4.4.13 The assessments provided within this RIAA include a number of assumptions that contribute to the predicted impacts and potential effects being considered overly precautionary, including;

- The population within each bio-season being the mean of the peaks from each survey year. This makes the assumption that such a high population is maintained for each of the months within the bio-season, whilst the actual abundance of each species is likely to be less than this for much of the bio-season;
- The maximum extent of displacement considered for each species is likely to be greater than actually experienced within the array area and buffer;
- The maximum of 10% mortality of birds displaced during the non-migratory breeding bio-season is highly unlikely, as the species assessed in this RIAA are not solely dependant upon the area within the Hornsea Four array area and buffer for all their foraging needs;
- That adult birds that are actively breeding will respond to displacement by putting themselves to further stress to the extent of dying rather than ceasing to breed (i.e. abandoning eggs or young) and surviving to breed in a later year;
- Not all adult birds within the Hornsea Four array area and / or buffer will be from Flamborough and Filey Coast SPA;
- Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the Hornsea Four array area throughout the year; and
- That the layers of precaution that are provided within the most precautionary assessments within this RIAA (under Scenario 2 of relevant assessments) are highly unlikely to occur.

Greater Wash SPA – red-throated diver

11.4.4.14 Red-throated diver has been screened in to the assessment of the O&M phase on the basis of its sensitivity to WTG and vessel presence.

11.4.4.15 Red-throated diver was not recorded within the Hornsea Four array area on any of the 24 months of aerial survey. Red-throated diver was recorded in a single month, with an abundance of 10 individuals within the 4 km buffer. This very low abundance is because of the depth of the water at this distance from the coast, with deep water not being favoured by red-throated diver for foraging. The array area and its 4 km buffer are outside the Greater Wash SPA.

11.4.4.16 If on a worst-case assessment basis, the assessment is made assuming 100% displacement of the maximum and only recorded abundance of 10 individuals then 10 red-throated diver would be displaced. With an assumed resultant mortality of 1% of displaced birds this would mean a maximum mortality of one tenth of a bird. The Greater Wash SPA population is 1,407 individuals. Background annual survival of red-throated diver has been estimated

as 0.84 (Robinson, 2017). On this basis 225 individuals out of the population of the Greater Wash SPA might be expected to die each year. The one individual identified above is a 0.04% increase in background mortality. This very small increase in mortality, that would be temporary given that it relates to the construction phase, would make no material difference to the long-term maintenance of the red-throated diver population of the Greater Wash SPA.

- 11.4.4.17 There is, therefore, no potential for an AEol to the conservation objectives of the red-throated diver feature of Greater Wash SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, red-throated diver will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Greater Wash SPA – common scoter

- 11.4.4.18 Common Scoter has been screened in to the assessment of the O&M phase on the basis of its sensitivity to WTG and vessel presence.
- 11.4.4.19 Common scoter was not recorded within the Hornsea Four array area or the 4 km buffer on any of the 24 months of aerial survey. This absence of common scoter is because of the depth of the water at this distance from the coast, with deep water not being favoured by common scoter for foraging. The array area and its 4 km buffer are outside the Greater Wash SPA.
- 11.4.4.20 There is, therefore, no potential for an AEol to the conservation objectives of the common scoter feature of Greater Wash SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, common scoter will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - gannet

- 11.4.4.21 Gannet has been screened in to the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTGs. In order to assess the potential impact on gannet a displacement effect distance was determined of the array area and no buffer. The percentage of birds displaced and consequential mortality was determined, with both factors varying by bio-season. During the non-migratory breeding bio-season the percentage of birds displaced was set at 60-70% and the consequential mortality was set at 1-2%. During the non-breeding bio-seasons the percentage of birds displaced was set at 100% and the consequential mortality was set at 1%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Volume 2, Chapter 5, Section 5.11](#).

11.4.4.22 In the assessment below:

- [Scenario 1 Breeding Season](#) is assessed where displacement from the array area is 60% and consequential mortality is 1%; and
- [Scenario 2 Breeding Season](#) is assessed where displacement from the array area is 70% and consequential mortality is 2%.

11.4.4.23 In the non-breeding seasons **there is only a single scenario**, since the percentage of birds displaced was set at 100% and the consequential mortality was set at 1%.

11.4.4.24 All abundance data in the assessment below is drawn from [Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of the Hornsea Four EIA PEIR](#)). The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. However, for the purpose of this assessment the use of a generic population age ratio of gannets has been used of 0.6, which is based on the assumptions described in more detail within [Table 5.16 of Volume 2, Chapter 5, Section 5.11](#) (i.e. 60% of gannets are determined to be adults) across all months of the year, from which all are attributed to the Flamborough and Filey Coast SPA during the breeding season. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.

11.4.4.25 The Hornsea Four array area is within the mean maximum foraging distance of 229 km to the Flamborough and Filey Coast SPA at 63 km distant and also within the maximum foraging distance of 590 km (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding season and the non-breeding season. In the migration-free breeding bio-season the number of gannets estimated to occur in the array area is 1,048 individuals. Outside of the breeding season the number of gannets estimated to occur in the array area in the return migration bio-season is 449 individuals and in the post-breeding migration bio-season is 639 individuals (there is no migration free winter bio-season).

Scenario 1: Breeding Season

11.4.4.26 The number predicted to be displaced from the array area is 629 individuals and the predicted consequent mortality from being displaced is estimated at 6 individuals. On the basis of 60% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals (breeding adults), with an annual background mortality of this number of adult birds being

1,491 individuals) then the predicted consequent mortality from being displaced is estimated at 3.6 breeding adults. Using this prediction of 3.6 breeding adults suffering displacement consequent mortality would represent a 0.24% increase in baseline mortality. As the population of gannets has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 13,392 apparently occupied nests (or 26,784 breeding adults). On this basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 2,357 breeding individuals) then this prediction of 3.6 adult birds suffering displacement consequent mortality would represent a 0.15% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.27 The number predicted to be displaced from the array area is 734 individuals and the predicted consequent mortality from being displaced is estimated at 15 individuals. On the basis of 60% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals (breeding adults), with an annual background mortality of this number of adult birds being 1,491 individuals) then the predicted consequent mortality from being displaced is estimated at nine breeding adults. Using this prediction of nine breeding adults suffering displacement consequent mortality would represent a 0.6% increase in baseline mortality. When assessing against the current breeding adult population from the Flamborough and Filey Coast SPA (26,784 breeding individuals with an annual background mortality of 2,357 breeding individuals) then the prediction of nine birds suffering displacement consequent mortality would represent a 0.38% increase in baseline mortality.

Non-breeding season

- 11.4.4.28 The number predicted to be displaced from the array area in the return migration bio-season is 449 individuals and in the post-breeding migration bio-season is 639 individuals (there is no migration free winter bio-season). For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 11 individuals or 6.6 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,928 individuals. All of the breeding birds from the SPA for part of the UK North Sea non-breeding season migratory populations, which is a population of 16,938 individuals (from the SPA citation) or 22,122 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Accordingly the proportion of adult birds in the UK North Sea that can be attributed to the SPA is 4.84% when considering the apportionment of populations within the UK North Sea population according to Furness (2015). On that basis under one breeding individual (0.3 individuals) may be subject to displacement consequent mortality that can

be attributed to the SPA. This represents only a slight increase of under 0.014% in baseline mortality to the Flamborough and Filey Coast SPA.

- 11.4.4.29 The impact of displacement from the array area that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from 3.6 to nine adult birds from the SPA in the breeding season and 0.3 adult birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.15% to 0.38% in the breeding season and 0.01% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.30 There is, therefore, no potential for an AEoI to the conservation objectives of the gannet feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, gannet will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - guillemot

- 11.4.4.31 Guillemot has been screened in to the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTCs and the activities which will take place within the array area during maintenance.
- 11.4.4.32 In order to assess the potential impact on guillemot a displacement effect distance was determined of the array area and within a buffer out to 2 km. Within that displacement effect area the percentage of birds displaced from the array area was set at 30-80% during all bio-seasons and within the 2 km buffer a displacement of 30%. The level of mortality consequential on displacement was set at 1% during all non-breeding bio-seasons. During the non-migratory breeding bio-season the level of consequential mortality was set at 2-10%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.4.33 In the assessment below:
- *Scenario 1* is assessed where displacement from the array area is 30%, displacement from the buffer is 30%, consequential mortality is 1% in the non-breeding season and consequential mortality is 2% in the non-migratory breeding bio-season; and
 - *Scenario 2* is assessed where displacement from the array area is 80%, displacement from the buffer is 30%, consequential mortality is 1% in the non-breeding season and consequential mortality is 10% in the non-migratory breeding bio-season.
- 11.4.4.34 All abundance data in the assessment below is drawn from [Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis](#) of the Hornsea Four EIA PEIR [Volume 2, Chapter 5](#),

Section 5.11). The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. However, for the purpose of this assessment the use of a generic population age ratio of guillemots has been used of 0.552, which is based on the assumptions described in more detail within Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5 (i.e. 55.2% of guillemots are determined to be adults) across all months of the year, from which all are attributed to the Flamborough and Filey Coast SPA during the breeding season. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.

- 11.4.4.35 The Hornsea Four array area is within the mean maximum foraging distance of 84.2 km to the Flamborough and Filey Coast SPA at 63 km distant and also within the maximum foraging distance of 135 km (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding and non-breeding season. In the migration free breeding bio-season the number of guillemot estimated to occur in the array area and 2 km buffer is 9,804 individuals. In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals.

Scenario 1: Breeding Season

- 11.4.4.36 The number predicted to be displaced from the array area and buffer in the breeding season is 2,941 individuals and the predicted consequent mortality from being displaced is estimated at 59 individuals. On the basis of 55.2% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified guillemot population of 83,214 individuals (breeding adults), with an annual background mortality of this number of adult birds being 5,077 individuals) then the predicted consequent mortality from being displaced is estimated at 32.6 breeding adults. Using this prediction of 32.6 breeding adults suffering displacement consequent mortality would represent a 0.64% increase in baseline mortality. As the population of guillemots has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 121,754 breeding individuals. On this basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 7,427 individuals) then this prediction of 32.6 adult birds suffering displacement consequent mortality would represent a 0.44% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.37 The number predicted to be displaced from the array area and buffer in the breeding season is 6,162 individuals and the predicted consequent mortality from being displaced is estimated at 616 individuals. On the basis of 55.2% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified guillemot population of 83,214 individuals (breeding adults), with an annual background mortality of this number of adult birds being 5,077 individuals) then the predicted consequent mortality from being displaced is estimated at 340 breeding adults. As noted above, the assessment method applied for guillemot in Scenario 2 during the breeding season is considered likely to over-estimate the number of adult birds that show a disturbance response to Hornsea Four during the operational maintenance phase, with some individuals expected to show no response at all. Further, it is unlikely that the population within the Hornsea Four array area and buffer is as high as the mean peak throughout the entire breeding bio-season, 10% of all guillemots displaced are highly unlikely to be subject to mortality and 100% of those adults potentially displaced are not likely to come from a single SPA (in this case the FFC SPA). Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Scenario 1: Non-Breeding Season

- 11.4.4.38 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals or 137 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 74,893 individuals (from the SPA citation) or 79,282 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Therefore, there would be 71,354 breeding individuals remaining in the UK North Sea (based on 90% Furness (2015) population). Accordingly, the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.4% when considering the apportionment of populations within the UK North Sea population according to Furness (2015). On that basis six breeding individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.12% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.39 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals or 286 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 74,893 individuals (from the SPA citation) or 79,282 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Therefore, there would be 71,354 breeding individuals remaining in the UK North Sea (based on 90% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.4%. On that basis 12 breeding individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.26% increase in baseline mortality.
- 11.4.4.40 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from 32.6 to 340 adult birds from the SPA in the breeding season and six to 12 adult birds in the non-breeding season. The increase in baseline mortality ranging from 0.43% to 4.58% in the breeding season and 0.12% to 0.26% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.41 With the exception of Scenario 2 for the breeding season, which is considered to be highly unlikely due to assumptions that are overly precautionary. There is, therefore, no potential for an AEol to the conservation objectives of the guillemot feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement. However, as noted above, given the potential for an over estimate to be made of any potential effects during the breeding bio-season further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Flamborough and Filey Coast SPA - razorbill

- 11.4.4.42 Razorbill has been screened in to the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTCs and the activities which will take place within the array area during maintenance.
- 11.4.4.43 In order to assess the potential impact on razorbill a displacement effect distance was determined of the array area and within a buffer out to 2 km. Within that displacement effect area the percentage of birds displaced from the array area was set at 30-95% during all bio-seasons and within the 2 km buffer a displacement of 25%. The level of mortality consequential on displacement was set at 1% during all non-breeding bio-seasons. During the non-migratory breeding bio-season the level of consequential mortality was set at 2-10%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.4.44 In the assessment below:
- [Scenario 1](#) is assessed where displacement from the array area is 30%, displacement from the buffer is 25%, consequential mortality is 1% in the non-breeding season and consequential mortality is 2% in the non-migratory breeding bio-season; and
 - [Scenario 2](#) is assessed where displacement from the array area is 95%, displacement from the buffer is 25%, consequential mortality is 1% in the non-breeding season and consequential mortality is 10% in the non-migratory breeding bio-season.
- 11.4.4.45 All abundance data in the assessment below is drawn from [Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of the Hornsea Four EIA PEIR Volume 2, Chapter 5](#). The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. However, for the purpose of this assessment the use of a generic population age ratio of guillemots has been used of 0.613, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (i.e. 61.3% of razorbills are determined to be adults) across all months of the year, from which all are attributed to the Flamborough and Filey Coast SPA during the breeding season. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.

- 11.4.4.46 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Flamborough and Filey Coast SPA at 63 km distant and within the maximum foraging distance of 95 km (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding and non-breeding season.
- 11.4.4.47 In the migration free breeding bio-season the number of razorbill estimated to occur in the array area and 2 km buffer is 508 individuals. In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Breeding Season

- 11.4.4.48 The number predicted to be displaced from the array area and buffer in the breeding season is 145 individuals and the predicted consequent mortality from being displaced is estimated at three individuals. On the basis of 61.3% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified razorbill population of 21,140 individuals (breeding adults), with an annual background mortality of this number of adult birds being 2,220 individuals) then the predicted consequent mortality from being displaced is estimated at 1.8 breeding adults. Using this prediction of 1.8 breeding adults suffering displacement consequent mortality would represent a 0.08% increase in baseline mortality. As the population of razorbills has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 40,506 breeding individuals. On this basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of birds being 4,253 individuals) then this prediction of 1.8 adult birds suffering displacement consequent mortality would represent a 0.04% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.49 The number predicted to be displaced from the array area and buffer in the breeding season is 380 individuals and the predicted consequent mortality from being displaced is estimated at 38 individuals. On the basis of 61.3% of all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified razorbill population of 21,140 individuals (breeding adults), with an annual background mortality of this number of adult birds being 2,220 individuals) then the predicted consequent mortality from being displaced is estimated at 23.3 breeding adults. As the population of razorbills has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 40,506 breeding individuals. On this basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of birds being 4,253 individuals) then this prediction of 23.3 adult birds suffering displacement consequent mortality would represent a 0.55% increase in baseline mortality.

Scenario 1: Non-Breeding Season

- 11.4.4.50 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals or 12 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 21,140 individuals (from the SPA citation) or 20,002 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 20,002 breeding individuals remaining in the UK North Sea (based on 100% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.38% when considering the apportionment of populations within the UK North Sea population according to Furness (2015). On that basis, less than one breeding individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.51 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals or 34 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 21,140 individuals (from the SPA citation) or 20,002 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 20,002 breeding individuals remaining in the UK North Sea (based on 100% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.38%. On that basis 1.2 breeding individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.06% increase in baseline mortality.
- 11.4.4.52 The impact of displacement from the array area and buffer, that would occur throughout the operational life of Hornsea Four, is a prediction of consequent mortality ranging from 1.8 to 23.3 adult birds from the SPA in the breeding season and under one to 1.2 adult birds

in the non-breeding season. The increase in baseline mortality ranging from 0.04% to 0.55% in the breeding season and 0.02% to 0.06% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.53 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - puffin

- 11.4.4.54 Puffin has been screened in to the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTGs and the activities which will take place within the array area during maintenance.
- 11.4.4.55 In order to assess the potential impact on puffin a displacement effect distance was determined of the array area and within a buffer out to 2 km. Within that displacement effect area the percentage of birds displaced from the array area was set at 50-70% during all bio-seasons and within the 2 km buffer a displacement of 40%. The level of mortality consequential on displacement was set at 1% during all non-breeding bio-seasons. During the non-migratory breeding bio-season the level of consequential mortality was set at 2-10%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Hornsea Four EIA PEIR Volume 2, Chapter 5, Section 5.11](#).
- 11.4.4.56 In the assessment below:
- [Scenario 1](#) is assessed where displacement from the array area is 50%, displacement from the buffer is 40%, consequential mortality is 1% in the non-breeding season and consequential mortality is 2% in the non-migratory breeding bio-season; and
 - [Scenario 2](#) is assessed where displacement from the array area is 70%, displacement from the buffer is 40%, consequential mortality is 1% in the non-breeding season and consequential mortality is 10% in the non-migratory breeding bio-season.
- 11.4.4.57 All abundance data in the assessment below is drawn from [Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of the Hornsea Four EIA PEIR Volume 2, Chapter 5](#). The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. However, for the purpose of

this assessment the use of a generic population age ratio of puffins has been used of 0.577, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (ie 57.7% of puffins are determined to be adults) across all months of the year, from which all are attributed to the Flamborough and Filey Coast SPA during the breeding season. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.

- 11.4.4.58 The Hornsea Four array area is within the mean maximum foraging distance of 105.4 km to the Flamborough and Filey Coast SPA at 63 km distant and also within the maximum foraging distance of 200 km (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding and non-breeding season. In the migration free breeding bio-season the number of puffin estimated to occur in the array area and 2 km buffer is 102 individuals. In the non-breeding season the number of puffin estimated to occur in the array area and 2 km buffer in the return migration bio-season is 237 individuals, in the post-breeding migration bio-season is 422 individuals and in the migration free winter bio-season is 285 individuals

Scenario 1: Breeding Season

- 11.4.4.59 The number predicted to be displaced from the array area and buffer in the breeding season is 49 individuals and the predicted consequent mortality from being displaced is estimated at one individual. On the basis of 57.7% all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified puffin population of 980 individuals (breeding adults), with an annual background mortality of this number of adult birds being 92 individuals) then the predicted consequent mortality from being displaced is estimated at under one breeding adult. Using this prediction of under one breeding adult suffering displacement consequent mortality would represent a 0.63% increase in baseline mortality. As the population of puffins has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 5,758 breeding individuals. On this basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of birds being 541 individuals) then this prediction of under one adult bird suffering displacement consequent mortality would represent a 0.11% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.60 The number predicted to be displaced from the array area and buffer in the breeding season is 64 individuals and the predicted consequent mortality from being displaced is estimated at six individuals. On the basis of 57.7% all the birds predicted to be displaced being breeding adult birds from the Flamborough and Filey Coast SPA (classified puffin population

of 980 individuals (breeding adults), with an annual background mortality of this number of adult birds being 92 individuals) then the predicted consequent mortality from being displaced is estimated at 3.5 breeding adults. As the population of puffins has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 5,758 breeding individuals. On this basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of birds being 541 individuals) then this prediction of 3.5 adult birds suffering displacement consequent mortality would represent a 0.64% increase in baseline mortality.

Scenario 1: Non-Breeding Season

- 11.4.4.61 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals or 1.7 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 980 individuals (from the SPA citation) or 1,916 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 958 individuals remaining in the UK North Sea (based on 50% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.41% when considering the apportionment of populations within the UK North Sea population according to Furness (2015). On that basis well under one breeding individual (under 0.01 of an individual) would suffer displacement consequent mortality that can be attributed to the SPA. This represents no material increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.62 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals or 3.5 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of

the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 980 individuals (from the SPA citation) or 1,916 individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 958 individuals remaining in the UK North Sea (based on 50% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.41% when considering the apportionment of populations within the UK North Sea population according to Furness (2015). On that basis well under one breeding individual (0.01 of an individual) would suffer displacement consequent mortality that can be attributed to the SPA. This represents no material increase in baseline mortality.

- 11.4.4.63 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from under one to 3.5 adult birds from the SPA in the breeding season and 1.7 to 3.5 in the non-breeding season. The increase in baseline mortality ranging from 0.10% to 0.62% in the breeding season and no material increase in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.64 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Coquet Island SPA - puffin

- 11.4.4.65 Puffin has been screened into the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTGs and the activities which will take place within the array area during maintenance.
- 11.4.4.66 In order to assess the potential impact on puffin a displacement effect distance was determined of the array area and within a buffer out to 2 km. Within that displacement effect area the percentage of birds displaced from the array area was set at 50-70% during all bio-seasons and within the 2 km buffer a displacement of 40%. The level of mortality consequential on displacement was set at 1% during all non-breeding bio-seasons. During the non-migratory breeding bio-season the level of consequential mortality was set at 2-10%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.4.67 In the assessment below:
- [Scenario 1](#) is assessed where displacement from the array area is 50%, displacement from the buffer is 40%, consequential mortality is 1% in the non-breeding season and consequential mortality is 2% in the non-migratory breeding bio-season; and

- **Scenario 2** is assessed where displacement from the array area is 70%, displacement from the buffer is 40%, consequential mortality is 1% in the non-breeding season and consequential mortality is 10% in the non-migratory breeding bio-season.

- 11.4.4.68 All abundance data in the assessment below is drawn from Table 2 of Annex 5.2 Offshore Ornithology Displacement Analysis of the PEIR)
- 11.4.4.69 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied.
- 11.4.4.70 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Coquet Island SPA at 167 km distant but it is within the maximum foraging distance of 200 km. Accordingly this species is assessed for both the breeding and non-breeding season.
- 11.4.4.71 In the migration-free breeding bio-season the number of puffins estimated to occur in the array area and the 2 km buffer combined is 102 individuals.
- 11.4.4.72 Outside of the breeding season the number of puffins estimated to occur in the array area and 2 km buffer in the return migration bio-season is 237 individuals, in the post-breeding migration bio-season is 422 individuals and in the migration free winter bio-season is 285 individuals

Scenario 1: Breeding Season

- 11.4.4.73 The number predicted to be displaced from the array area and buffer is 49 individuals and the predicted consequent mortality from being displaced is estimated at one individual. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Coquet Island SPA (classified puffin population of 31,686 individuals, with an annual background mortality of this number of birds being 2,408 individuals) then this prediction of one bird suffering displacement consequent mortality would represent a 0.04% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age and ad not all birds would come from this SPA.

Scenario 1: Non-Breeding Season

- 11.4.4.74 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Coquet Island SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 15,843 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 6.8%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.75 The number predicted to be displaced from the array area and buffer is 102 individuals and the predicted consequent mortality from being displaced is estimated at six individuals. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Coquet Island SPA (classified puffin population of 31,686 individuals, with an annual background mortality of this number of birds being 2,408 individuals) then this prediction of six birds suffering displacement consequent mortality would represent a 0.3% increase in baseline mortality. That is a worst-case prediction since not all birds occurring in the array area and buffer would be of adult breeding age and not all birds would come from this SPA.

Scenario 2: Non-Breeding Season

- 11.4.4.76 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Coquet Island SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 15,843 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 6.8%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

- 11.4.4.77 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from one to six birds from the SPA in the breeding season and no birds from the SPA in the non-breeding season. The increase in baseline mortality of none in the breeding season and none in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.78 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Coquet Island SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Farne Islands SPA - guillemot

- 11.4.4.79 Guillemot has been screened in to the assessment of the O&M phase on the basis of its sensitivity to the presence of the WTGs and the activities which will take place within the array area during maintenance.
- 11.4.4.80 In order to assess the potential impact on guillemot a displacement effect distance was determined of the array area and within a buffer out to 2 km. Within that displacement effect area the percentage of birds displaced from the array area was set at 30-80% during all bio-seasons and within the 2 km buffer a displacement of 30%. The level of mortality consequential on displacement was set at 1% during all non-breeding bio-seasons. During the non-migratory breeding bio-season the level of consequential mortality was set at 2-10%. Further details on the derivation of the extent of displacement and of the consequential mortality are given in [Volume 2, Chapter 5, Section 5.11](#).
- 11.4.4.81 In the assessment below:
- [Scenario 1](#) is assessed where displacement from the array area is 30%, displacement from the buffer is 30%, consequential mortality is 1% in the non-breeding season and consequential mortality is 2% in the non-migratory breeding bio-season; and
 - [Scenario 2](#) is assessed where displacement from the array area is 80%, displacement from the buffer is 30%, consequential mortality is 1% in the non-breeding season and consequential mortality is 10% in the non-migratory breeding bio-season.
- 11.4.4.82 All abundance data in the assessment below is drawn from Table 2 of [Annex 5.2 Offshore Ornithology Displacement Analysis of the PEIR](#).
- 11.4.4.83 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult

birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance and the mean maximum foraging distance from Thaxter *et al* (2012) determine which breeding colonies the birds may be apportioned to and in the non-breeding season the information on populations contained in Furness (2015) is applied.

- 11.4.4.84 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Farne Islands SPA at 198 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.85 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.86 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 59,175 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.7%. On that basis nine individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.3% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.87 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data

from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 59,175 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.7%. On that basis 19 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.5% increase in baseline mortality.

- 11.4.4.88 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from 9 to 19 birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.3% to 0.5% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.89 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Farne Islands SPA - puffin

- 11.4.4.90 Contextual information on, and the approach to, the assessment of displacement effects on puffin are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.91 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Farne Islands SPA at 225 km distant and also beyond the maximum foraging distance of 200 km. Accordingly this species is only assessed for the non-breeding season.

Scenario 1: Non-Breeding Season

- 11.4.4.92 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 38,399 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is

16.6%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.01% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.93 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 38,399 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 16.6%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.94 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from one to six birds from the SPA in the breeding season and one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.02% to 0.11% in the breeding season and ranging from 0.01% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.95 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Farne Islands SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Forth Islands (UK) SPA - guillemot

- 11.4.4.96 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.97 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Forth Islands SPA at 272 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.98 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding

migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.99 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 28,800 individuals. Accordingly, the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.8%. On that basis four individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.3% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.100 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 28,800 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.8%. On that basis nine individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.5% increase in baseline mortality.
- 11.4.4.101 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from four to nine birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.3% to 0.5% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.102 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Forth Islands SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Forth Islands (UK) SPA - razorbill

- 11.4.4.103 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.104 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Forth Islands SPA at 272 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.105 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.106 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 2,800 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.5%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.107 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From

that consequent mortality estimate the number which can be attributed to the Forth islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 2,800 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.5%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

- 11.4.4.108 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality of no birds from the SPA in the non-breeding season. The increase in baseline mortality that is none in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.109 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Forth Islands SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Forth Islands (UK) SPA - puffin

- 11.4.4.110 Contextual information on, and the approach to, the assessment of displacement effects on puffin are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.111 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Forth islands SPA at 272 km distant and also beyond the maximum foraging distance of 200 km. Accordingly this species is assessed only for the non-breeding season.

Scenario 1: Non-Breeding Season

- 11.4.4.112 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 14,000 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is

6%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.113 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 14,000 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 6%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.
- 11.4.4.114 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality of no birds from the SPA in the non-breeding season. The increase in baseline mortality ranging that is none in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.115 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Forth Islands SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Outer Firth of Forth and St Andrew's Complex pSPA - guillemot

- 11.4.4.116 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.117 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Outer Firth of Forth and St Andrew's Complex pSPA at 241 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.118 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding

migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.119 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 25,311 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.6%. On that basis four individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.3% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.120 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 25,311 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.6%. On that basis eight individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.5% increase in baseline mortality.
- 11.4.4.121 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from four to eight birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.3% to 0.5% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.122 There is, therefore, no potential for an AEol to the conservation objectives of the guillemot feature of Outer Firth of Forth and St Andrew's Complex pSPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Outer Firth of Forth and St Andrew's Complex pSPA - razorbill

- 11.4.4.123 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.124 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Outer Firth of Forth and St Andrew's Complex pSPA at 241 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.125 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.126 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 5,481 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.9%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.127 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from

being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 5,481 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.9%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.

- 11.4.4.128 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from no to one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from none to 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.129 There is, therefore, no potential for an AEoI to the conservation objectives of the razorbill feature of Outer Firth of Forth and St Andrew's Complex pSPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Outer Firth of Forth and St Andrew's Complex pSPA - puffin

- 11.4.4.130 Contextual information on, and the approach to, the assessment of displacement effects on puffin are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.131 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the Outer Firth of Forth and St Andrew's Complex pSPA at 241 km distant and also beyond the maximum foraging distance of 200 km. Accordingly this species is assessed only for the non-breeding season.

Scenario 1: Non-Breeding Season

- 11.4.4.132 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the

population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 30,543 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 13.2%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.133 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 30,543 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 13.2%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.134 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from none to one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from none to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.135 There is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Outer Firth of Forth and St Andrew's Complex pSPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Fowlsheugh SPA - guillemot

- 11.4.4.136 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.

- 11.4.4.137 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Fowlsheugh SPA at 341 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.138 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.139 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Eighty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 45,160 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 2.8%. On that basis seven individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.2% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.140 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Eighty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 45,160 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 2.8%. On that basis 15 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.5% increase in baseline mortality.

- 11.4.4.141 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from seven to 15 birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.2% to 0.5% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.142 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Fowlsheugh SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Fowlsheugh SPA - razorbill

- 11.4.4.143 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.144 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Fowlsheugh SPA at 341 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.145 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.146 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 5,800 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.0%. On that basis no individual that suffers displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.147 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 5,800 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.0%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.
- 11.4.4.148 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from none to one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from no to 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.149 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Fowlsheugh SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Buchan Ness to Collieston Coast SPA - guillemot

- 11.4.4.150 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.151 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Buchan Ness to Collieston Coast SPA at 381 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.152 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.153 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Buchan Ness to Collieston Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Eighty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 13,824 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.9%. On that basis two individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.2% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.154 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Buchan Ness to Collieston Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Eighty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 13,824 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.9%. On that basis four individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.5% increase in baseline mortality.
- 11.4.4.155 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from two to four birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.2% to 0.5% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.156 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Buchan Ness to Collieston Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change,

guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Troup, Pennan and Lion's Heads SPA - guillemot

- 11.4.4.157 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.158 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the Troup, Pennan and Lion's Heads SPA at 423 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.159 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.160 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 62,440 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.9%. On that basis 10 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.2% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.161 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to

the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 62,440 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.9%. On that basis 20 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.4% increase in baseline mortality.

- 11.4.4.162 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from 10 to 20x birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.2% to 0.4% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.163 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Troup, Pennan and Lion's Heads SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Troup, Pennan and Lion's Heads SPA - razorbill

- 11.4.4.164 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.165 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the Troup, Pennan and Lion's Heads SPA at 423 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.166 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.167 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From

that consequent mortality estimate the number which can be attributed to the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 9,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.6%. On that basis no individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.168 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 9,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.6%. On that basis, one individual that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.
- 11.4.4.169 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from none to one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from none to 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.170 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Troup, Pennan and Lion's Heads SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

East Caithness Cliffs SPA - guillemot

- 11.4.4.171 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.

- 11.4.4.172 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the East Caithness Cliffs SPA at 500 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.173 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.174 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 149,380 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 9.2%. On that basis 23 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.2% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.175 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 149,380 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 9.2%. On that basis 48 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.4% increase in baseline mortality.

- 11.4.4.176 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from 23 to 48 birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.2% to 0.4% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.177 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of East Caithness Cliffs SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

East Caithness Cliffs SPA - razorbill

- 11.4.4.178 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.179 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the East Caithness Cliffs SPA at 500 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.180 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.181 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 31,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 5.3%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.03% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.182 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 31,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 5.3%. On that basis three individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.
- 11.4.4.183 The impact of displacement from the array area and buffer that would occur throughout the operational life of Hornsea Four is a prediction of consequent mortality ranging from one to three birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.03% to 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.184 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of East Caithness Cliffs SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

North Caithness Cliffs SPA - guillemot

- 11.4.4.185 Contextual information on, and the approach to, the assessment of displacement effects on guillemot are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.186 The Hornsea Four array area is beyond the mean maximum foraging distance of 84.2 km to the North Caithness Cliffs SPA at 534 km distant and also beyond the maximum foraging distance of 135 km. Accordingly this species is only assessed for non-breeding season.
- 11.4.4.187 In the non-breeding season the number of guillemot estimated to occur in the array area and 2 km buffer in the return migration bio-season is 8,401 individuals, in the post-breeding migration bio-season is 58,920 individuals and in the migration free winter bio-season is 15,409 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.188 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 2,520 individuals, in the post-breeding migration bio-season is 17,676 individuals and in the migration free winter bio-season is 4,623 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 248 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 53,620 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.3%. On that basis eight individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.2% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.189 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 5,329 individuals, in the post-breeding migration bio-season is 37,507 individuals and in the migration free winter bio-season is 9,099 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 519 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 1,617,306 individuals. Seventy percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 53,620 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 3.3%. On that basis 17 individuals that suffer displacement consequent mortality can be attributed to the SPA. This represents a 0.4% increase in baseline mortality.
- 11.4.4.190 The impact of displacement from the array area and buffer, that would occur throughout the operational life of Hornsea Four, is a prediction of consequent mortality ranging from eight to 17 birds from the SPA in the non-breeding season. The increase in baseline mortality ranging from 0.2% to 0.4% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.191 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of North Caithness Cliffs SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change,

guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

North Caithness Cliffs SPA - razorbill

- 11.4.4.192 Contextual information on, and the approach to, the assessment of displacement effects on razorbill are provided above in the account on the Farne Islands SPA and for conciseness are not repeated here.
- 11.4.4.193 The Hornsea Four array area is beyond the mean maximum foraging distance of 48.5 km to the North Caithness Cliffs SPA at 534 km distant and also beyond the maximum foraging distance of 95 km. Accordingly this species is only assessed for the non-breeding season.
- 11.4.4.194 In the non-breeding season the number of razorbill estimated to occur in the array area and 2 km buffer in the return migration bio-season is 1,029 individuals, in the post-breeding migration bio-season is 5,428 individuals and in the migration free winter bio-season is 606 individuals

Scenario 1: Non-Breeding Season

- 11.4.4.195 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 309 individuals, in the post-breeding migration bio-season is 1,628 individuals and in the migration free winter bio-season is 172 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 20 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 591,874 individuals. Ninety five percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 7,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.3%. On that basis no individual that suffers displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.196 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 608 individuals, in the post-breeding migration bio-season is 4,508 individuals and in the migration free winter bio-season is 442 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at 56 individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the

breeding season is 591,874 individuals. Ninety five percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 7,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.3%. On that basis one individual that suffers displacement consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.

- 11.4.4.197 The impact of displacement from the array area and buffer, that would occur throughout the operational life of Hornsea Four, is a prediction of consequent mortality ranging from none to one bird from the SPA in the non-breeding season. The increase in baseline mortality ranging from none to 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.198 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of North Caithness Cliffs SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

North Caithness Cliffs SPA - puffin

- 11.4.4.199 Contextual information on, and the approach to, the assessment of displacement effects on puffin are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.200 The Hornsea Four array area is beyond the mean maximum foraging distance of 105.4 km to the North Caithness Cliffs SPA at 534 km distant and also beyond the maximum foraging distance of 200 km. Accordingly this species is assessed only for the non-breeding season.

Scenario 1: Non-Breeding Season

- 11.4.4.201 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 71 individuals, in the post-breeding migration bio-season is 127 individuals and in the migration free winter bio-season is 95 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at three individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifteen percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 624 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is

0.3%. On that basis no individual that suffers displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.202 The number predicted to be displaced from the array area and buffer in the return migration bio-season is 147 individuals, in the post-breeding migration bio-season is 263 individuals and in the migration free winter bio-season is 170 individuals. For the total number of individuals across the non-breeding bio-seasons the predicted consequent mortality from being displaced is estimated at six individuals. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 231,957 individuals. Fifteen percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 624 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.3%. On that basis no individual that suffers displacement consequent mortality can be attributed to the SPA. This represents no increase in baseline mortality.
- 11.4.4.203 The impact of displacement from the array area and buffer, that would occur throughout the operational life of Hornsea Four, is a prediction of consequent mortality ranging of no birds from the SPA in the non-breeding season. The increase in baseline mortality that is none in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.204 There is, therefore, no potential for an AEoI to the conservation objectives of the puffin feature of North Caithness Cliffs SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Collision Risk

- 11.4.4.205 The potential for mortality resultant from collision risk to result in an AEoI relates to the following designated sites and the relevant features:
- Greater Wash SPA; little gull during the non-breeding bio-season (migratory);
 - Flamborough and Filey Coast SPA; gannet and kittiwake during the breeding and non-breeding bio-seasons;
 - Humber Estuary SPA; waterbirds during the non-breeding bio-season (migratory);
 - Humber Estuary Ramsar; waterbirds during the non-breeding bio-season (migratory);
 - Hornsea Mere SPA; Gadwall during the non-breeding bio-season (migratory);
 - Northumbria Coast SPA; Arctic tern and little tern during the non-breeding bio-season (migratory);

- Coquet Island SPA; kittiwake, common tern, Arctic tern, roseate tern and Sandwich tern during the non-breeding bio-season (migratory);
- Farne Islands SPA; kittiwake during the non-breeding bio-season and common tern, Arctic tern, roseate tern and Sandwich tern during the non-breeding bio-season (migratory);
- Forth Islands (UK) SPA; gannet during the non-breeding bio-season and common tern, Arctic tern, roseate tern and Sandwich tern during the non-breeding bio-season (migratory);
- Outer Firth of Forth and St Andrew's Complex pSPA; gannet during the non-breeding bio-season;
- Fowlsheugh SPA; kittiwake during the non-breeding bio-season;
- Buchan Ness to Collieston Coast SPA; kittiwake during the non-breeding bio-season;
- Troup, Pennan and Lion's Heads SPA; kittiwake during the non-breeding bio-season;
- East Caithness Cliffs SPA; kittiwake and great black-backed gull during the non-breeding bio-season;
- North Caithness Cliffs SPA; kittiwake during the non-breeding bio-season;

11.4.4.206 There is a potential collision risk to birds which fly through the Hornsea Four array area whilst foraging for food, commuting between breeding sites and foraging areas, or when on migration. The risk to birds arises from colliding with the WTC rotors and associated infrastructure resulting in injury or fatality.

11.4.4.207 Collision Risk Modelling (CRM) has been used to estimate the potential risk to birds associated with the proposed development. The approach to CRM is presented in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#) of the PEIR and provides the methods, data input and results of the CRM. Modelling has been carried out using the Stochastic Collision Risk Model (sCRM), developed by Marine Scotland Science (McGregor, 2018) applied through the 'Shinyapp' interface using the density of flying birds measured by 24 months of aerial survey to produce predictions of mortality for particular species across set time periods (biological seasons) and on an annual basis. This most recent version of the Band (2012) CRM has been designed specifically to address uncertainty in developments and other key input parameters as progressed initially by Masden (2015) for application to the assessment of collision risk to seabirds from offshore wind farm developments.

11.4.4.208 The sCRM accounts for a number of different species-specific behavioural aspects of birds being assessed, including the height at which birds fly, their ability to avoid moving or static structures and how active they are diurnally and nocturnally, respectively. Details of these considerations are also provided [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#) of the PEIR.

11.4.4.209 The collision predictions included in this assessment present the results that have been output from a specific set of model runs. This is the sCRM from Band Option 1, which incorporates site-specific bird flight height data and from Band Option 2, which incorporates data information drawn from Johnson *et al* (2014) that was an update to the BTO SOSS-02 report (Cook *et al*, 2012) that sets out a generic percentage at potential

collision height (PCH) for each seabird species determined from survey data collected from waters in multiple locations in UK waters. The updated flight height data from Johnston *et al*, (2014) included a revised published spreadsheet used to determine the 'generic' percentage of flights at PCH for each species based on the proposed project's wind turbine parameters.

- 11.4.4.210 The avoidance rate for use in the gannet sCRM follows the guidance from Cook *et al*, (2014) and the SNCBs review of avoidance rates to be applied in the Band models (JNCC *et al*, 2014 in response to Cook *et al*, 2014). The avoidance rates from Bowgen & Cook (2018) were applied in the sCRM for kittiwake, lesser black-backed gull, herring gull and great black-backed gull. Bowgen & Cook (2018) presented upper and lower confidence intervals around the avoidance rates and as such a calculation assuming a normal distribution was undertaken to estimate a standard deviation for input to the sCRM.
- 11.4.4.211 It should be recognised that the collision estimates provided by the modelling are expected to be an overestimate of annual mortality rates that is they are a precautionary assessment. This is the result of a number of factors, including:
- Modelling using the MDS turbine array with respect to collision risk (a development of 180 WTGs);
 - Assuming a continuous flux of birds through the Hornsea Four array area at a rate resulting from the mean peak density for the relevant bio-season being applied on all days in that bio-season;
 - Assuming that flying birds encounter all WTGs within the Hornsea Four array area and the level of activity remains constant regardless of losses; and
 - Assuming each bird crosses through the longest possible trajectory in a straight line through the Hornsea Four array area.
- 11.4.4.212 It should be noted that Hornsea Four has taken significant measures to reduce the potential impacts from collision to seabirds through;
- A commitment to providing a significantly reduced risk from collision to seabirds through incorporating a raised minimum swept height commitment (the distance between sea level and the lower turbine tip or air gap) to 35 m above the Lowest Astronomical Tide (LAT); and
 - A major reduction in the size of the proposed developable area, from that presented at Scoping to that forming the assessments at PEIR, informed by an analysis of risk to seabirds.

Greater Wash SPA - little gull

- 11.4.4.213 Little gull has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the proximity of the Greater Wash SPA and its flight behaviour that places it at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.

- 11.4.4.214 The 24 months of aerial survey recorded little gull flying across the array area on two occasions. In October 2016 with an estimated abundance of 20 birds and in July 2017 with an estimated abundance of 40 birds (further details are given in at [Volume 5, Annex 5.1: Offshore and Intertidal Ornithology Baseline Characterisation Report](#)). Cook et al (2012) determined that 5.5% of little gull flights would be at PCH.
- 11.4.4.215 Quantitative CRM based on the site-specific aerial survey data is not justified for this species that passes through the area on migration, but reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate of between one and ten individuals may be subject to mortality per annum due to movements during migration being single passes on each occasion.
- 11.4.4.216 Given the limited risk of collision to this species of between one and ten individuals and the SPA population of 1,255 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.217 There is, therefore, no potential for an AEol to the conservation objectives of the little gull feature of the Greater Wash SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, little gull will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Flamborough and Filey Coast SPA – gannet

- 11.4.4.218 Gannet has been screened in to the assessment of the O&M phase based on the density of birds in flight in the array area and its flight behaviour that places it at risk of collision with the turning blades of the WTCs. It has been screened in for both the breeding and the non-breeding bio-seasons.
- 11.4.4.219 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four changes through the seasons with birds breeding at sites remote from the north-east coast of England either passing through the area on spring and autumn migration or arriving in the area to spend the winter. For the purpose of this assessment the use of a generic population age ratio of gannets has been used of 0.6, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (ie 60% of gannets are determined to be adults) across all months of the year.
- 11.4.4.220 During the breeding season, when birds are limited in the distance and number of days over which they can forage by the need to return regularly to the nest site, it can be expected that the area in and around Hornsea Four will contain a high proportion of adult birds that can be attributed to the SPA. The evidence gained from tracking adult gannets during the

breeding season across a series of colonies is that gannets show 'space partitioning', that is adjacent colonies do not have overlapping foraging areas in the breeding season (Wakefield *et al*, 2013). The consequence of this is that 100% of the adult birds in and around the Hornsea Four array area and those predicted to suffer from collision related mortality are attributable to the Flamborough and Filey Coast SPA.

- 11.4.4.221 Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season, for which this species is assessed, the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.
- 11.4.4.222 In the assessment below two scenarios are considered to assess the significance of collision risk, based on the application of two variants of the Band CRM run within the stochastic CRM software (further detail of the modelling is given in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#)). The two scenarios are:
- [Scenario 1](#) in which the Band CRM Option 1 is applied that makes use of site-specific bird flight height data; and
 - [Scenario 2](#) in which the Band CRM Option 2 is applied that makes use of flight height distribution determined from a large number of surveys carried out in UK waters.
- 11.4.4.223 All mortality predictions are drawn from the relevant species sections of [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

[Scenario 1: Breeding Season](#)

- 11.4.4.224 The predicted collision resultant mortality from the operation of Hornsea Four in the breeding season is 33.8 individuals or 20.3 adult birds. For the reason identified above, 100% of those individuals that are of breeding age can be expected to have come from the Flamborough and Filey Coast SPA. The breeding adult population of the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals (breeding adults)) has an annual background mortality of 1,491 adult birds and as a result the prediction of 20.3 breeding adults suffering collision consequent mortality would represent a 1.36% increase in baseline mortality. However, as the population of gannets has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 13,392 apparently occupied nests (or 26,784 breeding adults). On this basis if all the adult birds predicted to suffer from collision mortality were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 2,357 breeding individuals) then this prediction of 20.3 adult birds suffering collision consequent mortality would represent a 0.86% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.225 The predicted collision resultant mortality from the operation of Hornsea Four in the breeding season is 34.3 individuals or 20.6 adult birds. For the reason identified above, 100% of those individuals that are of breeding age can be expected to have come from the Flamborough and Filey Coast SPA. The breeding adult population of the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals (breeding adults)) has an annual background mortality of 1,491 individuals and as a result the prediction of 20.6 breeding adults suffering collision consequent mortality would represent a 1.36% increase in baseline mortality. However, as the population of gannets has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 13,392 apparently occupied nests (or 26,784 breeding adults). On this basis if all the adult birds predicted to suffer from collision mortality were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 2,357 breeding individuals) then this prediction of 20.6 adult birds suffering collision consequent mortality would represent a 0.87% increase in baseline mortality.

Scenario 1: Non-Breeding Season

- 11.4.4.226 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.1 individuals and in the post-breeding migration bio-season is 9.3 individuals (there is no migration free winter bio-season). In total 16.5 birds are predicted to suffer collision related mortality during the non-breeding season or 9.9 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 16,938 individuals (from the SPA citation) or 22,122 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Accordingly the proportion of adult birds in the UK North Sea that can be attributed to the SPA is 4.84%. On that basis less than one breeding adult (0.48 individuals) that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.227 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.3 individuals and in the post-breeding migration bio-season is 9.5 (there is no migration free winter bio-season). In total 16.9 birds are predicted to suffer collision related mortality during the non-breeding season or 10.1 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated.

Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 16,938 individuals from the SPA citation) or 22,122 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Accordingly the proportion of adult birds in the UK North Sea that can be attributed to the SPA is 4.84%. On that basis less than one breeding adult (0.49 individuals) that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.

- 11.4.4.228 The impact of collision related mortality, that would occur throughout the operational life of Hornsea Four, is for mortality ranging from 20.3 to 20.6 adult birds from the SPA in the breeding season and less than 0.5 adult birds in the non-breeding season. The increase in baseline mortality of 0.86 to 0.87% in the breeding season and an increase of 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.229 There is, therefore, no potential for an AEoI to the conservation objectives of the gannet feature of the Flamborough and Filey Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, gannet will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Flamborough and Filey Coast SPA – kittiwake

- 11.4.4.230 Kittiwake has been screened in to the assessment of the O&M phase based on the density of birds in flight in the array area and its flight behaviour that places it at risk of collision with the turning blades of the WTGs. It has been screened in for both the breeding and the non-breeding bio-seasons.
- 11.4.4.231 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four changes through the seasons with birds breeding at sites remote from the north-east coast of England either passing through the area on spring and autumn migration or arriving in the area to spend the winter. For the purpose of this assessment the use of a generic population age ratio of kittiwakes has been used of 0.53, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (i.e. 53% of kittiwakes are determined to be adults) across all months of the year.
- 11.4.4.232 During the breeding season, when birds are limited in the distance and number of days over which they can forage by the need to return regularly to the nest site, it can be expected that the area in and around Hornsea Four will contain a high proportion of adult birds that can be attributed to the SPA. The emerging evidence that is coming from studies tracking adult kittiwakes during the breeding season at colonies on the north-east coast of England (Robertson *et al* 2014, Aitken *et al* 2017; Wakefield *et al*, 2017), including at the

Flamborough and Filey Coast SPA, is that foraging kittiwakes from major colonies do not have overlapping foraging areas in the breeding season and that those in and around the Hornsea Four array area originate from the Flamborough and Filey Coast SPA and smaller colonies along the coast to the north within the mean maximum and maximum foraging range. The consequence of this is that 100% of the adult birds in and around the Hornsea Four array area and those predicted to suffer from collision related mortality are, on a worst-case basis, attributed to the Flamborough and Filey Coast SPA.

- 11.4.4.233 Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season, for which this species is assessed, the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.
- 11.4.4.234 In the assessment below two scenarios are considered to assess the significance of collision risk, based on the application of two variants of the Band CRM run within the stochastic CRM software (further detail of the modelling is given in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#)). The two scenarios are:
- *Scenario 1* in which the Band CRM Option 1 is applied that makes use of site-specific bird flight height data; and
 - *Scenario 2* in which the Band CRM Option 2 is applied that makes use of flight height distribution determined from a large number of surveys carried out in UK waters.
- 11.4.4.235 All mortality predictions are drawn from the relevant species sections of [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

Scenario 1: Breeding Season

- 11.4.4.236 The predicted collision resultant mortality from the operation of Hornsea Four in the breeding season is 3.0 individuals or 1.6 adult birds. For the reason identified above, 100% of those individuals that are of breeding age can be expected to have come from the Flamborough and Filey Coast SPA. The breeding adult population of the Flamborough and Filey Coast SPA (classified kittiwake population of 89,040 individuals (breeding adults)) has an annual background mortality of 7,836 individuals and as a result the prediction of 1.6 breeding adults suffering collision consequent mortality would represent a 0.02% increase in baseline mortality. However, as the population of kittiwakes has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 51,535 apparently occupied nests (or 103,070 breeding adults). On this basis if all the adult birds predicted to suffer from collision mortality were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds

being 9,070 breeding individuals) then this prediction of 1.6 adult birds suffering collision consequent mortality would represent a 0.02% increase in baseline mortality.

Scenario 2: Breeding Season

- 11.4.4.237 The predicted collision resultant mortality from the operation of Hornsea Four in the breeding season is 24.1 individuals or 12.8 adult birds. For the reason identified above, 100% of those individuals that are of breeding age can be expected to have come from the Flamborough and Filey Coast SPA. The breeding adult population of the Flamborough and Filey Coast SPA (classified kittiwake population of 89,040 individuals (breeding adults)) has an annual background mortality of 7,836 individuals and as a result the prediction of 12.8 breeding adults suffering collision consequent mortality would represent a 0.14% increase in baseline mortality. However, as the population of kittiwakes has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 55,535 apparently occupied nests (or 103,070 breeding adults). On this basis if all the adult birds predicted to suffer from collision mortality were breeding adult birds from the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 9,070 breeding individuals) then this prediction of 12.8 adult birds suffering collision consequent mortality would represent a 0.14% increase in baseline mortality.

Scenario 1: Non-Breeding Season

- 11.4.4.238 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season or 2.1 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 53,424 individuals (from the SPA citation) or 45,140 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Accordingly the proportion of adult birds in the UK North Sea that can be attributed to the SPA is 5.44%. On that basis less than one breeding adult (0.13 of an individual) that suffers collision consequent mortality can be attributed to the SPA. This represents a 0.001% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.239 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season is 20.2 individuals (there is no migration free winter bio-season). In total 31.9 birds

are predicted to suffer collision related mortality during the non-breeding season or 19.1 breeding adults. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 53,424 individuals (from the SPA citation) or 45,140 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). Accordingly the proportion of adult birds in the UK North Sea that can be attributed to the SPA is 5.44%. On that basis one adult bird that suffers collision consequent mortality can be attributed to the SPA. This represents a 0.01% increase in baseline mortality.

- 11.4.4.240 The impact of collision related mortality, that would occur throughout the operational life of Hornsea Four, is for mortality ranging from 1.6 to 12.8 adult birds from the SPA in the breeding season and 2.3 to 19.1 adult birds in the non-breeding season. The increase in baseline mortality of 0.02% to 0.14% in the breeding season and an increase of 0.001% to 0.01% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.241 There is, therefore, no potential for an AEoI to the conservation objectives of the kittiwake feature of the Flamborough and Filey Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Humber Estuary SPA – waterbirds

- 11.4.4.242 The migrant waterbird populations of the Humber Estuary SPA have been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of their twice yearly migratory flights across the North Sea (to spend the non-breeding season at the site) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. The water bird species concerned are shelduck, avocet, golden plover, black-tailed godwit, bar-tailed godwit, ruff, dunlin, redshank and knot. They have been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.243 The 24 months of aerial survey did not record any of these migratory waterbirds. Quantitative CRM based on the site-specific aerial surveys is not justified for these species that pass through the area on migration. Reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate, where available, for the species is for annual mortality (a single pass in the spring and autumn) as follows: Shelduck of between two and four individuals; avocet of one individual; golden plover of

between 16 and 23 individuals; [black-tailed godwit predictions are unavailable]; bar-tailed godwit of two individuals; [ruff predictions are unavailable]; dunlin of between 10 and 27 individuals; redshank of 22 individuals; and knot of between one and 12 individuals.

- 11.4.4.244 Given the limited risk of collision to these waterbird species of between one and 27 individuals and the SPA non-breeding populations consisting predominantly of large numbers of birds (the non-breeding assemblage population is 153,934 individuals), the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.245 There is, therefore, no potential for an AEoI to the conservation objectives of the non-breeding waterbird features of Humber Estuary SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, the non-breeding waterbirds will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Humber Estuary Ramsar – waterbirds

- 11.4.4.246 The migrant waterbird populations of the Humber Estuary Ramsar site have been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of their twice yearly migratory flights across the North Sea (to spend the non-breeding season at the site) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. The water bird species concerned are shelduck, golden plover, black-tailed godwit, bar-tailed godwit, dunlin, redshank and knot. They have been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.247 The 24 months of aerial survey did not record any of these migratory waterbirds. Quantitative CRM based on the site-specific aerial surveys is not justified for these species that pass through the area on migration. Reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate, where available, for the species is for annual mortality (a single pass in the spring and autumn) as follows: Shelduck of between two and four individuals; golden plover of between 16 and 23 individuals; [black-tailed godwit predictions are unavailable]; bar-tailed godwit of two individuals; dunlin of between 10 and 27 individuals; redshank of 22 individuals; and knot of between one and 12 individuals.
- 11.4.4.248 Given the limited risk of collision to these waterbird species of between one and 27 individuals and the Ramsar site non-breeding populations consisting predominantly of large numbers of birds (the non-breeding assemblage population is 153,934 individuals), the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the Ramsar site and as a result will not have an adverse effect on the integrity of the Ramsar site.

- 11.4.4.249 There is, therefore, no potential for an AEol to the conservation objectives of the non-breeding waterbird features of Humber Estuary Ramsar site in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, the non-breeding waterbirds will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Hornsea Mere SPA – Gadwall

- 11.4.4.250 Gadwall has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights across the North Sea (to spend the non-breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.251 The 24 months of aerial survey did not record this species. Quantitative CRM based on the site-specific aerial surveys is not justified for this species that pass through the area on migration. Reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate for the species is for annual mortality (a single pass in the spring and autumn) of one individual.
- 11.4.4.252 Given the limited risk of collision to this species of one individual and the SPA population of 210 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.253 There is, therefore, no potential for an AEol to the conservation objectives of the gadwall feature of Hornsea Mere SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, gadwall will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Northumbria Coast SPA - Arctic tern

- 11.4.4.254 Arctic tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.255 Arctic tern was screened in on a precautionary basis for collision risk despite it only being recorded on limited occasions in flight during the completion of the programme of 24 months of aerial digital surveys of Hornsea Four. Despite only being recorded from site-specific surveys the species may pass across the Hornsea Four array area during the non-

breeding bio-season on migration and be placed at risk of collision. The 24 months of aerial survey recorded 'commic' terns (common and / or Arctic terns) on three occasions, with abundance estimates in flight in the array area of 1,422 in August 2017, 30 in September 2017, 80 in May 2018, 20 in August 2018 and 170 in September 2018. Cook *et al* (2012) determined that 2.8% of Arctic tern flights would be at PCH. Quantitative CRM is not justified for this species, but reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate of between zero and 50 individuals may be subject to mortality per annum due to movements during migration being single passes on each occasion.

- 11.4.4.256 Given the limited risk of collision to this species of between zero to 50 individuals, the SPA population of 3,098 individuals, the wider population migrating through the Southern North Sea of 163,930 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 1.9%, then risk of mortality of SPA birds is in the order of zero to one individual.
- 11.4.4.257 Given the limited risk of collision to this species from the SPA of between zero and one individuals and the SPA population of 3,098 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.258 There is, therefore, no potential for an AEol to the conservation objectives of the Arctic tern feature of Northumbria Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Arctic tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Northumbria Coast SPA - little tern

- 11.4.4.259 Little tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.260 Little tern was screened in on a precautionary basis for collision risk despite it not being recorded during the completion of the programme of 24 months of aerial digital surveys of Hornsea Four. Despite not being recorded from site-specific surveys the species may pass across the Hornsea Four array area during the non-breeding bio-season on migration and be placed at risk of collision. Little terns on passage to a breeding colony off the Northumberland coast would only pass the region of Hornsea Four once in spring and once in autumn and as a result the risk of collision is extremely low. Cook *et al* (2012) did not provide an estimated PCH for little tern, but it is assumed to be similar to, or less than,

common and Arctic terns (therefore likely to be in or below the range of 12.7% to 2.8% PCH). Due to the low population in the North Sea and limited connectivity to the Hornsea Four array area quantitative CRM is not justified for this species.

- 11.4.4.261 Given that no birds were recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.262 There is, therefore, no potential for an AEol to the conservation objectives of the little tern feature of Northumbria Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, little tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Coquet Island SPA – kittiwake

- 11.4.4.263 Kittiwake has been screened in to the assessment of the O&M phase based on the density of birds in flight in the array area and its flight behaviour that places it at risk of collision with the turning blades of the WTGs. It has been screened in for the non-breeding bio-seasons.
- 11.4.4.264 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season, for which this species is assessed, the information on populations contained in Furness (2015) is applied.
- 11.4.4.265 In the assessment below two scenarios are considered to assess the significance of collision risk, based on the application of two variants of the Band CRM run within the stochastic CRM software (further detail of the modelling is given in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#)). The two scenarios are:
- [Scenario 1](#) in which the Band CRM Option 1 is applied that makes use of site-specific bird flight height data; and
 - [Scenario 2](#) in which the Band CRM Option 2 is applied that makes use of flight height distribution determined from a large number of surveys carried out in UK waters.

- 11.4.4.266 All mortality predictions are drawn from the relevant species sections of [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

Scenario 1: Non-Breeding Season

- 11.4.4.267 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Coquet Island SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 256 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.03%. On that basis 0.001 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.268 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Coquet Island SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 256 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.03%. On that basis 0.01 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.269 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.001 to 0.01 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.270 There is, therefore, no potential for an AEoI to the conservation objectives of the kittiwake feature of Coquet Island SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained

as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Coquet Island SPA - common tern

- 11.4.4.271 Common tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.272 Common tern was screened in on a precautionary basis for collision risk despite it only being recorded on limited occasions in flight during the completion of the programme of 24 months of aerial digital surveys of Hornsea Four. Despite only being recorded from site-specific surveys the species may pass across the Hornsea Four array area during the non-breeding bio-season on migration and be placed at risk of collision. The 24 months of aerial survey recorded 'commic' terns (common and / or Arctic terns) on three occasions, with abundance estimates in flight in the array area of 1,422 in August 2017, 30 in September 2017, 80 in May 2018, 20 in August 2018 and 170 in September 2018. Cook *et al* (2012) determined that 12.7% of common tern flights would be at PCH. Quantitative CRM is not justified for this species, but reference to migrant apportionment undertaken for impact assessments for offshore wind farms within the Southern North Sea (see [Section 5.11.2](#) of the [Volume 2, Chapter 5: Offshore and Intertidal Ornithology](#) of the PEIR) suggest that for a project of the scale of Hornsea Four a precautionary estimate of between zero and nine individuals may be subject to mortality per annum due to movements during migration being single passes on each occasion.
- 11.4.4.273 Given the limited risk of collision to this species of between zero to nine individuals, the SPA population of 2,378 individuals, the wider population migrating through the Southern North Sea of 144,911 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 1.6%, then risk of mortality of SPA birds is in the order of zero to 0.1 individuals.
- 11.4.4.274 Given the limited risk of collision to this species from the SPA of between zero and 0.1 individuals and the SPA population of 2,378 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.275 There is, therefore, no potential for an AEol to the conservation objectives of the common tern feature of Coquet Island SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, common tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Coquet Island SPA - Arctic tern

- 11.4.4.276 Arctic tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.277 Contextual information on, the approach to and the predictions for collision mortality of Arctic tern on migration through the North Sea in the non-breeding season are provided above in the account on the Northumbria Coast SPA and for conciseness are not repeated here.
- 11.4.4.278 Given the limited risk of collision to this species of between zero to 50 individuals, the SPA population of 2,460 individuals, the wider population migrating through the Southern North Sea of 163,930 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 1.5%, then risk of mortality of SPA birds is in the order of zero to 0.8 individuals.
- 11.4.4.279 Given the limited risk of collision to this species from the SPA of between zero and 0.8 individuals and the SPA population of 2,460 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.280 There is, therefore, no potential for an AEol to the conservation objectives of the Arctic tern feature of Coquet Island SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Arctic tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Coquet Island SPA - roseate tern

- 11.4.4.281 Roseate tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.282 Roseate tern was screened in on a precautionary basis for collision risk despite it not being recorded during the completion of the programme of 24 months of aerial digital surveys of Hornsea Four. Despite not being recorded from site-specific surveys the species may pass across the Hornsea Four array area during the non-breeding bio-season on migration and be placed at risk of collision. Roseate terns on passage to a breeding colony off the Northumberland coast would only pass the region of Hornsea Four once in spring and once in autumn and as a result the risks of collision are extremely low. Cook *et al* (2012) did not

provide an estimated PCH for roseate terns, but it is assumed to be similar to common and Arctic terns (therefore likely to be between 12.7 and 2.8 % PCH). Due to the very low population in the North Sea and limited connectivity to the Hornsea Four array area quantitative CRM is not justified for this species.

- 11.4.4.283 Given that no birds were recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.284 There is, therefore, no potential for an AEol to the conservation objectives of the roseate tern feature of Coquet Island SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, roseate tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Coquet Island SPA - Sandwich tern

- 11.4.4.285 Sandwich tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.286 Sandwich tern was screened in on a precautionary basis for collision risk despite it only being recorded once in flight during the completion of the programme of 24 months of aerial digital surveys of Hornsea Four. Despite only being recorded once from site-specific surveys the species may pass across the Hornsea Four array area during the non-breeding bio-season on migration and be placed at risk of collision. The 24 months of aerial survey recorded Sandwich tern on only one occasion, three birds in the array area, in August 2018, but on the water surface and not in flight and as a result the risks of collision is extremely low. Cook *et al* (2012) determined that 3.6% of Sandwich tern flights would be at PCH. Quantitative CRM is not justified for this species.
- 11.4.4.287 Given the very low numbers recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.288 There is, therefore, no potential for an AEol to the conservation objectives of the Sandwich tern feature of Coquet Island SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Sandwich tern will be

maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Farne Islands SPA – kittiwake

- 11.4.4.289 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.290 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 4,945 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.6%. On that basis 0.02 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.291 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Farne Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 4,945 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.6%. On that basis 0.19 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.292 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.02 to 0.19 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding

season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.293 There is, therefore, no potential for an AEol to the conservation objectives of the kittiwake feature of Farne Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Farne Islands SPA - common tern

- 11.4.4.294 Common tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.295 Contextual information on, the approach to and the predictions for collision mortality of common tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.296 Given the limited risk of collision to this species of between zero to nine individuals, the SPA population of 366 individuals, the wider population migrating through the Southern North Sea of 144,911 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 0.3%, then risk of mortality of SPA birds is in the order of zero to 0.03 individuals.
- 11.4.4.297 Given the limited risk of collision to this species from the SPA of between zero and 0.03 individuals and the SPA population of 366 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.298 There is, therefore, no potential for an AEol to the conservation objectives of the common tern feature of Farne Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, common tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Farne Islands SPA - Arctic tern

- 11.4.4.299 Arctic tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and

at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.

- 11.4.4.300 Contextual information on, the approach to and the predictions for collision mortality of Arctic tern on migration through the North Sea in the non-breeding season are provided above in the account on the Northumbria Coast SPA and for conciseness are not repeated here.
- 11.4.4.301 Given the limited risk of collision to this species of between zero to 50 individuals, the SPA population of 8,012 individuals, the wider population migrating through the Southern North Sea of 163,930 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 4.9%, then risk of mortality of SPA birds is in the order of zero to 2.5 individuals.
- 11.4.4.302 Given the limited risk of collision to this species from the SPA of between zero and 2.5 individuals and the SPA population of 8,012 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.303 There is, therefore, no potential for an AEol to the conservation objectives of the Arctic tern feature of Farne Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Arctic tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Farne Islands SPA - Roseate tern

- 11.4.4.304 Roseate tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.305 Contextual information on, the approach to and the predictions for collision mortality of roseate tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.306 Given that no birds were recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.307 There is, therefore, no potential for an AEol to the conservation objectives of the roseate tern feature of Farne Islands SPA in relation to collision mortality effects in the O&M phase

from Hornsea Four alone and therefore, subject to natural change, roseate tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Farne Islands SPA - Sandwich tern

- 11.4.4.308 Sandwich tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.309 Contextual information on, the approach to and the predictions for collision mortality of Sandwich tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.310 Given the very low numbers recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.311 There is, therefore, no potential for an AEoI to the conservation objectives of the Sandwich tern feature of Farne Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Sandwich tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Forth Islands (UK) SPA – Gannet

- 11.4.4.312 Gannet has been screened in to the assessment of the O&M phase based on the density of birds in flight in the array area and its flight behaviour that places it at risk of collision with the turning blades of the WTCs. It has been screened in for the non-breeding bio-seasons.
- 11.4.4.313 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season, for which this species is assessed, the information on populations contained in Furness (2015) is applied.
- 11.4.4.314 In the assessment below two scenarios are considered to assess the significance of collision risk, based on the application of two variants of the Band CRM run within the stochastic

CRM software (further detail of the modelling is given in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#)). The two scenarios are:

- [Scenario 1](#) in which the Band CRM Option 1 is applied that makes use of site-specific bird flight height data; and
- [Scenario 2](#) in which the Band CRM Option 2 is applied that makes use of flight height distribution determined from a large number of surveys carried out in UK waters.

11.4.4.315 All mortality predictions are drawn from the relevant species sections of [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

[Scenario 1: Non-Breeding Season](#)

11.4.4.316 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.1 individuals and in the post-breeding migration bio-season the figure is 9.3 individuals (there is no migration free winter bio-season). In total 16.5 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 43,200 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 9.5%. On that basis 1.55 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.04% increase in baseline mortality.

[Scenario 2: Non-Breeding Season](#)

11.4.4.317 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.3 individuals and in the post-breeding migration bio-season the figure is 9.5 (there is no migration free winter bio-season). In total 16.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Forth Islands SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 43,200 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 9.5%. On that basis 1.59 individuals that suffer collision consequent

mortality can be attributed to the SPA. This represents a 0.05% increase in baseline mortality.

- 11.4.4.318 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 1.55 to 1.59 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.04% to 0.05% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.319 There is, therefore, no potential for an AEol to the conservation objectives of the gannet feature of Forth Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, gannet will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Forth Islands (UK) SPA - Common tern

- 11.4.4.320 Common tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.321 Contextual information on, the approach to and the predictions for collision mortality of common tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.322 Given the limited risk of collision to this species of between zero to nine individuals, the SPA population of 668 individuals, the wider population migrating through the Southern North Sea of 144,911 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 0.5%, then risk of mortality of SPA birds is in the order of zero to 0.05 individuals.
- 11.4.4.323 Given the limited risk of collision to this species from the SPA of between zero and 0.05 individuals and the SPA population of 668 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.324 There is, therefore, no potential for an AEol to the conservation objectives of the common tern feature of Forth Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, common tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Forth Islands (UK) SPA - Arctic tern

- 11.4.4.325 Arctic tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.326 Contextual information on, the approach to and the predictions for collision mortality of Arctic tern on migration through the North Sea in the non-breeding season are provided above in the account on the Northumbria Coast SPA and for conciseness are not repeated here.
- 11.4.4.327 Given the limited risk of collision to this species of between zero to 50 individuals, the SPA population of 1,080 individuals, the wider population migrating through the Southern North Sea of 163,930 (Furness, 2015) and the proportion of SPA birds that might be within the number predicted to be subject to collision resultant mortality being 0.7%, then risk of mortality of SPA birds is in the order of zero to 0.3 individuals.
- 11.4.4.328 Given the limited risk of collision to this species from the SPA of between zero and 0.3 individuals and the SPA population of 1,080 individuals, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.329 There is, therefore, no potential for an AEol to the conservation objectives of the Arctic tern feature of Forth islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Arctic tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Forth Islands (UK) SPA - Roseate tern

- 11.4.4.330 Roseate tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTCs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.331 Contextual information on, the approach to and the predictions for collision mortality of roseate tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.332 Given that no birds were recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a

prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.333 There is, therefore, no potential for an AEoI to the conservation objectives of the roseate tern feature of Forth Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, roseate tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Forth Islands (UK) SPA - Sandwich tern

- 11.4.4.334 Sandwich tern has been screened in to the assessment of the O&M phase on a precautionary basis as a result of the potential for a proportion of its twice yearly migratory flights through the North Sea (to spend the breeding season at the SPA) to pass across the array area and at a height that places them at risk of collision with the turning blades of the WTGs. It has been screened in for the migratory non-breeding bio-seasons.
- 11.4.4.335 Contextual information on, the approach to and the predictions for collision mortality of Sandwich tern on migration through the North Sea in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.
- 11.4.4.336 Given the very low numbers recorded, the very low number of potential passes across the Hornsea Four array area and the low flight height, the risk of collision is extremely low. Consequently, the risk of an adverse effect on the population is extremely low and hence a prediction that Hornsea Four will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.337 There is, therefore, no potential for an AEoI to the conservation objectives of the Sandwich tern feature of Forth Islands SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, Sandwich tern will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Outer Firth of Forth and St Andrew's Complex pSPA – Gannet

- 11.4.4.338 Contextual information on, and the approach to, the assessment of collision effects on gannet in the non-breeding season are provided above in the account on the Forth Islands SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.339 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.1 individuals and in the post-breeding migration bio-season the figure is 9.3 individuals (there is no migration free winter bio-season). In total 16.5 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding

colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 10,945 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 2.4%. On that basis 0.39 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.04% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.340 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 7.3 individuals and in the post-breeding migration bio-season the figure is 9.5 (there is no migration free winter bio-season). In total 16.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Outer Firth of Forth and St Andrew's Complex pSPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 456,298 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 10,945 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 2.4%. On that basis 0.40 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.05% increase in baseline mortality.
- 11.4.4.341 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.39 to 0.40 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.04% to 0.05% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.342 There is, therefore, no potential for an AEol to the conservation objectives of the gannet feature of Outer Firth of Forth and St Andrew's Complex pSPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, gannet will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Fowlsheugh SPA – Kittiwake

- 11.4.4.343 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.344 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 43,980 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.05%. On that basis 0.2 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.345 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Fowlsheugh SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 43,980 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 0.05%. On that basis 1.7 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.346 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.2 to 1.7 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.347 There is, therefore, no potential for an AEol to the conservation objectives of the kittiwake feature of Fowlsheugh SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Buchan Ness to Collieston Coast SPA – Kittiwake

- 11.4.4.348 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.349 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Buchan Ness to Collieston Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 36,542 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.4%. On that basis 0.2 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.350 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Buchan Ness to Collieston Coast SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 36,542 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.4%. On that basis 1.4 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.351 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.2 to 1.4 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.352 There is, therefore, no potential for an AEoI to the conservation objectives of the kittiwake feature of Buchan Ness to Collieston Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Troup, Pennan and Lion's Heads SPA – Kittiwake

- 11.4.4.353 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.354 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 37,920 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.6%. On that basis 0.18 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.355 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the Troup, Pennan and Lion's Heads SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 37,920 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.6%. On that basis 1.5 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.

11.4.4.356 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.18 to 1.5 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

11.4.4.357 There is, therefore, no potential for an AEol to the conservation objectives of the kittiwake feature of Troup, Pennan and Lion's Heads SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

East Caithness Cliffs SPA – Kittiwake

11.4.4.358 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

11.4.4.359 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 39,000 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.7%. On that basis 0.2 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

11.4.4.360 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding

birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 39,000 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 4.7%. On that basis 1.5 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.

- 11.4.4.361 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.2 to 1.5 birds from the SPA in the non-breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.362 There is, therefore, no potential for an AEoI to the conservation objectives of the kittiwake feature of East Caithness Cliffs SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

East Caithness Cliffs SPA - Great black-backed gull

- 11.4.4.363 Great black-backed gull has been screened in to the assessment of the O&M phase based on the density of birds in flight in the array area and its flight behaviour that places it at risk of collision with the turning blades of the WTGs. It has been screened in for the non-breeding bio-seasons.
- 11.4.4.364 The potential for impact on the SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds that can be attributed to a breeding colonies (including SPAs) within the species' mean max and maximum foraging range. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season, for which this species is assessed, the information on populations contained in Furness (2015) is applied.
- 11.4.4.365 In the assessment below two scenarios are considered to assess the significance of collision risk, based on the application of two variants of the Band CRM run within the stochastic CRM software (further detail of the modelling is given in [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#)). The scenarios are:
- [Scenario 1](#) in which the Band CRM Option 1 is applied that makes use of site-specific bird flight height data; and
 - [Scenario 2](#) in which the Band CRM Option 2 is applied that makes use of flight height distribution determined from a large number of surveys carried out in UK waters.

- 11.4.4.366 All mortality predictions are drawn from the relevant species sections of [Volume 2, Chapter 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

Scenario 1: Non-Breeding Season

- 11.4.4.367 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 3.2 individuals, in the post-breeding migration bio-season is 1.9 individuals and in the migration free winter bio-season is 1.9 individuals. In total 6.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 91,399 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 1,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.8%. On that basis 0.1 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.368 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 3.2 individuals, in the post-breeding migration bio-season is 1.9 individuals and in the migration free winter bio-season is 1.9 individuals. In total 6.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the East Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 91,399 individuals. All of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 1,600 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.8%. On that basis 0.1 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.1% increase in baseline mortality.
- 11.4.4.369 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality of 0.1 birds from the SPA under both scenarios in the non-breeding season. The increase in baseline mortality of 0.1% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.
- 11.4.4.370 There is, therefore, no potential for an AEoI to the conservation objectives of the great black-backed gull feature of East Caithness Cliffs SPA in relation to collision mortality

effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, great black-backed gull will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

North Caithness Cliffs SPA – Kittiwake

- 11.4.4.371 Contextual information on, and the approach to, the assessment of collision effects on kittiwake in the non-breeding season are provided above in the account on the Coquet Island SPA and for conciseness are not repeated here.

Scenario 1: Non-Breeding Season

- 11.4.4.372 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 1.4 individuals and in the post-breeding migration bio-season the figure is 2.5 individuals (there is no migration free winter bio-season). In total 3.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 15,720 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.9%. On that basis 0.1 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.002% increase in baseline mortality.

Scenario 2: Non-Breeding Season

- 11.4.4.373 The predicted collision resultant mortality as a result of the operation of Hornsea Four in the return migration bio-season is 11.7 individuals and in the post-breeding migration bio-season the figure is 20.2 (there is no migration free winter bio-season). In total 31.9 birds are predicted to suffer collision related mortality during the non-breeding season. In the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas. From that consequent mortality estimate the number which can be attributed to the North Caithness Cliffs SPA has to be calculated. Furness (2015) provides the population data from which those calculations can be carried out. The UK North Sea population outside the breeding season is 829,937 individuals. Sixty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 15,720 individuals. Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA is 1.9%. On that basis 0.6 individuals that suffer collision consequent mortality can be attributed to the SPA. This represents a 0.02% increase in baseline mortality.
- 11.4.4.374 The impact of collision related mortality (that would occur throughout the operational life of Hornsea Four) is for mortality ranging from 0.1 to 0.6 birds from the SPA in the non-

breeding season. The increase in baseline mortality of 0.002% to 0.02% in the non-breeding season will not affect the achievement of the conservation objectives for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

- 11.4.4.375 There is, therefore, no potential for an AEol to the conservation objectives of the kittiwake feature of North Caithness Cliffs SPA in relation to collision mortality effects in the O&M phase from Hornsea Four alone and therefore, subject to natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

Barrier Effect - Flamborough and Filey Coast SPA – Guillemot, razorbill and puffin

- 11.4.4.376 In the operational phase of Hornsea Four the presence of WTCs could create a barrier to the movements of seabirds. This may result in permanent changes in flight routes for the birds concerned and an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for the individuals affected.
- 11.4.4.377 Ecological theory suggests that birds, while they are breeding, will take the shortest (energetically most efficient) route to and from known areas that provide good foraging resources. For birds breeding at the Flamborough and Filey Coast SPA those routes would, if the location of food resources is known, result in straight-out-and-back flights from the breeding cliffs to known foraging areas. For the Hornsea projects in general, and Hornsea Four specifically, to create a barrier to such flights then they/it would need to be sited across such flight lines and the bird species concerned would have to be known, or suspected, not to enter an operational wind farm (i.e. exhibit a high degree of avoidance). Given the location of the Hornsea projects it is flights in an almost due east-west alignment from the Flamborough and Filey Coast SPA that would encounter the under-construction, consented or proposed Hornsea projects.
- 11.4.4.378 The assessment of Hornsea Four and the potential for its construction and operation to create a barrier to the movement of seabirds breeding at the Flamborough and Filey Coast SPA can be informed by knowledge of the existing routes that seabirds take as they commute back and forth from their breeding sites to forage offshore. It might be considered that auks species (guillemot, razorbill and puffin) nesting at the Flamborough and Filey Coast SPA may be susceptible to a barrier effect from Hornsea Four, but due to the distance to the Hornsea Four array area to the Flamborough and Filey Coast SPA (65 km at its closest point) being greater than the known mean max foraging range for razorbill (48.5 km) and at the outer limits of the known mean max foraging range for guillemot (84.2 km) and puffin (105.4 km) (Thaxter *et al.*, 2012) the presence of WTCs would not be the cause of a barrier effect on a regular basis, as very few auks forage in the waters to the east of the Hornsea Four array area. Therefore, due to the distance of the Hornsea Four array area from the

Flamborough and Filey Coast SPA there would be no barrier effect on auk species and so they are screened out of further assessment.

11.5 Onshore Ecology

11.5.1 Assessment Criteria

- 11.5.1.1 As all potential effects related to onshore ecology have been screened out, as confirmed with Natural England following submission of the update to Screening ([Appendix B](#)) no assessment methodology is presented with regard to onshore ecology. Full details on impacts and effects related to onshore ecology is presented within [Volume 3, Chapter 3: Ecology and Nature Conservation](#).

11.5.2 Description of Significance

- 11.5.2.1 All potential effects alone that are related to onshore ecology have been screened out, as confirmed with Natural England following the updated Hornsea Four Screening Report ([Appendix B](#)) and as presented within [Section 8](#) and the screening matrices supporting this RIAA ([Appendix C](#)).

11.6 Migratory Fish

- 11.6.1.1 The approach taken to the assessment of migratory fish is strongly linked to the following points:
- The distance between the array boundary and cable corridor and the relevant designated sites (which is effectively the minimum distance to the mouth of the Humber Estuary, being the migratory route for fish accessing all three sites screened in, located at least 32km from landfall of the offshore ECC);
 - The effect screened in for potential LSE (limited to accidental pollution) and the potential for a pathway to link the effect to the relevant receptor (namely migratory fish accessing the entrance to the Humber Estuary); and
 - Relevant mitigation, as identified in [Table 3](#).

11.6.2 Description of Significance

- 11.6.2.1 Essentially, the approach considers source (accidental pollution), pathway (the route by which the source could reach the receptor) and receptor (migratory fish accessing the Humber Estuary), all in the context of mitigation. It should be noted that the initial screening considered a wider export cable corridor, that lay some 26 km from the mouth of the Humber – compared to the 32 km that now applies.
- 11.6.2.2 A description of the significance of project level effects upon the receptors grouped under 'migratory fish', as relevant to the designated sites and their associated features screened in for potential LSE, is provided below. All designated sites screened in, including the

features and effects for which potential for LSE has been concluded, are summarised in [Table 6](#).

11.6.3 Construction and Decommissioning

Accidental Pollution

11.6.3.1 The potential for an AEoI as a result of accidental pollution on migratory fish during construction and decommissioning relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase.

- River Derwent SAC (river lamprey and sea lamprey);
- Humber Estuary SAC (river lamprey and sea lamprey); and
- Humber Estuary Ramsar (river lamprey and sea lamprey).

11.6.3.2 The potential for accidental pollution to affect migratory fish relates to the migratory pathway from the North Sea into the mouth of the Humber Estuary SAC and on into the River Derwent SAC, both designated for sea and river lamprey. The mouth of the Humber Estuary is located at least 32 km from the Hornsea Four offshore ECC and approximately 74 km from the array.

11.6.3.3 The potential for accidental pollution to affect migratory fish was scoped out from the PEIR ([Volume 2, Chapter 3: Fish and Shellfish Ecology](#)), with [Table 3.8](#) of that chapter including accidental pollution events among impacts scoped out of assessment. Project specific mitigation is provided for in [Table 3.9](#) of that chapter, specifically referencing the following:

'A Project Environmental Management and Monitoring Plan (PEMMP) (construction and operation phases) and Decommissioning Plan (decommissioning phase) will be produced and followed. The PEMMP and Decommissioning Plan will cover the construction, operation and maintenance, and decommissioning phases of Hornsea Four respectively and will include a Marine Pollution Contingency Plan (MPCP). This MPCP will outline procedures to protect personnel working and to safeguard the marine environment in the event of an accidental pollution event arising from offshore operations relating to Hornsea Four. The MPCP will also outline mitigation measures should an accidental spill occur, address potential contaminant releases and include key emergency contact details (e.g. Environment Agency, Natural England and MCA)'.

11.6.3.4 It is noted that the above plans will be secured in the dMLs through the requirement for a PEMMP and Decommissioning Programme.

11.6.3.5 A similar approach to screening out the effect from accidental pollution has not been applied to the RIAA, as to do so would require reliance on mitigation measures.

- 11.6.3.6 The implementation of the PEMMP and Decommissioning Programme, produced in consultation with relevant bodies, and provided for in the DCO as part of the standard dML requirements, enables the conclusion that there is, therefore, no AEol to migratory fish in relation to accidental pollution from Hornsea Four alone and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

11.6.4 Operation and Maintenance

Accidental Pollution

- 11.6.4.1 The potential for an AEol as a result of accidental pollution on migratory fish during operation & maintenance relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE).
- River Derwent SAC (river lamprey and sea lamprey);
 - Humber Estuary SAC (river lamprey and sea lamprey); and
 - Humber Estuary Ramsar (river lamprey and sea lamprey).
- 11.6.4.2 The potential for accidental pollution to affect migratory fish relates to the migratory pathway from the North Sea into the mouth of the Humber Estuary SAC and on into the River Derwent SAC, both designated for sea and river lamprey. The mouth of the Humber Estuary is located at least 32 km from the Hornsea Four offshore ECC and approximately 74 km from the array.
- 11.6.4.3 The potential for accidental pollution to affect migratory fish was scoped out from the PEIR ([Volume 2, Chapter 3: Fish and Shellfish Ecology](#)), with [Table 3.8](#) of that chapter including accidental pollution events among impacts scoped out of assessment. Project specific mitigation is provided for in [Table 3.9](#) of that chapter, specifically referencing the following:
- 11.6.4.4 'A Project Environmental Management and Monitoring Plan (PEMMP) (construction and operation phases) and Decommissioning Plan (decommissioning phase) will be produced and followed. The PEMMP and Decommissioning Plan will cover the construction, operation and maintenance, and decommissioning phases of Hornsea Four respectively and will include a Marine Pollution Contingency Plan (MPCP). This MPCP will outline procedures to protect personnel working and to safeguard the marine environment in the event of an accidental pollution event arising from offshore operations relating to Hornsea Four. The MPCP will also outline mitigation measures should an accidental spill occur, address potential contaminant releases and include key emergency contact details (e.g. Environment Agency, Natural England and MCA)'.
- 11.6.4.5 It is noted that the above plans will be secured in the dMLs through the requirement for a PEMMP and Decommissioning Programme.
- 11.6.4.6 A similar approach to screening out the effect from accidental pollution has not been applied to the RIAA, as to do so would require reliance on mitigation measures.

- 11.6.4.7 The implementation of the PEMMP and Decommissioning Programme, produced in consultation with relevant bodies, and provided for in the DCO as part of the standard dML requirements, enables the conclusion that there is, therefore, no AEol to migratory fish in relation to accidental pollution from Hornsea Four alone and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

12 Assessment of Adverse Effect In-Combination

- 12.1.1.1 Screening for designated sites and features in-combination is presented in [Section 9](#), essentially identifying the plans and projects to be considered for assessment. The assessment presented here draws on that presented within relevant topic specific chapters of the PEIR, tailored for the requirements of the RIAA, to enable the determination of AEol in-combination to the features and effects screened in.
- 12.1.1.2 In assessing the potential for in-combination effects associated with Hornsea Four, it is important to bear in mind that some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward, or taken forward in the same design envelope as currently presented. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans with consent and (if required) CfD (or similar) are more likely to contribute to in-combination impact with Hornsea Four (providing temporal and spatial pathways exist), whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.
- 12.1.1.3 For this reason, all relevant projects/ plans considered in-combination alongside Hornsea Four have been allocated into 'Tiers', reflecting their current stage within the planning and development process. Where the tiering approach differs between receptor groups, this is noted in the relevant section. The tiering approach allows the in-combination impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. The definition of each tier is described in ([Section 9](#)), with the plans and projects screened in for further consideration here defined within [Table 14](#).
- 12.1.1.4 For each plan/ project screened in, the in-combination maximum adverse scenario draws on the information presented in topic specific chapters of the PEIR. The aim is to identify, for each receptor group, the aspects of the plans, projects and programmes screened in to be assessed. Consideration is given to the following points:
- Level of detail available for project/ plans;
 - Potential for an effect-pathway-receptor link;
 - Potential for a physical interaction; and
 - Potential for temporal interaction.
- 12.1.1.5 [Table 14](#) below identifies, for all plans and projects screened in for consideration in-combination, the relevant receptor group(s), the maximum adverse scenario as it applies to

that receptor group(s) and the relevant years within which the works are planned to occur. It is of note that, for a number of projects, insufficient information exists to provide a maximum adverse scenario, with that noted where relevant.

Table 14: In-Combination Projects and Relevant Years.

Status	Project/ Plan Name	Tier	Relevant Receptor ³⁶						Relevant Years
			Intertidal and subtidal	Harbour porpoise	Harbour Seal	Grey Seal	Offshore ornithology	Onshore Ecology	
Offshore Wind Farms									
In-Planning	Norfolk Vanguard	1							Construction 2023/24-winter 2028/29.
	Hornsea Project Three	1							Construction 2024-2028.
	Norfolk Boreas	1							Q4 2024- Q2 2025 - pre-construction survey. Q3 2025-Q1 2026 - UXO clearance. Q2 2026-Q3 2027 - foundation installation.
	East Anglia One North	2							Construction 2025-2028
	East Anglia Two	2							Construction 2026-2029
Consented	East Anglia Three	1							Piling summer 2020-winter 2023/24.
	Dogger Creyke Beck A	1							Construction winter 2020-21-winter 2027-28).
	Dogger Creyke Beck B	1							Construction winter 2020-21-winter 2028-29).
	Dogger Teesside A	1							Construction winter 2020-21-summer 2028
	Sofia	1							Construction winter 2020-21-summer 2028).
	SeaGreen Delta	1							Works must commence no later than 5 years following August 2018.
	SeaGreen Charlie	1							Works must commence no later than 5 years following August 2018.
	Borkum Riffgrund West	1							Commissioning 2024-2025
	EnBW He Dreiht	1							Commissioning 2025
Other Sectors as relevant									
Marine aggregates	Humber Overfalls Area 493	1							Active
	Off Saltfleet Area 197	1							
	Humber Estuary Area 400	1							
	Humber 1 Area 514/1	1							
	Humber 2 Area 514/2	1							
	Humber Estuary Area 514/3	1							
Operational	Bridlington A disposal site	1							Open

³⁶ Note that for marine mammal species, if Table 8.2 found 'no' to the potential for overlap with construction, the plan or project has not been screened in for construction effects and therefore has not been carried over here. Effects during O&M may draw on additional projects as appropriate.

Status	Project/ Plan Name	Tier	Relevant Receptor ³⁶						Relevant Years
			Intertidal and subtidal	Harbour porpoise	Harbour Seal	Grey Seal	Offshore ornithology	Onshore Ecology	
Dredge spoil dumping	Humber 4	1							
	Humber 3a	1							
	Humber 2	1							
	Goole Reach	1							
	Whitgift Bight (River Ouse)	1							
	Hedon Haven	1							
	Bull Sand Fort Extension	1							
	Sunk Dredge Channel Window C	1							
	Humber 1a	1							
	Holme Channel Deep	1							
	Humber 4B/Hook Extension	1							
	Humber 4B Hook	1							
Discharge consent	South Killingholme Water Recycling Centre (WRC)	1							Active
	Barton Upon Humber WRC	1							
	North Ferry WRC	1							
	The Old Tile Works	1							
	Humberston Tetney Road SPS	1							
	Grimsby Fish Docks Pumping Station	1							

12.1.1.6 Following the identification of the plans and projects with the potential to result in an AEol in-combination with Hornsea Four, the assessment is made below. The information is presented according to the following receptor groupings:

- Subtidal and Intertidal Benthic Ecology;
- Marine Mammals;
- Offshore Ornithology; and
- Onshore Ecology

12.2 Subtidal and Intertidal Benthic Ecology

12.2.1 Construction and Decommissioning

Temporary increases in suspended sediment concentration during construction

12.2.1.1 The potential for an AEol in-combination as a result of effect on subtidal and intertidal benthic ecology during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

Flamborough Head

- Reefs; and
- Submerged or partially submerged sea caves (from the cable corridor works only).

12.2.1.2 The plans and projects identified in [Table 14](#) above with the potential to contribute to an in-combination effect on one or more designated site are as follows, together with the relevant feature:

- Bridlington A Dredge Spoil Site, Tier 1, ongoing intermittent use (reefs; and submerged or partially submerged sea caves (s)); and
- Creyke Beck A and B, Tier 1, timescale not known but anticipated to be completed before Hornsea Four commences (reefs; and submerged or partially submerged sea caves (s)).

Bridlington Bay HU015

12.2.1.3 Disposal site HU015 is located in Bridlington Bay, to the northwest of the South Smithic sandbank. Charted water depth is approximately 7m. The site has been in use since the inception of the Food and Environment Protection Act in 1985. Currently, HU015 is used for the disposal of maintenance dredged material from the port of Bridlington. The maximum quantity that is currently authorised for disposal in any one year is 30,000 tonnes. Material deposited at HU015 varies in composition but is generally a mixture of fine sands and silts,

and can therefore be expected to move by both wave and tidal currents.

- 12.2.1.4 The effects of the Bridlington A Dredge Spoil Site on the Flamborough Head SAC have been considered by Cefas. They concluded that there would not be a likely significant effect on the features for which the SAC had been identified as a result of the disposal of dredged material at Bridlington A (CEFAS, 2009).
- 12.2.1.5 The interaction of Bridlington Bay disposal site and Hornsea Four have been considered in [Volume 5, Annex 1.1: Marine Processes Technical Report](#). This stated that during these times when the disposal site is being used, plumes will form at the disposal site as the silts are rapidly dispersed away. The use of the spoil site is expected to be relatively infrequent and on demand. The number of disposals varies year to year and month to month.
- 12.2.1.6 If Hornsea Four is discharging overspill of fine silts and sands in the nearshore from cable trenching on an ebb tide period at the same time as spoil disposal is occurring at HU015 then a larger and sediment plume may form, however, this will also quickly disperse given the location of the spoil site in an area of faster flows. [Volume 5, Annex 1.1: Marine Processes Technical Report](#) concluded that the cumulative impact is considered to be negligible due to the low likelihood of occurrence and relatively short-term impacts.

Creyke Beck

- 12.2.1.7 The Creyke Beck landfall is around 1.5 km to the south of the Hornsea Four landfall. The anticipation is this installation is completed first and the Hornsea Four export cable will cross the Creyke Beck export cable east of Smithic Sands. Depending on the period between completion of the Creyke Beck landfall works and commencement of Hornsea Four landfall works there may be a potential for the (designated at Hornsea Four landfall) beach to be in a state of partial recovery.
- 12.2.1.8 For Creyke Beck, the applicant considered the effects of their Export Cable on the Flamborough Head SAC, which is situated 5 km from their ECC. In their potential LSE Screening report (Forewind, 2013a) they concluded that there was the potential for LSE because, potential indirect effects could arise from the re-suspension of sediment, sediment deposition, and introduction of contaminants into during the construction phase when physical disturbance activities occur to the seabed. Therefore, potential LSE was determined.
- 12.2.1.9 This concern was subsequently resolved following confirmation of the distance between the cable and site and hydrodynamic modelling of sediment deposition. Forewind (2013) concluded that "The temporary and short-term (3 days) increase in suspended sediment concentrations that are predicted to occur during the construction of Dogger Bank Creyke Beck in-combination with the other projects would not be expected to result in physical damage to reefs and submerged and partially submerged sea caves communities due to the short-term nature of this impact which would remain within the levels of natural

variability (e.g. storm induced suspended sediment concentrations). Consequently, the favourable condition of the sensitive communities would not be affected.

- 12.2.1.10 No increases in suspended sediments would extend from Dogger Bank Creyke Beck to the SAC during the operation phase, therefore no impact could arise alone or in-combination. The impacts from suspended sediment concentrations during decommissioning would be similar to, though possibly lesser in extent and magnitude than those for construction, again being temporary and short-term in duration. Therefore as with construction, the favourable condition of the sensitive communities would not be affected (Forewind, 2013b). No Aeol was concluded (DECC, 2015).
- 12.2.1.11 The potential interaction of Hornsea Four and the Creyke Beck project was considered in the [Volume 5, Annex 1.1: Marine Processes Technical Report](#). The report was written on the expectation that Hornsea Four will take place after any similar landfall works required for Dogger Bank Creyke Beck offshore wind farm (noting that landfall works do not necessarily occur simultaneously with offshore works). This expectation removes the opportunity for cumulative impacts between two activities occurring in a similar timescale and close together (n.b. Creyke Beck landfall is around 1.5 km to the south of Hornsea Four landfall).
- 12.2.1.12 Overall, it is concluded that there is no potential for an AEol to the conservation objectives of the reef and submerged cave features of the Flamborough Coast SAC in relation to increases in suspended sediment from Hornsea Four in-combination with other plans or projects and therefore, subject to natural change, the reef features will maintain as favourable in the long term with respect to this effect.

Invasive non-native species

- 12.2.1.13 The potential for an AEol in-combination as a result of effect on subtidal and intertidal benthic ecology during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

Flamborough Head

- Reefs; and
 - Submerged or partially submerged sea caves (from the cable corridor works only).
- 12.2.1.14 The assessment alone ([Section 12](#)) identified that there is a risk that the project could increase the spread of INNS through the movement of vessels in and out of the benthic subtidal study area. It was concluded that the risk was of negligible significance and no potential for AEol for the project alone.
- 12.2.1.15 The other plan or project listed in [Table 14](#) which is considered to have the potential to also increase the spread of INNS is the Creyke Beck project. The risk of Creyke Beck increasing

the spread of INNS is likely to be very similar to that of Hornsea Four as the projects are of a similar type and location. It is therefore considered that Creyke Beck is likely to also have a negligible risk of spreading INNS.

- 12.2.1.16 Given the negligible significance of effects of both projects, it is considered that in-combination there would be no potential for an AEol to the conservation objectives of the reef and submerged cave features of the Flamborough Coast SAC through risk of spread of INNS and that the reef and submerged cave features will maintain as favourable in the long term with respect to this effect.

12.2.2 Operation & Maintenance

Changes to physical processes

- 12.2.2.1 The potential for an AEol in-combination as a result of effect on subtidal and intertidal benthic ecology during operation and maintenance relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE).

Flamborough Head

- Reefs.

- 12.2.2.2 The plans and projects identified in [Table 14](#) above with the potential to contribute to an in-combination effect through changes to physical processes on one or more designated site are as follows, together with the relevant feature:

- Creyke Beck A and B, Tier 1, timescale not known but anticipated to be completed before construction of Hornsea Four commences (reefs).

- 12.2.2.3 For Creyke Beck, in the potential LSE Screening report (Forewind, 2013a) changes to physical processes were not identified as a potential impact and were not screened in for potential LSE. If any impact were to occur on physical processes it is likely that they would be of similar significance to those of Hornsea Four given the similarities in the type of project and their location. It is therefore likely that they would be at worst of negligible significance.

- 12.2.2.4 In light of the above, it is considered that in-combination there would be no potential for an AEol to the conservation objectives of the reef feature of the Flamborough Coast SAC through changes to physical processes and that the reef feature will maintain as favourable in the long term with respect to this effect.

Invasive non-native species

- 12.2.2.5 The potential for an AEol in-combination as a result of effect on subtidal and intertidal benthic ecology during operation and maintenance relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE).

Flamborough Head

- Reefs; and
- Submerged or partially submerged sea caves (from the cable corridor works only).

12.2.2.6 The assessment alone ([Section 12](#)) identified that there is a risk that the project could increase the spread of INNS through the introduction of hard substrate into a sedimentary habitat and also the movement of vessels in and out of the benthic subtidal study area. It was concluded that the risk was of negligible significance and no potential for AEol for the project alone.

12.2.2.7 The other plan or project listed in [Table 14](#) which is considered to have the potential to also increase the spread of INNS is the Creyke Beck project. The risk of Creyke Beck increasing the spread of INNS is likely to be very similar to that of Hornsea Four as the projects are of a similar type and location. It is therefore considered that Creyke Beck is likely to also have a negligible risk of spreading INNS.

12.2.2.8 Given the negligible significance of effects of both projects, it is considered that in-combination there would be no potential for an AEol to the conservation objectives of the reef and submerged cave features of the Flamborough Coast SAC through risk of spread of INNS and that the reef and submerged cave features will maintain as favourable in the long term with respect to this effect.

12.3 Marine Mammals

12.3.1.1 A description of the significance of potential in-combination effects upon the receptors grouped under 'marine mammals' is provided below, drawing on [Volume 2, Chapter 4: Marine Mammals](#).

12.3.2 Construction and Decommissioning

Underwater Noise

12.3.2.1 The potential for an AEol in-combination as a result of underwater noise on marine mammals during construction and decommissioning relates to the following designated sites and the relevant features (i.e. the features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

- Southern North Sea SAC (harbour porpoise);
- Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (for harbour seal, specifically Doggersbank (Dutch) SAC and Klaverbank SCI); and

- Transboundary sites (twelve sites for grey seal, specifically Doggersbank (Dutch) SAC, Klaverbank SCI, Bancs des Flandres, Vlaamse Banken, SBZ 1, SBZ 2, SBZ 3, Vlake van de Raan, Westerschelde & Saefthinghe, Voordelta, Noordzeekustzone and Waddenzee).

12.3.2.2 The plans and projects identified in [Table 14](#) above with the potential to contribute to an in-combination effect on one or more designated site with respect to marine mammals are as follows, together with the relevant species:

- East Anglia THREE, Tier 1 (consented), works from 2020 (harbour porpoise, harbour seal and grey seal);
- Dogger Bank Creyke Beck A, Tier 1 (consented), works from 2021 (harbour porpoise, harbour seal and grey seal);
- Dogger Bank Creyke Beck B, Tier 1 (consented), works from 2021 (harbour porpoise, harbour seal and grey seal);
- Dogger Bank Teesside A, Tier 1 (consented), works from 2021 (harbour porpoise, harbour seal and grey seal);
- Sofia, Tier 1 (consented), works from 2021 (harbour porpoise, harbour seal and grey seal);
- Norfolk Vanguard, Tier 1 (in planning), works from 2023 (harbour porpoise, harbour seal and grey seal);
- Hornsea Project Three, Tier 1 (in planning), works from 2024 (harbour porpoise, harbour seal and grey seal);
- Norfolk Boreas, Tier 1 (in planning), works from 2024 (harbour porpoise, harbour seal and grey seal);
- East Anglia One North, Tier 2 (in planning), works from 2025 (harbour porpoise, harbour seal and grey seal);
- East Anglia Two, Tier 2 (in planning), works from 2026 (harbour porpoise, harbour seal and grey seal);
- Seagreen Delta, Tier 1 (consented), works no later than 5 years post August 2028 (grey seal);
- Seagreen Charlie, Tier 1 (consented), works no later than 5 years post August 2028 (grey seal);
- Borkum Riffgrund, Tier 1 (consented), commissioning 2024 (grey seal); and
- EnBW He Dreiht, Tier 1 (consented), commissioning 2025 (grey seal).

12.3.2.3 Effectively for a project to be screened in for in-combination assessment, there needs to be potential for relevant works (in this case noisy activity) to occur within the same timeframe as relevant works at Hornsea Four, with these identified in [Table 9](#). The sites/features included in-combination are then those that are located within the species-specific screening distance from one or more of the projects identified for in-combination assessment.

12.3.2.4 The locations of these projects, in relation to Hornsea Four, are shown in [Figure 11](#).

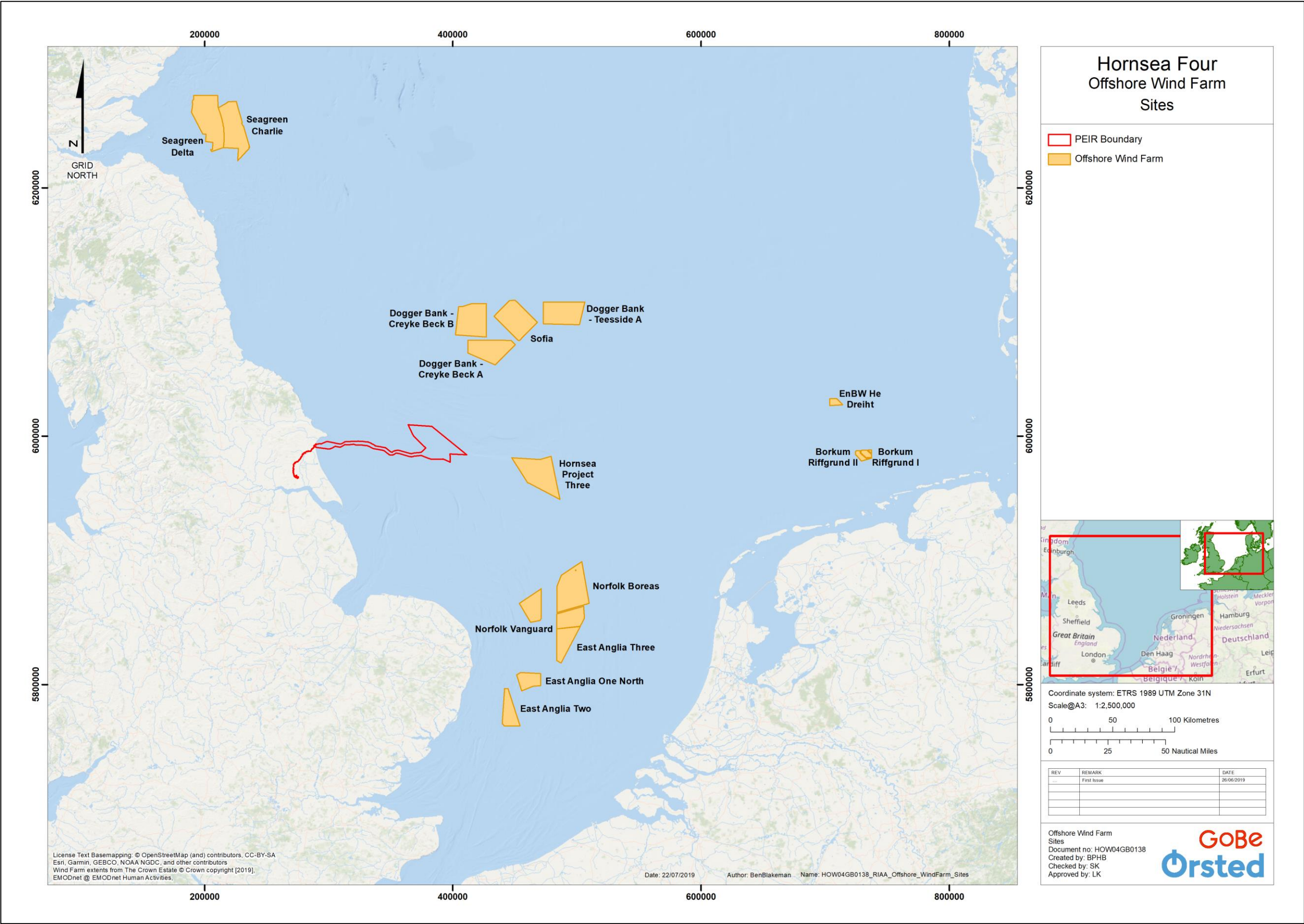


Figure 11: Projects considered in-combination for marine mammals (not to scale).

12.3.2.5 Timeframes for decommissioning are highly uncertain for all projects and therefore an assessment of the potential for an in-combination effect during decommissioning cannot be made at this time. However, it is likely that the potential for effect during decommissioning would be less than that during construction and would in any case be assessed in line with the regulatory requirements at the time.

12.3.2.6 As highlighted in the AEoI for the project alone, there are a number of potential sources of underwater noise associated with construction of an OWF. Comment on these for the purposes of the in-combination assessment is provided below:

- Percussive piling – to be carried through to the assessment for projects screened in in-combination;
- UXO clearance – planned and licensed UXO activity associated with projects screened in is included (where that information is in the public domain);
- Geophysical and seismic survey –planned geophysical/seismic survey included within the screening range (where that information is in the public domain); and
- Seabed preparation and cable laying – as noted in [Section 11](#), such activities associated with Hornsea Four would result in a highly localised and short-term level of effect only, with these therefore not taken forward in-combination as no pathway exists for a contribution to an in-combination effect.

12.3.2.7 Focusing the assessment in-combination on percussive piling noise (together with project related sources of underwater noise, namely UXO clearance and geophysical/seismic survey) is supported by the PEIR, the approach to which is presented in [Section 4.12.1](#) and summarised here. It is of note that vessel disturbance is considered separately, as is operational noise.

12.3.2.8 The potential for underwater noise to result during construction of Hornsea Four, together with the sensitivity of harbour porpoise, harbour seal and grey seal to such noise, has been discussed in [Section 11.3](#) as part of the assessment of AEoI alone, with that information not repeated here.

12.3.2.9 The assessment in-combination is made below, initially for harbour porpoise and then for harbour seal and grey seal.

Potential for an In-combination Effect on Harbour Porpoise from Underwater Noise

12.3.2.10 [Table 15](#) below provides further information on the potential for temporal in-combination effects in relation to the above plans and projects screened in for assessment in relation to harbour porpoise only and is therefore limited to the SNS SAC. It is noted that the projects assigned into Tier 1 include projects assigned into Tiers 1, 2, 3 and 4 within the marine mammal chapter for PEIR – the marine mammal tiering differentiating between the certainty of projects (tier 1 having consent and CfD, tier 2 having consent but no CfD, tier 3 application submitted but not determined and tier 4 application not yet submitted). That tiering is differentiated here from the tiering used in the marine mammal chapter for PEIR by the suffix Tier 1a (analogous to Tier 1), Tier 1b (Tier 2), Tier 1c (Tier 3) and Tier 1d (Tier 4) for clarity.

Table 15: Temporal Overlap with Hornsea Four of Plans and Projects Considered In-Combination (SNS SAC and Harbour Porpoise).

Project	Temporal Overlap with Construction Window											Relevant Activity
	Summer Season (2023)	Winter Season (2023-24)	Summer Season (2024)	Winter Season (2024-25)	Summer Season (2025)	Winter Season (2025-26) ³⁷	Summer Season (2026)	Winter Season (2026-27)	Summer Season (2027)	Winter Season (2027-28)	Summer Season (2028)	
Hornsea Four												Geophysical/seismic survey (uncertain timing and duration but would precede piling and UXO clearance), assumed 2023-2024 (before 2025)
Hornsea Four												UXO clearance (uncertain requirement, timing and duration but would precede piling, assumed 2023-2024 (before 2025)
Hornsea Four												Percussive piling. 12 months in the period 2025-2028
Tier 1a (Grey shading represents the construction window within which the activity may occur)												
None identified – all scheduled to complete construction prior to 2023												
Tier 1b (Grey shading represents the construction window within which the activity may occur)												
Dogger Creyke Beck A												Construction winter 2020-21-winter 2027-28). No dates or numbers for UXO or survey.
Dogger Creyke Beck B												Construction winter 2020-21-winter 2028-29). No dates or numbers for UXO or survey.
Dogger Teesside A												Construction winter 2020-21-summer 2028. No dates or numbers for UXO or survey.
Sofia												Construction winter 2020-21-summer 2028). No dates or numbers for UXO or survey.
East Anglia Three												Piling summer 2020-winter 2023/24. No dates for UXO, geophysical or seismic.
Tier 1c (Grey shading represents the construction window within which the activity may occur)												
Norfolk Vanguard												Piling 2023/24-winter 2028/29. No dates for UXO, geophysical or seismic, 42 UXO maximum.
Hornsea Project Three												Piling 2024-2028. No dates for UXO, geophysical or seismic (outside piling window). Maximum 23 UXO.
Norfolk Boreas												Q4 2024- Q2 2025 - pre-construction survey. Q3 2025-Q1 2026 - UXO clearance. Q2 2026-Q3 2027 - foundation installation. Max 80 UXO.
Tier 1d (Grey shading represents the construction window within which the activity may occur)												
East Anglia One North												Construction 2025-2028
East Anglia Two												Construction 2026-2029
Tier 2 (Grey shading represents the construction window within which the activity may occur)												
No projects screened in for assessment in Tier 2 onwards												

³⁷ Noting that for piling in the winter season, only works within the HVAC location are relevant to the RIAA.

- 12.3.2.11 There is strong presumption of certainty that Tier 1a projects will proceed to construction on the specified timeframe and scale, with these projects having achieved consent, CfD and preparing for construction (not least because the CfD sets milestones and long-stop dates). Hornsea Four is progressing on the timeframe and scale specified by the Applicant, as included within the assessment process as the project design and project programme (Section 6.5), and therefore can be afforded the same level of certainty within the in-combination assessment here. The SIP provides certainty that even if the project timescales change from that assessed within the RIAA, provision is made within the SIP (with the SIP provided for in the DCO) to ensure that any such changes to project timescales would not change the conclusions of the RIAA (with provision for mitigation to apply if required).
- 12.3.2.12 For Tier 1b, 1c and 1d projects, there is a much lower degree of certainty in terms of project programme timeframe and project scale. Whilst it is recognised that the planned construction windows of the Tier 1b, 1c and 1d wind farm projects, where publicly available, may overlap with (and may extend beyond) the construction window of Hornsea Four, it is acknowledged, in common with all such projects with such a large construction window during the planning process and prior to securing a Contract for Difference (CfD), that actual construction will last for a proportion of the total construction window and that in reality the actual construction window may shift further. In addition, it is common for the scale of a project to change following consent or achieving CfD, for example a reduced number of WTGs (potentially with an increased capacity per WTG) may be progressed to final scheme design.
- 12.3.2.13 Therefore the quantitative assessment is presented in stages – essentially increasing the potential for impact as each tier is added (while increasing the uncertainty that such a scenario would ever occur). The purpose is to provide a comprehensive assessment – ranging from most likely to maximum design scenario to most likely/least likely (as relevant), and to enable the areas of ‘risk’ in-combination to be identified³⁸. The areas of risk are effectively seasons where, for whatever reason, there is a risk of an in-combination exceedance of the thresholds. The certainty of that exceedance being driven by the tier within which the relevant project(s) sit. All such risk is highlighted and taken forward into the draft SIP (to be submitted at application, noting that should changes in projects in-combination occur between the issue of the draft RIAA and application, those changes will be incorporated into the RIAA at that point). The main purpose of the SIP is to manage the risk posed by such uncertainty going forward, and to provide certainty in planning terms that where a risk of threshold exceedance has been identified, measures are in place to address that risk and ensure the thresholds are not breached. Such an approach was first used on East Anglia Three, a project which achieved consent in August 2017.
- 12.3.2.14 The determination of AEol for plans and projects in-combination with Hornsea Four in relation to harbour porpoise is determined below.

³⁸ The certainty attached to the projects within various tiers has been explored by previous projects, for example during the Examination of Hornsea Three. In that case, the Applicant provided text at Deadline 1 in response to the ExA question 1.1.6 (https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001153-DL_HOW03_ExAFirstWQ.pdf)

The Species potential to remain a Viable Component of the Site

- 12.3.2.15 For the purposes of the assessment of AEol in-combination for harbour porpoise, the methodology applied to the assessment alone for the Conservation Objectives concerned with viability (in relation to potential for injury), has been extended to consider the potential for effect from the above projects in-combination.
- 12.3.2.16 It has been concluded for Hornsea Four alone that, given the proposed mitigation and project commitments (as controlled through the MMMP and, where necessary, the EPS licensing process), the risk of such injurious or lethal effects is appropriately managed. As a result of these existing controls, the type, scale and extent of potential impacts arising from Hornsea Four (and indeed other licenced projects and activities) means that there is no AEol for harbour porpoise viability (in relation to injury or mortality effects) as a result of the construction, operation and decommissioning of Hornsea Four. The potential for impact is such that it can similarly be concluded (and confirmed within the Screening and Integrity Matrices ([Appendix C](#) and [Appendix D](#)), taking account of the similar controls on all licenced projects and or activities that may result in underwater noise sufficient to result in injurious and or lethal effects on harbour porpoise) that no pathway exists for a contribution to AEol in-combination from Hornsea Four. The same logic applies to all other projects identified within [Table 15](#).
- 12.3.2.17 There is, therefore, no AEol to the viability of harbour porpoise in relation to mortality or injury effects from Hornsea Four in-combination and therefore, subject to natural change, harbour porpoise will be maintained as a 'viable component' of the SNS SAC in the long-term.

Potential for Significant Disturbance to the Species within the Site

- 12.3.2.18 For the purposes of the assessment of AEol in-combination for harbour porpoise, the methodology applied to the assessment alone for the Conservation Objective concerned with significant disturbance in harbour porpoise has been extended to consider the potential for effect from the above projects in-combination.
- 12.3.2.19 The overall aim of the assessment of disturbance within the SNS SAC is to identify the percentage of the relevant part of the SAC within which harbour porpoise may exhibit avoidance behaviour (displacement) together with an understanding of the total duration of such disturbance, within the overall construction window. The approach takes account of both spatial and temporal elements, as required by the definition of significance. As the overall indicative construction window falls at least partially within more than one season (although in total it will extend across an estimated 12 months), the assessment is presented on a seasonal basis – to enable the potential for effect to be fully understood for each of the seasons within which works may occur at Hornsea Four.
- 12.3.2.20 The following assessment includes a number of assumptions, with these summarised as follows:

- Only relevant works planned for the period 1st April 2023 – 30th September 2028 (i.e. the seasons that fall across the period within which relevant project related works at Hornsea Four may result in underwater noise, with works commencing August 2023 at the earliest) to be included;
- An assumption that all UXO clearance, geophysical/seismic survey and foundation piles at Hornsea Four will be installed within this timeframe;
- Should geophysical/seismic survey occur, a 10 km buffer has been applied; and
- The maximum spatial overlap that may occur from an individual UXO clearance or piling location within each project has been assumed (based on a 26 km EDR).

12.3.2.21 **Table 16** summarises the potential for effect from a single event (whether that be piling or UXO clearance) per day. The potential effect from two activities (whichever would result in the worst footprint), to occur per 24 hours is summarised in **Table 17**. Values are presented as minimum and maximum (where relevant) as the location of noise relevant to the SNS SAC will affect the degree of spatial overlap. It is also particularly relevant to note that the calculations assume that all projects will progress in the timeframes specified, that activities will occur at the worst possible locations for each project simultaneously, and do not take account of overlap between projects. It is therefore clear that the values in combination represent a highly unlikely scenario – with considerable precaution built into the assessment.

Table 16: Spatial Effect In-Combination from a Single Event in a Single Day per Season.

Project		Temporal Overlap with Construction Window											Relevant Activity
		Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ³⁹	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
Hornsea Four	Max (km²)	159	89	159									Geophysical/seismic survey (uncertain timing and duration but would precede piling and UXO clearance), assumed 2023-2024 (before 2025)
	Min (km²)	0	0	0									
	Max (km²)	2,124	368	2,124									UXO clearance (uncertain requirement, timing and duration but would precede piling, assumed 2023-2024 (before 2025))
	Min (km²)	0	266	0									
	Max (km²)					2,124	0	2,124	0	2,124	0	2,124	Percussive piling. 12 month (WTG) window in the period 2025-2028
	Min (km²)					1,522	0	1,522	0	1,522	0	1,522	
	Max (km²)					641	368	641	368	641	368	641	12 month window in the period 2025-2028
	Min (km²)					357	266	357	266	357	266	357	
Tier 1a													
None identified – all scheduled to complete construction prior to 2023													
Tier 1b													
Dogger Creyke Beck A	Max (km²)	2,124	0	2,124	0	2,124	0	2,124	0	2,124	0		Construction winter 2020-21-winter 2027-28). No dates or numbers for UXO or survey.
	Min (km²)	1,246	0	1,246	0	1,246	0	1,246	0	1,246	0		
Dogger Creyke Beck B	Max (km²)	2,124	0	2,124	0	2,124	0	2,124	0	2,124	0	2,124	Construction winter 2020-21-winter 2028-29). No dates or numbers for UXO or survey.
	Min (km²)	1,556	0	1,556	0	1,556	0	1,556	0	1,556	0	1,556	
Dogger Teesside A	Max (km²)	25	0	25	0	25	0	25	0	25	0	25	Construction winter 2020-21-summer 2028. No dates or numbers for UXO or survey.
	Min (km²)	0	0	0	0	0	0	0	0	0	0	0	
Sofia	Max (km²)	1,509	0	1,509	0	1,509	0	1,509	0	1,509	0	1,509	Construction winter 2020-21-summer 2028). No dates or numbers for UXO or survey.
	Min (km²)	125	0	125	0	125	0	125	0	125	0	125	
East Anglia Three ⁴⁰	Max (km²)	2,124	1,827										Piling summer 2020-winter 2023/24. No dates for UXO, geophysical or seismic.

³⁹ Noting that for piling in the winter season, only works within the HVAC location are relevant to the RIAA
⁴⁰ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

Project		Temporal Overlap with Construction Window											Relevant Activity
		Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ³⁹	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
	Min (km²)	1,524	288										
Tier 1b plus Hornsea Four	Max (km²)	10,030	2,195	7,906	0	7,906	368	7,906	368	7,906	368	5,782	
	Min (km²)	4,451	288	2,927	0	3,284	266	3,284	266	3,284	266	2,038	
Tier 1b plus Hornsea Four	Max (%)	37	17	29	0	29	3	29	3	29	3	21	
	Min (%)	16	2	11	0	12	2	12	2	12	2	8	
Tier 1c													
Norfolk Vanguard ⁴¹	Max (km²)		1,081	2,124	1,081	2,124	1,081	2,124	1,081	2,124	1,081	2,124	Piling 2023/24-winter 2028/29. No dates for UXO, geophysical or seismic, 42 UXO maximum.
	Min (km²)		2	1,345	2	1,345	2	1,345	2	1,345	2	1,345	
Hornsea Project Three ⁴²	Max (km²)		0	432	0	432	0	432	0	432	0	432	Piling 2024-2028. No dates for UXO, geophysical or seismic (outside piling window). Maximum 23 UXO.
	Min (km²)		0	0	0	0	0	0	0	0	0	0	
Norfolk Boreas ⁴³	Max (km²)				292	2,109	292	2,109	292	2,109			Q4 2024- Q2 2025 - pre-construction survey. Q3 2025-Q1 2026 - UXO clearance. Q2 2026-Q3 2027 - foundation installation. Maximum 80 UXO.
	Min (km²)				0	383	0	383	0	383			
Tier 1b and 1c plus Hornsea Four	Max (km²)	10,030	3,276	10,462	1,373	11,221	1,741	12,571	1,741	12,571	1,449	8,338	
	Min (km²)	4,469	556	4,272	2	5,012	268	5,012	268	5,012	268	3,383	
Tier 1b and 1c plus Hornsea Four	Max (%)	37	26	39	11	42	14	47	12	47	11	31	
	Min (%)	17	4	16	0	19	2	19	2	19	2	13	
Tier 1d													
East Anglia One North ⁴⁴	Max (km²)				2,124	1,181	2,124	1,181	2,124	1,181	2,124	1,181	Construction 2025-2028
	Min (km²)				2,089	305	2,089	305	2,089	305	2,089	305	
East Anglia Two ⁴⁵	Max (km²)						2,124	179	2,124	179	2,124	179	Construction 2026-2029
	Min (km²)						2,034	0	2,034	0	2,034	0	
Tier 2													

⁴¹ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁴² Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁴³ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁴⁴ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁴⁵ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

Project	Temporal Overlap with Construction Window											Relevant Activity
	Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ³⁹	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
No projects screened in for assessment in Tier 2 onwards												

Table 17: Spatial Effect In-Combination from two Events in a Single Day per Season.

Project		Temporal Overlap with Construction Window											Relevant Activity
		Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ⁴⁶	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
Hornsea Four	Max (km²)	159	89	159									Geophysical/seismic survey (uncertain timing and duration but would precede piling and UXO clearance), assumed 2023-2024 (before 2025)
	Min (km²)	0	0	0									
	Max (km²)	3,958	368	3,958									UXO clearance (uncertain requirement, timing and duration but would precede piling, assumed 2023-2024 (before 2025))
	Min (km²)	0	266	0									
	Max (km²)					3,958	0	3,958	0	3,958	0	3,958	Percussive piling. 12 month (WTG) window in the period 2025-2028
	Min (km²)					1,522	0	1,522	0	1,522	0	1,522	
	Max (km²)					691	418	691	418	691	418	691	12 month window in the period 2025-2028
	Min (km²)					357	266	357	266	357	266	357	
Tier 1a													
None identified – all scheduled to complete construction prior to 2023													
Tier 1b													
Dogger Creyke Beck A	Max (km²)	3,569	0	3,569	0	3,569	0	3,569	0	3,569	0		Construction winter 2020-21-winter 2027-28). No dates or numbers for UXO or survey.
	Min (km²)	1,246	0	1,246	0	1,246	0	1,246	0	1,246	0		
Dogger Creyke Beck B	Max (km²)	3,640	0	3,640	0	3,640	0	3,640	0	3,640	0	3,640	Construction winter 2020-21-winter 2028-29). No dates or numbers for UXO or survey.
	Min(km²)	1,556	0	1,556	0	1,556	0	1,556	0	1,556	0	1,556	
Dogger Teesside A	Max (km²)	25	0	25	0	25	0	25	0	25	0	25	Construction winter 2020-21-summer 2028. No dates or numbers for UXO or survey.
	Min (km²)	0	0	0	0	0	0	0	0	0	0	0	
Sofia	Max (km²)	2,080	0	2,080	0	2,080	0	2,080	0	2,080	0	2,080	Construction winter 2020-21-summer 2028). No dates or numbers for UXO or survey.
	Min (km²)	125	0	125	0	125	0	125	0	125	0	125	
East Anglia Three ⁴⁷	Max (km²)	3,107	1,982										Piling summer 2020-winter 2023/24. No dates for UXO, geophysical or seismic.

⁴⁶ Noting that for piling in the winter season, only works within the HVAC location are relevant to the RIAA
⁴⁷ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

Project		Temporal Overlap with Construction Window											Relevant Activity
		Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ⁴⁶	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
	Min (km²)	1,524	288										
Tier 1b plus Hornsea Four	Max (km²)	16,379	2,350	13,272	0	13,272	418	13,272	418	13,272	418	9,703	
	Min (km²)	4,451	288	2,927	0	4,449	266	4,449	266	4,449	266	3,203	
Tier 1b plus Hornsea Four	Max (%)	61	19	49	0	49	3	49	3	49	3	36	
	Min (%)	16	2	11	0	16	2	16	2	16	2	12	
Tier 1c													
Norfolk Vanguard ⁴⁸	Max (km²)		798	3,616	798	3,616	798	3,616	798	3,616	798	3,616	Piling 2023/24-winter 2028/29. No dates for UXO, geophysical or seismic, 42 UXO maximum.
	Min (km²)		2	1,345	2	1,345	2	1,345	2	1,345	2	1,345	
Hornsea Project Three ⁴⁹	Max (km²)		0	432	0	432	0	432	0	432	0	432	Piling 2024-2028. No dates for UXO, geophysical or seismic (outside piling window). Maximum 23 UXO.
	Min (km²)		0	0	0	0	0	0	0	0	0	0	
Norfolk Boreas ⁵⁰	Max (km²)				292	2,490	292	2,490	292	2,490			Q4 2024- Q2 2025 - pre-construction survey. Q3 2025-Q1 2026 - UXO clearance. Q2 2026- Q3 2027 - foundation installation. Maximum 80 UXO.
	Min (km²)				0	383	0	383	0	383			
Tier 1b and 1c plus Hornsea Four	Max (km²)	16,379	3,148	17,320	1,090	19,810	1,508	19,810	1,508	19,810	1,216	13,751	
	Min (km²)	4,451	290	4,272	2	6,177	268	6,177	268	6,177	268	4,548	
Tier 1b and 1c plus Hornsea Four	Max (%)	61	25	64	9	73	12	73	12	73	10	51	
	Min (%)	16	2	16	0	23	2	23	2	23	2	17	
Tier 1d													
East Anglia One North ⁵¹	Max (km²)				2,124	1,175	2,124	1,175	2,124	1,175	2,124	1,175	Construction 2025-2028
	Min (km²)				2,089	305	2,089	305	2,089	305	2,089	305	
East Anglia Two ⁵²	Max (km²)						2,124	175	2,124	175	2,124	175	Construction 2026-2029
	Min (km²)						2,034	0	2,034	0	2,034	0	
Tier 2													

⁴⁸ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁴⁹ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁵⁰ Values calculated for the array boundary only, noting that UXO clearance (and piling in the cable corridor if required) may offer different values

⁵¹ Note – no concurrent piling mentioned in available documents and therefore not considered here. Values remain as per the single event.

⁵² Note – no concurrent piling mentioned in available documents and therefore not considered here. Values remain as per the single event.

Project	Temporal Overlap with Construction Window											Relevant Activity
	Summer (2023)	Winter (2023-24)	Summer (2024)	Winter (2024-25)	Summer (2025)	Winter (2025-26) ⁴⁶	Summer (2026)	Winter (2026-27)	Summer (2027)	Winter (2027-28)	Summer (2028)	
No projects screened in for assessment in Tier 2 onwards												

- 12.3.2.22 **Table 18** identifies the minimum and maximum combined spatial overlap for projects screened in for in-combination assessment within all seasons within which underwater noise during construction may occur at Hornsea Four, assuming that all such activity is limited to a maximum of a single event per day. The values for Tier 1 projects are sub-divided according to project status. These values should be viewed in the context of the project uncertainties highlighted above.
- 12.3.2.23 For Hornsea Four in-combination with all Tier 1b projects for one activity per day (no Tier 1a projects have been screened in, based on construction timeframes), it is clear that in all years and all seasons, the 20% threshold per day is not at risk based on minimum values, but is at risk based on maximum values for all projects during the summer seasons only (ie if all projects undertook works at the worst possible location on the same day in any summer season considered, there is risk of a threshold exceedance, discounting areas of overlap between projects). It is clear that during all winter seasons assessed, no exceedance of the 20% daily threshold is noted even at maximum values.
- 12.3.2.24 That trend is repeated when Tier 1c projects are added on, i.e. the minimum values all remain within the 20% daily threshold, while the maximum values for all summer seasons do not, this time including winter season 2023/24 only in those exceedances (during which pre-construction works may occur at Hornsea Four).
- 12.3.2.25 It should be noted that the above assessment does not take account of any overlap between a single piling event associated with individual projects – which would occur if all such activity occurred in the same day. Once such double counting is taken account, the remaining potential for overlap (based on each project piling at the worst possible location for each project, assuming an unrealistic build out and ignoring the timeframes evident in **Table 18**) is provided in **Table 18** below as a maximum design scenario.

Table 18: Potential for Overlap with the SNS SAC for Single Activity Only, Excluding Project Overlap.

Scenario		Winter Season Overlap		Summer Season Overlap	
		Km ²	%	Km ²	%
Hornsea Four plus Tier 1b projects (Dogger Creyke Beck A, Dogger Creyke Beck B, Dogger Teesside A, Sofia and East Anglia Three)	Max	1,827	14.4	9,036	33.4
	Min	289	2.3	5,664	21.0
Hornsea Four plus Tier 1b projects plus Tier 1c projects (Norfolk Vanguard, Hornsea Project Three, Norfolk Boreas)	Max	2,511	19.8	12,350	45.7
	Min	289	2.3	6,417	23.8

- 12.3.2.26 The minimum values above remain highly precautionary, as the timeframe of projects means that such a risk would not actually materialise, with the maximum values even more so (as this requires simultaneous works at all projects at the worst location). The values do, however, provide an indication of the reduction in potential effect afforded by removal of the 'double counting' that occurs from such overlap demonstrating the potential for

appropriate mitigation to work towards compliance with the threshold (as applied through the SIP).

12.3.2.27 **Table 17** provides the information for two activities per project in a single day (where that project identifies the potential for concurrent piling). For Hornsea Four plus Tier 1b projects, it is clear that all minimum values are within the threshold, as are all winter values. There is a risk of exceedance during the summer seasons, however, based on maximum values. For Hornsea Four together with Tier 1b and 1c, the minimum values again all fall below the 20% threshold in all cases, however for the maximum values all summer seasons and the winter season 2023-2024 (when pre-construction works may occur at Hornsea Four) indicate a risk of threshold exceedance.

12.3.2.28 When considering the risk of a threshold exceedance, the above needs to be taken in the context of project certainty as well as the precaution inherent in the assessment (a consistent theme with such assessments, as noted above and was explored for example by Hornsea Three during Examination). In particular, the following key points:

- The assessment assumes all projects will be active on the same day and in the worst possible location (a wholly unrealistic assumption);
- The assessment does not account for double counting between projects;
- Not all projects in the assessment currently hold consent;
- Not all projects in the assessment hold CfD, with the current CfD round having a cap on the available MW below that of the combined MW of projects bidding;
- It is normal for projects to be refined post consent, with the actual project constructed often being reduced in terms of WTC numbers (not necessarily in total capacity);
- It is normal for projects when constructed to require a much smaller and focused window for construction; and
- All projects within the in-combination assessment are subject to the same limitations as Hornsea Four as regards the SNS SAC.

12.3.2.29 Overall, despite the precaution inherent in the assessment, the assessment has enabled the identification of capacity within the thresholds (i.e. capacity between the minimum and maximum levels per project, in the context of project certainty/relevant tiers), providing the ability for appropriate measures to be in place to ensure that the daily 20% threshold is not exceeded. It is the purpose of the SIP to highlight these risks, and to identify the appropriate measures to be taken (and the timeframe attached to the SIP process) to ensure that Hornsea Four, alone or in-combination, would not exceed the 20% daily thresholds. Such a SIP is anticipated to be a requirement on all OWF within 26km of the SNS SAC going forward. The draft SIP for Hornsea Four will be provided with the application.

In-combination Effects on Disturbance Across A Season

12.3.2.30 As regards the consideration of the potential for an in-combination effect across a season (the 10% value), as for the assessment of the project alone a number of highly precautionary assumptions have been made (following the precedent set by the determination for the

project alone in [Section 11](#)). These are based on three scenarios (all assuming a maximum of 1 activity per day per project):

- **Scenario 1 (to test the requirement for UXO clearance at Hornsea Four):** Hornsea Four plus Tier 1b and 1c projects in winter season 2023/2024. Assumes 84 UXO clearances at Hornsea Four in total, of which it is assumed that up to 20 may occur within range of the winter extents of the SNS SAC (one per day for 20 days, each at the worst location possible), together with piling at East Anglia Three and Norfolk Vanguard (the only projects with potential for overlap in that season). East Anglia Three has at most 172 WTC, therefore piling is assumed to occur on 172 days; Table 8.17 of the Norfolk Vanguard Information for HRA⁵³ has total piling days per season as 59 days as a maximum, with that value applied here (the overlap for both based on an average value of the min/max overlap possible);
- **Scenario 2 (to test piling at the Hornsea Four HVAC station in a winter season):** Hornsea Four plus Tier 1b and 1c projects in winter season 2026/2027 – assumes 20 days of piling at the HVAC location for Hornsea Four (the only piling location with winter season overlap) together with piling at Norfolk Vanguard and Norfolk Boreas (the only projects with overlap in a winter season when HVAC piling may occur). Table 8.17 of the Norfolk Vanguard Information for HRA⁵⁴ has total piling days per season as 59 days as a maximum. Similarly, Table 8.18 of the Norfolk Boreas Information for HRA⁵⁵ has a total of 54 piling days per season as a maximum, with those values applied here (the overlap for both based on an average value of the min/max overlap possible); and
- **Scenario 3 (to test Hornsea Four array piling in a summer season):** Hornsea Four plus Tier 1b and 1c projects in summer season 2026 – assumes piling at Hornsea Four, together with piling at Dogger Creyke Beck A, Dogger Creyke Beck B, Dogger Teesside A, Sofia, Norfolk Vanguard, Hornsea Project Three (project HRA has 111 piling days per summer season⁵⁶) and Norfolk Boreas (Norfolk Vanguard and Boreas piling days as above) (the overlap for all based on an average value of the min/max overlap possible).

12.3.2.31 Based on the above assumptions, the temporal assessment (the 10% threshold within a season) is not exceeded in Scenario 1 or 2 – being 9.5% in Scenario 1 (noting that only a proportion of the Hornsea Four export cable corridor is within range of the winter seasonal extents) and 2.0% in Scenario 2, the latter demonstrating capacity for additional piling days at the HVAC location if required. The same conclusions applies to all winter seasons within the construction window, when UXO clearance or piling at the HVAC station may occur.

12.3.2.32 As regards Scenario 3, the number of projects whose piling window includes summer 2026 means that there is a risk of the 10% seasonal threshold being exceeded, should all projects

⁵³<https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001479-5.03%20Norfolk%20Vanguard%20Information%20to%20Support%20HRA.pdf>

⁵⁴<https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001479-5.03%20Norfolk%20Vanguard%20Information%20to%20Support%20HRA.pdf>

⁵⁵[https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000374-5.3%20Information%20to%20Support%20Habitats%20Regulations%20Assessment%20Report%20\(HRA\).pdf](https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000374-5.3%20Information%20to%20Support%20Habitats%20Regulations%20Assessment%20Report%20(HRA).pdf)

⁵⁶https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-000521-HOW03_5.2_Report%20to%20Inform%20Appropriate%20Assessment.pdf

be in a position to construct to the maximum level assessed. Similar issues apply to all summer seasons. It is clear that the risk is highly precautionary and an over estimate, for a number of reasons:

- For a number of the projects, no total piling days exist and therefore it is assumed that piling would occur every day of the season (an assumption that would not in reality be feasible);
- A number of the projects have a very large construction window and it is extremely unlikely that all projects will be in a position to construct within the same summer season (and for individual projects to the extent assumed);
- As noted above, the Tiering structure reflects project certainty, with significant uncertainty for most of the projects as regards final scheme design and for all projects final construction window; and
- All projects within the in-combination assessment are similarly constrained by the SNS SAC and the requirement for a SIP – which will prevent any project exceeding the thresholds alone or in-combination.

12.3.2.33 Given that Hornsea Four will require a SIP (to be submitted at Application) to provide certainty of no AEol with respect to the SNS SAC, the following table summarises the risks in a summer season of piling at Hornsea Four as regards the 10% seasonal threshold. From **Table 19**, it is clear that the key risks in-combination are due to assumptions that piling will occur each day of the same season at Hornsea Four, Dogger Creyke Beck A and Dogger Creyke Beck B, and to a lesser extent at Sofia, a scenario that is not technically feasible. All these projects are likely to be subject to the requirement for a SIP⁵⁷, which provides certainty that the thresholds will not be breached by any project.

⁵⁷https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/753026/RoC_SNS_cSAC_HRA_5.0.pdf

Table 19: Summary of Risk to the 10% Threshold In-Combination from Piling in a Summer Season.

Project	Tier	Activities per season ⁵⁸	Average % overlap per day	Average % per season	Threshold Risk?
Hornsea Four	N/A	Assumed that piling will occur every day (183 of 183).	6.75%	6.75%	Represents a considerable proportion. However, it is extremely unlikely that piling would (could) occur every day of the season. Capacity therefore exists for mitigation through management of activities.
Dogger Creyke Beck A	1b		6.24%	6.24%	As yet does not hold CfD. It is extremely unlikely that piling would (could) occur every day of the season. Will require consideration of the SNS SAC.
Dogger Creyke Beck B	1b		6.81%	6.81%	As yet does not hold CfD. It is extremely unlikely that piling would (could) occur every day of the season. Will require consideration of the SNS SAC.
Dogger Teesside A	1b		0.05%	0.05%	Very small contribution to the total. As yet does not hold CfD. It is extremely unlikely that piling would (could) occur every day of the season. Will require consideration of the SNS SAC.
Sofia	1b		3.03%	3.03%	As yet does not hold CfD. It is extremely unlikely that piling would (could) occur every day of the season. Will require consideration of the SNS SAC.
Norfolk Vanguard	1c	59 days (see note above regarding the project level HRA)	4.39%	1.42%	Small contribution to the total. Awaiting a decision post Examination. Will require consideration of the SNS SAC.

⁵⁸ The summer season is 183 days

Project	Tier	Activities per season ⁵⁸	Average % overlap per day	Average % per season	Threshold Risk?
Hornsea Project Three	1c	111 days (project HRA ⁵⁹)	0.81%	0.49%	Very small contribution to the total. Awaiting a decision post Examination. Will require consideration of the SNS SAC.
Norfolk Boreas	1c	54 days (see note above regarding the project level HRA)	1.51%	0.45%	Very small contribution to the total. Currently progressing through Examination. Will require consideration of the SNS SAC.

⁵⁹ https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-000521-HOW03_5.2_Report%20to%20Inform%20Appropriate%20Assessment.pdf

- 12.3.2.34 It is clear from [Table 20](#) that where a project applies a more realistic number of piling days in a season, the proportional contribution of that project to the overall totals reduces considerably. The risks to the 10% seasonal threshold in [Table 19](#) above come from those projects that do not identify a maximum number of piling days per season (a scenario that is technically not feasible); that risk would be managed through the SIP process.

How the SIP will Manage Adherence to the Thresholds

- 12.3.2.35 The draft SIP will be provided with the Application and will address the key points identified in Section 9.3. In particular, confirmation of the relevant project design for Hornsea Four alone but also the in-combination scenario, to confirm the risk and ensure measures in place address that risk (drawing on the range of mitigation options available).
- 12.3.2.36 It is important to note that the understanding of underwater noise, the potential for impact and how best to mitigate it is constantly evolving. For example, it is understood that a research project is currently underway (during 2019) that is hoped will provide much greater clarity on the risk posed by UXO clearance. A recent paper by SMRU⁶⁰ also highlights how solutions to underwater noise are constantly developing. Further, the recent paper by Hastie *et al* (2019) provide evidence, for the first time, demonstrating the change in impulsive noise to non-impulsive noise characteristics over distance, which when developed further is expected to considerably affect predicted impact ranges for impulsive noise sources (such as piling and UXO). The SIP will draw on such advances and ensure, in the context of the risks posed by Hornsea Four alone or in-combination, that the daily 20% and seasonal 10% thresholds with respect to the SNS SAC are not exceeded.
- 12.3.2.37 In that context, it can be concluded that, with the mitigation afforded by the SIP, the piling-MMMP and the anticipated requirement for a UXO-MMMP (and certainty on their delivery given the requirement to consult with SNCBs), an AEoI will not occur as a result of disturbance to harbour porpoise (as defined by the daily 20% and seasonal 10% thresholds) in-combination with other projects during all relevant seasons, within which geophysical survey, UXO clearance and piling activity may take place at Hornsea Four.

Seismic and geophysical survey

- 12.3.2.38 No specific information on the requirement for seismic and geophysical survey for Hornsea Four alone are identified at this point; further detail will be provided at application as it becomes available. In any case, the potential for effect from such surveys will be less than that considered here for UXO clearance (and occurring within that timeframe). No specific information on such surveys in-combination has been identified within the relevant timeframe for inclusion in the assessment here.

Key Points for Hornsea Four in-combination with respect to the SNS SAC

⁶⁰ <https://www.nature.scot/snh-research-report-1070-review-noise-abatement-systems-offshore-wind-farm-construction-noise-and>

- 12.3.2.39 A summary of the key points for Hornsea Four in relation to the SNS SAC are provided in [Table 20](#) below.
- 12.3.2.40 In the context of the piling-MMMP, the SIP and the anticipated requirement for a UXO-MMMP, there is, therefore, no AEol resulting from disturbance of harbour porpoise within the SNS SAC from Hornsea Four alone or in-combination and therefore, subject to natural change, the feature will be maintained in the long-term.

Table 20: Summary of the In-Combination Risk for Hornsea Four and the SNS SAC.

Project Element	Winter Season	Summer Season	Risk Management
Piling within the array boundary	No potential for overlap and therefore no implications for the SNS SAC	Risk of exceedance of the daily 20% threshold on a maximum basis in-combination only, depending on which projects are in a position to proceed. Risk of exceedance of the seasonal 10% threshold in-combination depending on the number of piling days committed to in a season by individual projects, location of any such piling and which projects are in a position to proceed.	Requirement for a SIP is becoming a typical requirement for OWF within 26km of the SNS. The SIPs are provided for within individual project DCOs and provide management and mitigation measures that ensure compliance with the thresholds.
Piling at the HVAC station	Minimal potential for overlap. No Tier 1b projects contribute in-combination, with East Anglia Three representing a Tier 1c risk based on maximum values.	Potential for overlap from piling at the HVAC is less than in the array and therefore the risk is less than that described for array piling.	Risk is far less than piling within the array.
UXO clearance within the array boundary	No potential for overlap and therefore no implications for the SNS SAC	Risk of exceedance of the daily 20% threshold on a maximum basis in-combination only, depending on which projects are in a position to proceed. Risk of exceedance of the seasonal 10% threshold depending on the number of piling days committed to in a season by individual projects, location of works and which projects are in a position to proceed.	Requirement for a SIP is expected to be universal for OWF within 26km of the SNS. The SIPs are provided for within individual project DCOs and provide management and mitigation measures that ensure compliance with the thresholds.
UXO clearance within the export cable corridor	Some locations are outside consideration of the SNS SAC. Potential for daily threshold exceedance in-combination depending on UXO location and activity at East Anglia Three and Norfolk Vanguard.	Some locations are outside consideration of the SNS SAC. Potential for daily threshold exceedance in-combination depending on UXO location and activity at other Tier 1b and 1c offshore wind farms. Seasonal threshold risk less than for piling.	Requirement for a SIP is expected to be universal for OWF within 26km of the SNS. The SIPs are provided for within individual project DCOs and provide management and mitigation measures that ensure compliance with the thresholds.

Project Element	Winter Season	Summer Season	Risk Management
	Seasonal threshold complied with (if UXO within range of the winter extents limited to 20).		
Geophysical and seismic survey	Very small contribution to totals for a small area of the export cable corridor. Risk much reduced from that for UXO and piling.	Very small contribution to totals for a small area of the export cable corridor. Risk much reduced from that for UXO and piling.	Requirement for a SIP is expected to be universal for OWF within 26km of the SNS. The SIPs are provided for within individual project DCOs and provide management and mitigation measures that ensure compliance with the thresholds.

- 12.3.2.41 For the purposes of the assessment of AEol in-combination for harbour porpoise, the methodology applied to the assessment alone for the Conservation Objectives concerned with the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC, has been extended to consider the potential for effect from the above projects in-combination.
- 12.3.2.42 The Advice on Activities refers to supporting habitats as 'the characteristics of the seabed and water column' in the context of 'ensuring prey is maintained within the site'. Potential for supporting habitats and processes to be affected are considered within [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#). That chapter has concluded at most a minor adverse effect (which is not considered significant in EIA terms), with no significant cumulative effects on physical processes identified.
- 12.3.2.43 There is, therefore, no AEol to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from Hornsea Four alone or in-combination and therefore, subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.

Consideration of Harbour Seal and Grey Seal

- 12.3.2.44 [Table 21](#) below provides further information on the potential for temporal and spatial in-combination effects in relation to the above plans and projects screened in for assessment in relation to harbour seal and grey seal sites only. It should be noted that the location of the projects screened in is such that each project is relevant to a different suite of transboundary sites.

Table 21: Plans and Projects Relevant In-Combination to Harbour Seal and grey Seal Sites.

Designated Site	Relevant Species	Project	Timing of Effect
The Wash and North Norfolk Coast SAC	Harbour seal	East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		Hornsea Three	All works
		Norfolk Boreas	Construction period
		EA One North	Construction period
		EA Two	Construction period
Humber Estuary SAC	Grey seal	Hornsea Three	All works
Humber Estuary Ramsar	Grey seal	Hornsea Three	All works
Berwickshire and North Northumberland SAC	Grey seal	SeaGreen Delta	Unclear
		DeaGreen Charlie	Unclear
Doggersbank SCI	Harbour seal and grey seal	Hornsea Three	All works
		Dogger Creyke Beck A	All works
		Dogger Creyke Beck B	All works
		Dogger Teesside	All works
		Sofia	All works
	Grey seal only	Norfolk Boreas	Construction period
Klaverbank SCI	Harbour seal and grey seal	East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		Hornsea Three	All works
		Norfolk Boreas	Construction period
		Dogger Creyke Beck A	All works
		Dogger Creyke Beck B	All works
		Dogger Teesside	All works
		Sofia	All works
Bancs des Flandres SCI	Grey seal	East Anglia Three	Pre-construction
		EA One North	Construction period
		EA Two	Construction period
Vlaamse Banken SCI	Grey seal	East Anglia Three	Pre-construction

Hornsea 4



Designated Site	Relevant Species	Project	Timing of Effect
		Norfolk Vanguard	All works
		EA One North	Construction period
		EA Two	Construction period
SBZ 1 SCI	Grey seal	East Anglia Three	Pre-construction
		EA One North	Construction period
		EA Two	Construction period
SBZ 2 SCI	Grey seal	East Anglia Three	Pre-construction
		EA One North	Construction period
		EA Two	Construction period
SBZ 3 SCI	Grey seal	East Anglia Three	Pre-construction
		EA One North	Construction period
		EA Two	Construction period
Vlakte van de Raan SCI	Grey seal	East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		EA One North	Construction period
		EA Two	Construction period
Westerschelde & Saeftinghe SCI	Grey seal	East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		EA One North	Construction period
		EA Two	Construction period
Voordelta SCI	Grey seal	East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		Norfolk Boreas	Construction period
		EA One North	Construction period
		EA Two	Construction period
Noordzeekustzone SCI	Grey seal	East Anglia Three	Pre-construction works
		Norfolk Vanguard	All works
		Hornsea Three	All works
		Norfolk Boreas	Construction period
		EA One North	Construction period

Designated Site	Relevant Species	Project	Timing of Effect
Waddenzee SCI	Grey seal	Borkum Riffgrund West	Pre construction
		EnBW He Dreiht	Pre construction
		East Anglia Three	Pre-construction
		Norfolk Vanguard	All works
		Norfolk Boreas	Construction period
		EnBW He Dreiht	Pre construction

- 12.3.2.45 Consideration of the potential for an in-combination effect on harbour seal and grey seal, on a site by site basis, applies the same conservation objectives as the assessment alone. For harbour seal and grey seal, the relevant points effectively relate to the habitat (its structure and function, extent and distribution and the supporting processes on which the habitats depend) together with the population and distribution of the species.
- 12.3.2.46 For both species there is no potential for underwater noise alone or in-combination to affect the habitats utilised by seals. [Volume 2, Chapter 3: Fish and Shellfish Ecology](#) found the potential for effect on fish species to be not significant in EIA terms. There is, therefore, no AEol to the supporting habitats relevant to harbour seal and grey seal and their prey for any of the sites under consideration as a result of Hornsea Four alone or in-combination and therefore, subject to natural change, the supporting habitat for grey seal and harbour seal prey will be maintained in the long-term.
- 12.3.2.47 The potential for Hornsea Four to contribute to any in-combination risk of injury (defined as PTS) with respect to harbour seal and grey seal is considered to be negligible, given that the unmitigated effect for the project alone is less than one animal, based on a PTS range of <100m (a precautionary maximum, being the minimum range feasible within the model). Such an effect is fully provided for within the piling-MMMP and the anticipated requirement for a UXO-MMMP, with the mitigation area exceeding the <100m range of effect. There is, therefore, no potential for AEol with respect to injury (PTS) for harbour seal or grey seal for any of the sites under consideration as a result of Hornsea Four alone or in-combination and therefore, subject to natural change, the population and distribution of grey seal and harbour seal will be maintained in the long-term.
- 12.3.2.48 With respect to the potential for an in-combination effect on the population and distribution of harbour seal and grey seal, the risk applies to harbour seal and grey seal at sea regardless of the site within which they are associated and therefore is considered here on a species by species basis (not withstanding seals from some sites having a greater potential for connectivity with the region around Hornsea Four than others). It should be noted that [Section 4.12.1](#) of [Volume 2, Chapter 4: Marine Mammals](#) excluded harbour seal from the cumulative assessment on the basis that 'disturbance from underwater noise during construction to ... and harbour seals due to the negligible levels predicted for these species in the project alone assessment'.
- 12.3.2.49 [Volume 2, Chapter 4: Marine Mammals](#) in [Section 4.12.2](#) identifies the potential for an underwater noise from Tier 2 projects (defined in the Chapter as projects with consent but no CfD, analogous to the Tier 1b projects considered here), finding the potential for a temporary disturbance of up to 2.12% of the grey seal population. The effect was considered to be localised to individual projects and although up to 2% of the population may be affected, on average over the whole period that effect was less than 1%. When the Chapter added in Tier 3 projects (being projects for which an application has been submitted but not yet determined, analogous to the Tier 1c projects considered here), the potential for disturbance at population level rose slightly to 2.3% as a maximum but for a reduced period of time (7 months). Again, when averaged over the period that level reduced to less than 1%. Such an effect was concluded to be minor adverse and therefore not significant in EIA terms. The much lower density of harbour seal means that the potential for effect on that species would be significantly lower than for grey seal.

Table 22: Potential for AEol with Respect to Harbour Seal and Grey Seal Population and Distribution.

Designated Site	Relevant Species	Relevant Risk	Conclusion
The Wash and North Norfolk Coast SAC	Harbour seal	Very low levels of harbour seal found at Hornsea Four, with the Marine Mammal Chapter finding the levels so low that no cumulative assessment was required. There is no potential for the short term and temporary disturbance from Hornsea Four to contribute to an in-combination effect on the harbour seal population at the Wash and North Norfolk Coast SAC.	No AEol
Humber Estuary SAC	Grey seal	The cumulative assessment in Volume 2, Chapter 4: Marine Mammals in Figure 4.21 found the potential for grey seal disturbance at Hornsea Four and Hornsea Three to overlap, i.e. the disturbance would not be additive, with very little difference in overall disturbance levels when the two projects were combined. Given that the assessment for Hornsea Four alone is no AEol, and even at population level the PEIR considered the effect to be not significant, there is no potential for the short term and temporary disturbance from Hornsea Four to contribute to an in-combination effect on the grey seal population at the Humber Estuary SAC and Ramsar.	No AEol
Humber Estuary Ramsar	Grey seal		
Berwickshire and North Northumberland SAC	Grey seal	The SAC is located a considerable distance from the area of potential disturbance associated with Hornsea Four (171km) with a number of other foraging grounds apparent for the colony, with uncertainty around the construction window for both SeaGreen projects (required to commence within 5 years of August 2018). Given the not significant effect at population level, and the relatively low connectivity at site level, there is no potential for the short term and temporary disturbance from Hornsea Four to contribute to an in-combination effect on the grey seal population at the Berwickshire and North Northumberland SAC.	No AEol
Doggersbank SCI	Harbour seal	Although the Doggersbank SCI is within screening range of Hornsea Four (with all the Dogger projects being much closer), the at sea usage of harbour seals from the UK do not show significant connectivity (see Figure 31 of Volume 5, Annex 4.1: Marine Mammals Technical Report), indicating that the location of Hornsea Four does not appear to lie between UK coastal harbour seal sites and the Doggersbank SCI. However Figure 33 from the same report similarly does not show significant connectivity to the Dutch coast. In any case, the very low contribution of Hornsea Four to any in-combination effect results in a conclusion of no AEol on the Doggersbank SCI population.	No AEol
	Grey seal	Although the Doggersbank SCI is within screening range of Hornsea Four (with all the Dogger projects being much closer), the at sea usage of grey seals from the UK shows limited connectivity, having greater activity to the west of the SCI (see Figure 36 of Volume 5, Annex 4.1: Marine Mammals Technical Report), indicating that the location of Hornsea Four does not appear to lie between UK	No AEol

Designated Site	Relevant Species	Relevant Risk	Conclusion
		coastal grey seal sites and the Doggersbank SCI. Figure 39 from the same report appears to show greater connectivity with the Dutch coast (although the seal track in question ranges very widely). Despite being within the screening range of Hornsea Four, the SCI lies beyond the range of disturbance effect and there does not appear to be significant linkages between the areas of sea, with no potential for Hornsea Four to result in an in-combination effect on the Doggersbank SCI population.	
Klaverbank SCI	Harbour seal and grey seal	The assessment for the Klaverbank SCI mirrors that for the Doggersbank SCI above. Although the Klaverbank lies to the south of the Doggersbank SCI, the observations on at sea usage by harbour seal and grey seal apply equally to both SCIs, with the potential for impact from Hornsea Four remaining the same.	No AEol
Bancs des Flandres SCI	Grey seal	The Bancs des Flandres SCI is located some 296km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three) or two projects yet to submit an application (referred to here as Tier 1d projects). There is therefore limited potential for an in-combination effect with any degree of certainty. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal as a result of Hornsea Four in-combination.	No AEol
Vlaamse Banken SCI	Grey seal	The Vlaamse Banken SCI is located some 278km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three), from Norfolk Vanguard or two projects yet to submit an application (referred to here as Tier 1d projects). There is therefore limited potential for an in-combination effect with any degree of certainty, with Norfolk Vanguard lying between Hornsea Four and the SCI in any case. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal as a result of Hornsea Four in-combination.	No AEol
SBZ 1 SCI	Grey seal	The SCIs are all located >300km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three) or two projects yet to submit an application (referred to here as Tier 1d projects). There is limited potential for an in-combination effect with any degree of certainty. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is	No AEol
SBZ 2 SCI			

Designated Site	Relevant Species	Relevant Risk	Conclusion
SBZ 3 SCI		no potential for a significant effect on the population and distribution of grey seal as a result of Hornsea Four in-combination.	
Vlakte van de Raan SCI	Grey seal	The Vlakte van de Raan SCI is located some 292km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three), from Norfolk Vanguard or two projects yet to submit an application (referred to here as Tier 1d projects). There is limited potential for an in-combination effect with any degree of certainty, with Norfolk Vanguard lying between Hornsea Four and the SCI in any case. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal from Hornsea Four in-combination.	No AEol
Westerschelde & Saeftinghe SCI	Grey seal	The Westerschelde & Saeftinghe SCI is located some 301km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three), from Norfolk Vanguard or two projects yet to submit an application (referred to here as Tier 1d projects). There is limited potential for an in-combination effect with any degree of certainty, with Norfolk Vanguard lying between Hornsea Four and the SCI in any case. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal as a result of Hornsea Four in-combination.	No AEol
Voordelta SCI	Grey seal	The Voordelta SCI is located some 272km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three), from Norfolk Vanguard, Norfolk Boreas and two projects yet to submit an application (referred to here as Tier 1d projects). Despite the increase in potential project activity, a number have significant uncertainty, and all lie between Hornsea Four and the SCI. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal from Hornsea Four in-combination.	No AEol
Noordzeekustzone SCI	Grey seal	The Noordzeekustzone SCI is located some 221km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three, Borkum Riffgrund West and EnBW He Dreiht), from Norfolk Vanguard, Norfolk Boreas and two projects yet to submit an application (referred to here as Tier 1d projects). Despite the increase in	No AEol

Designated Site	Relevant Species	Relevant Risk	Conclusion
		potential project activity, a number have significant uncertainty, and all UK projects lie between Hornsea Four and the SCI. Further, the non UK projects do not have a specified construction window, but a commissioned date and it is therefore not certain that there will be any overlap of construction activity. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal from Hornsea Four in-combination.	
Waddenzeel SCI	Grey seal	The Waddenzeel SCI is located some 229km from Hornsea Four, with the potential for in-combination effect coming during the pre-construction period at Hornsea Four (with East Anglia Three and EnBW He Dreiht), from Norfolk Vanguard and Norfolk Boreas. All the UK projects lie between Hornsea Four and the SCI, with the non UK project not having a specified construction window, but a commissioned date, and it is therefore not certain that there will be any overlap of construction activity. Compounded with the considerable distance between SCI and Hornsea Four, with numerous foraging grounds in between both locations, there is no potential for a significant effect on the population and distribution of grey seal as a result of Hornsea Four in-combination.	No AEol

- 12.3.2.50 There is, therefore, no AEol to the population and distribution of harbour seal and grey seal for any of the sites under consideration as a result of Hornsea Four alone or in-combination and therefore, subject to natural change, the population and distribution of grey seal and harbour seal will be maintained in the long-term.

Vessel Disturbance

- 12.3.2.51 The potential for an AEol in-combination as a result of vessel disturbance on marine mammals during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.
- Southern North Sea SAC (harbour porpoise);
 - The Wash and North Norfolk Coast SAC (harbour seal);
 - Humber Estuary SAC (grey seal);
 - Humber Estuary Ramsar (grey seal);
 - Berwickshire and North Northumberland Coast SAC (grey seal);
 - Transboundary sites (two sites for harbour seal); and
 - Transboundary sites (twelve sites for grey seal).
- 12.3.2.52 **Volume 2, Chapter 4: Marine Mammals** considers the potential for disturbance to marine mammals from vessels as part of the overall risk of disturbance from projects resulting from underwater noise. Effectively, it is difficult to separate the two out, with the potential for disturbance from vessels tending to sit inside (and being less in terms of extent) than potential for disturbance from activities such as piling. Further, the localised nature of vessel disturbance to individual projects, and the widespread nature of those projects, within the context of the overall habitat availability for harbour porpoise, harbour seal and grey seal means that the potential for an in-combination effect is minimal.
- 12.3.2.53 Specifically, under **Section 4.12.2 of Volume 2, Chapter 4: Marine Mammals** identifies that 'during piling operations no additional disturbance is included as a result of vessel activity but during the non-piling parts of each OWF construction schedule, a small local disturbance effect of a maximum radius of 1 km is assumed as a result of non-piling construction noise (including vessels) (this equates to 3 porpoises and a single grey seal). The potential for underwater noise disturbance to affect harbour seals and grey seals associated with sites screened in is provided in **Table 22** above, concluding no AEol in all cases. Outside the periods of piling, it is considered that the potential for disturbance to (at most) a single grey seal is insufficient to result in any in-combination effect on grey seal (with the potential for effect on harbour seal being even less).
- 12.3.2.54 It can therefore be concluded that therefore, no AEol to the habitat (its structure and function, extent and distribution and the supporting processes on which the habitats depend) together with the population and distribution of the species of harbour seal and grey seal for any of the sites under consideration as a result of Hornsea Four alone or in-

combination and therefore, subject to natural change, the population and distribution of grey seal and harbour seal will be maintained in the long-term.

Collision Risk

- 12.3.2.55 The potential for an AEol in-combination as a result of collision risk on marine mammals during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.
- Southern North Sea SAC (harbour porpoise);
 - Humber Estuary SAC (grey seal); and
 - Humber Estuary Ramsar (grey seal).
- 12.3.2.56 There is currently a lack of information on the frequency of occurrence of vessel collisions as a source of marine mammal mortality. There is little evidence from marine mammals stranded in the UK that injury from vessel collisions is an important source of mortality. The UK Cetacean Standings Investigation Programme (CSIP) data (cited in [Volume 2, Chapter 4: Marine Mammals](#)) shows that very few standings have been attributed to vessel collisions, therefore, while there is evidence that mortality from vessel collisions can and does occur, it is not considered to be a key source of mortality highlighted from post mortem examinations.
- 12.3.2.57 Harbour porpoise and seals are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision. Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (e.g. Nowacek *et al.* 2001, Lusseau 2003, 2006). The vessel management plan for Hornsea Four (a document typically produced for offshore wind farms) will ensure that vessel traffic moves along predictable routes and will define how vessels should behave in the presence of marine mammals. Further, it is highly likely that a proportion of vessels will be stationary or slow moving throughout construction activities for significant periods of time, particularly smaller vessels. Therefore, the actual increase in vessel traffic moving around the site and to/from the port to the site will occur over short periods of the offshore construction activity.
- 12.3.2.58 [Volume 2, Chapter 4: Marine Mammals](#) found, in [Section 4.12.2](#) that it is extremely difficult to reliably quantify the increased collision risk to marine mammals resulting from increased vessel activity on a cumulative basis, given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with the spatial and temporal variation in marine mammal movements across the region. In addition, vessel routes to and from offshore windfarms and other projects will use existing vessel routes where marine mammals will be accustomed to, and potentially habituated to, regular vessel movements and therefore the additional risk is confined mainly to construction sites. Vessel movements within construction areas are likely to be limited and relatively slow. In addition, most projects (and including Hornsea Four) are likely to adopt vessel management

plans in order to minimise any potential effects on marine mammals. Overall, the chapter found that the increases risk in-combination is low, with no predicted significant effect on the trajectory or size of any marine mammal population. The significance of effect was found to be minor, which is not significant in EIA terms.

- 12.3.2.59 It can therefore be concluded that Hornsea Four will not contribute to any in-combination collision risk to any marine mammal species associated with the designated sites screened in for assessment and that there will be no AEol to the marine mammal features of these sites as a result of collision risk from Hornsea Four alone or in-combination.

12.3.3 Operation and maintenance

Increase in Underwater Noise

- 12.3.3.1 The potential for an AEol in-combination as a result of underwater noise on marine mammals during operation and maintenance relates to the following designated site and the relevant feature (i.e. the feature screened in for potential LSE):
- SNS SAC (harbour porpoise).
- 12.3.3.2 [Section 4.10.5](#) of the [Volume 2, Chapter 4: Marine Mammals](#) found that there are very few data available on the underwater noise levels produced by operational wind farms, however, is expected that the operational noise produced by WTGs will increase with increasing rotor size. The MDS for Hornsea Four is a WTG rotor diameter of 305 m, however there are currently no measured empirical data on the sound that these size turbines will produce. Therefore, an assessment was made based on extrapolations from measured data from operational offshore wind farms sites with smaller sizes rotors (see [Volume 4, Annex 4.5: Subsea Noise Technical Report](#)). Data were available for the underwater noise generated by WTGs with rotor diameters between 107 and 120 m at a range of water depths from 0 to 15 m in a range of sediment types. These are smaller than the maximum 305 m rotor diameter at Hornsea Four, and in shallower waters than at Hornsea Four. Subacoustech assumed a linear fit to extrapolate the data out to larger rotor diameters, however it was highlighted that this was the most conservative extrapolation method and that this will likely overestimate true operational noise levels from the largest WTGs planned for Hornsea Four.
- 12.3.3.3 A summary of operational noise from Hornsea Four alone is provided in [Section 11](#). The conclusion of no risk of PTS for the project alone results in a conclusion of no AEol in-combination. Similarly, the risk to harbour porpoise prey alone is viewed as negligible, being an effect only at very close range to individual turbines. Such a small and localised effect from projects dispersed across the SNS SAC is not considered to result in AEol in-combination.
- 12.3.3.4 As regards the risk of disturbance to harbour porpoise from operational noise from Hornsea Four in-combination, the low level and localised nature of sound predicted to result from individual turbines, combined with the lack of evidence in general of displacement of

harbour porpoise following construction of an offshore wind farm supports the conclusion that any response would be highly localised to individual turbines. Indeed, the potential for effect from operational noise is considered so low that the Marine Mammal chapter for PEIR screened it out from cumulative assessment for all species based on the 'localised effects and an assessment of negligible significance in the project alone assessment'.

- 12.3.3.5 It is therefore concluded that operational noise from Hornsea Four alone or in-combination will not, subject to natural change, result in any AEol and that the marine mammal feature will be maintained in the long term with respect to operational noise.

Vessel Disturbance

- 12.3.3.6 The potential for an AEol in-combination as a result of vessel disturbance on marine mammals during operation and maintenance relates to the following designated sites and the relevant features (i.e. the features screened in for potential LSE):

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (two sites for harbour seal); and
- Transboundary sites (twelve sites for grey seal).

- 12.3.3.7 **Volume 2, Chapter 4: Marine Mammals** considers the potential for disturbance to marine mammals from vessels during operation and maintenance. Effectively, it is extremely difficult to reliably quantify the level of increased noise related disturbance to marine mammals resulting from increased vessel activity on a cumulative basis given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with the spatial and temporal variation in marine mammal movements across the region.

- 12.3.3.8 Vessel routes to and from offshore windfarms and other projects will use existing vessel routes where marine mammals will be accustomed to regular vessel movements and therefore the underwater noise from vessels will already be an existing feature of the ambient noise landscape. Vessel activity within array areas are likely to be limited and relatively slow. Increases in underwater noise from vessels during the operational phases of projects are likely to be small in relation to current and ongoing levels of shipping. The potential for effect is predicted to be highly localised, intermittent and reversible for the duration of the project. Such a low-level additional contribution to existing levels of shipping disturbance is not predicted (**Section 4.12.3**) to have a significant effect on the trajectory or size of any marine mammal population.

- 12.3.3.9 It can therefore be concluded that therefore, no AEol will result from vessel related disturbance for any of the sites under consideration as a result of Hornsea Four alone or in-

combination and therefore, subject to natural change, the features will be maintained in the long-term.

Collision Risk

- 12.3.3.10 The potential for an AEol in-combination as a result of collision risk on marine mammals during operation and maintenance relates to the following designated sites and the relevant features (i.e. the features screened in for potential LSE):
- Southern North Sea SAC (harbour porpoise);
 - Humber Estuary SAC (grey seal); and
 - Humber Estuary Ramsar (grey seal).
- 12.3.3.11 **Volume 2, Chapter 4: Marine Mammals** considers the potential for disturbance to marine mammals from vessels during operation and maintenance in **Section 4.12.3**. Effectively, it is extremely difficult to reliably quantify the level of increased collision risk to marine mammals resulting from increased vessel activity on a cumulative basis given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with the spatial and temporal variation in marine mammal movements across the region. As such, the assessment presented at PEIR considers the increased potential for collision with marine mammals, due to the potential increase in vessel movements from the operation of Hornsea Four with other planned or existing projects, plans and activities.
- 12.3.3.12 Vessel routes to and from offshore windfarm and other projects will use existing vessel routes where marine mammals will be accustomed to regular vessel movements and therefore the additional risk is confined mainly to the OWF sites themselves. Vessel movements within array areas are likely to be limited and relatively slow. In addition, most projects are likely to adopt vessel management plans to ensure the risk of collision to marine mammals is minimised. Marine mammals in the area are also likely to be habituated to the presence of vessels.
- 12.3.3.13 Vessel activity within array areas are likely to be limited and relatively slow. The potential for effect is predicted to be irreversible for any individual, although the overall increased risk of such incidents is considered to be low. Such a low-level additional contribution to existing levels of collision risk mortality is not predicted (**Section 4.12.3**) to have a significant effect on the trajectory or size of any marine mammal population.
- 12.3.3.14 It can therefore be concluded that therefore, no AEol will result from vessel collision risk for any of the sites under consideration as a result of Hornsea Four alone or in-combination and therefore, subject to natural change, the features will be maintained in the long-term.

12.4 Offshore Ornithology

- 12.4.1.1 A description of the significance of project level effects upon the receptors grouped under 'offshore ornithology', as relevant to the designated sites and their associated features screened in for LSE is provided below.

12.4.2 Construction and Decommissioning

- 12.4.2.1 Following the HRA Screening process undertaken for this RIAA no potential effects were considered to require further assessment during the construction of decommissioning phase in-combination with other plans or projects. This is due to Hornsea Four having no proposed overlap with other projects within a reasonable distance that would be considered to occur at the same time on the same features of designated sites reviewed for this RIAA.

12.4.3 Operation and maintenance

Direct disturbance and displacement

- 12.4.3.1 The potential for offshore wind farms direct disturbance and displacement to result in an AEoI in-combination with Hornsea Four relates to the following designated sites and the relevant features:
- Flamborough and Filey Coast SPA; guillemot, razorbill and puffin.
- 12.4.3.2 This site and the relevant interest features identified were screened in for LSE for the project 'alone' and the attribution of the predicted displacement mortality. With the project 'alone' displacement and attribution having been completed the assessment of potential in-combination impacts can be carried out on a quantitative basis.
- 12.4.3.3 The quantitative assessment of all other sites for displacement alone has identified that the Hornsea Four does not make a material contribution to in-combination displacement mortality rates for any of the sites that have been assessed. Accordingly, it can be concluded that there is no SPA, pSPA or Ramsar site where the Hornsea Four is considered to give rise to an in-combination adverse effect on integrity. Therefore, the Flamborough and Filey Coast SPA is considered the only site where LSE in-combination could not be ruled out.
- 12.4.3.4 The assessments provided within this RIAA include a number of assumptions that contribute to the predicted impacts and potential effects being considered overly precautionary, including;
- The population within each bio-season for all of the offshore wind farms being the mean of the peaks from each survey year. This makes the assumption that such a high population is maintained for each of the months within the bio-season, whilst the actual abundance of all three auk species is likely to be less than this for much of the breeding bio-season;

- The population within offshore wind farm array areas and / or buffers to the south of Hornsea Four is likely to include non-breeding and migratory auks moving north and south during the months considered as being included in the breeding bio-season for this assessment;
- All sites being considered within the maximum foraging range is very precautionary, considering that many of offshore wind farm array areas and their buffers are beyond a reasonable distance to assume to be regularly used (if at all) by auks species during the breeding bio-season from the FFC SPA;
- The maximum extent of displacement considered for each species is likely to be greater than actually experienced within the array area and buffer;
- The maximum of 10% mortality of birds displaced during the non-migratory breeding bio-season is highly unlikely within all the offshore wind farms included within this assessment, as the species assessed in this RIAA are not solely dependant upon these area for all their foraging needs;
- Not 100% of adult birds within the offshore wind farms included within the in-combination assessment during the breeding bio-season will be from Flamborough and Filey Coast SPA;
- Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the offshore wind farms considered within this in-combination assessment throughout the year; and
- That the layers of precaution that are provided within the most precautionary assessments within this RIAA (under Scenario 2 of relevant assessments) are highly unlikely to occur.

Flamborough and Filey Coast SPA - guillemot

- 12.4.3.5 Guillemot has been screened in to the in-combination assessment of the Hornsea Four O&M phase. The projects screened in are the proposed and operating offshore wind farms in the UK waters of the North Sea and English Channel. They have been screened in on the basis of the species' sensitivity to the presence of the WTGs, the activities which will take place within the array area during maintenance and the experience of the in-combination assessments carried out for offshore wind farms in recent years.
- 12.4.3.6 In order to assess the potential in-combination impact on this species, information was compiled on the abundances that were measured at each of the OWF projects included in the in-combination assessment.
- 12.4.3.7 Due to limitations in the available data for other offshore wind farm projects, seasonal population estimates have been collated for two separate bio-seasons covering the entire annual cycle, one for breeding and one for non-breeding. A further limitation is that for some projects data are also not available for their array area plus 2 km buffer. In these instances the data have been scaled up or down based on data from the project area alone. The subsequent abundance estimates by bio-season are presented in Table 5.40 of the [Hornsea Four EIA PEIR Volume 2, Chapter 5, Section 5.12](#) and it is those values that are applied in this in-combination assessment. To account for that scaling process, a standardised approach has been taken to estimating the resulting number of individual birds displaced

from the numbers of birds present (the abundance data). This was to apply a standard set of displacement rates across the array area and 2 km buffer for all projects and, as for the alone assessment, to establish two scenarios to apply with a range of displacement rates and consequential mortality.

12.4.3.8 In the in-combination assessment below:

- 'Scenario 1' is assessed where displacement from the array area and the buffer is 30% and consequential mortality is 1% in the non-breeding season and 2% in the breeding season.
-
- 'Scenario 2' is assessed where displacement from the array area and the buffer is 80% and consequential mortality is 1% in the non-breeding season and 10% in the breeding season.

12.4.3.9 For the purpose of this assessment the use of a generic population age ratio of guillemots has been used of 0.552, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (i.e. 52.2% of guillemots are determined to be adults) across all months of the year.

12.4.3.10 The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance from Thaxter *et al* (2012) determines which breeding colonies the birds may be coming from and the contribution of that population to the total displaced is calculated using the SNH apportionment tool (SNH, 2018).

12.4.3.11 In the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment. The UK North Sea population outside the breeding season is 1,617,306 individuals (Furness, 2015). Ninety percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 74,893 individuals (from the SPA citation) or 79,282 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 71,354 breeding individuals remaining in the UK North Sea (based on 90% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 4.4%.

12.4.3.12 The Hornsea Four array area is within the maximum foraging distance of 135 km to the Flamborough and Filey Coast SPA at 63 km distant (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding and non-breeding season. There are no other

colonies within the maximum foraging distance to account for in the apportionment of breeding numbers to the Flamborough and Filey Coast SPA.

- 12.4.3.13 **Table 23** below sets out the calculation of the in-combination total of birds displaced. The first two columns present the abundances in the breeding season and non-breeding season respectively for each offshore wind farm included in the in-combination assessment. The subsequent columns identify whether or not a particular offshore wind farm project is included in the assessment, and if so, what percentage of displaced birds is apportioned to the Flamborough and Filey Coast SPA. The last two columns identify the estimate for the number of birds displaced by each project.

Table 23: In-combination displacement totals for guillemot attributed to the Flamborough and Filey Coast SPA.

	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to FFC SPA	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
Beatrice Demonstrator	0	0	no	0	yes	4.4%	0.0	0.0
Blyth Demonstration Site	1,220	1,321	no	0	yes	4.4%	0.0	58.3
Dudgeon	334	542	yes	100%	yes	4.4%	334.0	23.9
EOWDC	547	225	no	0	yes	4.4%	0.0	9.9
Galloper	305	593	no	0	yes	4.4%	0.0	26.2
Greater Gabbard	345	548	no	0	yes	4.4%	0.0	24.2
Gunfleet Sands Demo	0	0	no	0	yes	4.4%	0.0	0.0
Gunfleet Sands I	0	0	no	0	yes	4.4%	0.0	0.0
Gunfleet Sands II	0	0	no	0	yes	4.4%	0.0	0.0
Humber Gateway	99	138	yes	100%	yes	4.4%	99.0	6.1
Kentish Flats I	0	0	no	0	yes	4.4%	0.0	0.0
Kentish Flats II	0	0	no	0	yes	4.4%	0.0	0.0
Lincs, Lynn & Inner Dowsing	582	814	yes	100%	yes	4.4%	582.0	35.9
London Array	192	377	no	0	yes	4.4%	0.0	16.6
Methil (Samsung) Demo	0	0	no	0	yes	4.4%	0.0	0.0
Race Bank	361	708	yes	100%	yes	4.4%	361.0	31.2
Rampion	0	0	no	0	yes	4.4%	0.0	0.0
Scroby Sands	0	0	no	0	yes	4.4%	0.0	0.0

	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to FFC SPA	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
Sheringham Shoal	390	715	yes	100%	yes	4.4%	390.0	31.5
Teesside	267	901	yes	100%	yes	4.4%	267.0	39.8
Thanet	18	124	no	0	yes	4.4%	0.0	5.5
Westernmost Rough	347	486	yes	100%	yes	4.4%	347.0	21.4
Beatrice	13,610	2,755	no	0	yes	4.4%	0.0	121.5
East Anglia One	274	640	no	0	yes	4.4%	0.0	28.2
Hornsea Project One	13,374	17,772	yes	100%	yes	4.4%	13,374.0	784.1
Hornsea Project Two	2,126	1,847	yes	100%	yes	4.4%	2,126.0	81.5
Dogger Bank Creyke Beck A	5,407	6,142	no	0	yes	4.4%	0.0	271.0
Dogger Bank Creyke Beck B	9,479	10,621	no	0	yes	4.4%	0.0	468.6
Dogger Bank Teesside A	3,283	2,268	no	0	yes	4.4%	0.0	100.1
East Anglia Three	1,744	2,859	no	0	yes	4.4%	0.0	126.1
Hywind 2 Demonstration	249	2,136	no	0	yes	4.4%	0.0	94.2
Inch Cape	4,371	3,177	no	0	yes	4.4%	0.0	140.2
Moray East	9,820	547	no	0	yes	4.4%	0.0	24.1
Moray West	24,426	38,174	no	0	yes	4.4%	0.0	1,684.2
Neart na Gaoithe	1,755	3,761	no	0	yes	4.4%	0.0	165.9
Seagreen Alpha	13,606	4,688	no	0	yes	4.4%	0.0	206.8
Seagreen Bravo	11,118	4,112	no	0	yes	4.4%	0.0	181.4
Sofia	5,211	3,701	no	0	yes	4.4%	0.0	163.3
Triton Knoll	425	746	yes	100%	yes	4.4%	425.0	32.9
Hornsea Three	4,183	1,847	no	0	yes	4.4%	0.0	81.5
Norfolk Boreas	7,767	13,777	no	0	yes	4.4%	0.0	607.8
Norfolk Vanguard	4,320	4,776	no	0	yes	4.4%	0.0	210.7
Thanet Extension	49	837	no	0	yes	4.4%	0.0	36.9
Seasonal Total (Excl. Hornsea Four)	141,604	134,675					17,971.0	5,849.6
Annual Total (Excl. Hornsea Four)	276,279						23,820.6	
Hornsea Four	9,804	58,920	yes	100%	yes	4.4%	9,804.0	2,599.5

	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to FFC SPA	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
Seasonal Totals (Incl. Hornsea Four)	151,408	193,595					27,775.0	8,449.1
Annual Total (Incl. Hornsea Four)	345,003						12,403.5	

- 12.4.3.14 To these in-combination totals the displacement and consequential mortality scenarios are applied as follows:

Scenario 1 Breeding Season

- 12.4.3.15 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 8,333 individuals and the predicted consequent mortality from being displaced is estimated at 167 individuals or 92 adult birds. On a worst-case basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of 121,754 individuals, with an annual background mortality of this number of birds being 7,427 individuals) then 92 adult birds may suffer displacement consequent mortality. As noted above, the assessment method applied for guillemot in Scenario 1 during the breeding season is considered likely to over-estimate the number of adult birds that show a disturbance response to Hornsea Four during the operational maintenance phase, with some individuals expected to show no response at all. Further, it is unlikely that the population within the offshore wind farms included in this in-combination assessment are as high as the mean peak throughout the entire breeding bio-season, 2% of all guillemots displaced are unlikely to be subject to mortality and 100% of those adults potentially displaced are not likely to come from a single SPA (in this case the FFC SPA). Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Scenario 2 Breeding Season

- 12.4.3.16 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 22,220 individuals and the predicted consequent mortality from being displaced is estimated at 2,222 individuals or 1,227 adult birds. On a worst-case basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of

121,754 individuals, with an annual background mortality of this number of birds being 7,427 individuals) then this may lead to 1,227 birds suffering displacement consequent mortality. As noted above, the assessment method applied for guillemot in Scenario 2 during the breeding season is considered almost certainly to over-estimate the number of adult birds that show a disturbance response to Hornsea Four during the operational maintenance phase, with some individuals expected to show no response at all. Further, it is unlikely that the population within the offshore wind farms included in this in-combination assessment are as high as the mean peak throughout the entire breeding bio-season, 10% of all guillemots displaced are highly unlikely to be subject to mortality and 100% of those adults potentially displaced are not likely to come from a single SPA (in this case the FFC SPA). Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Scenario 1 Non-Breeding Season

- 12.4.3.17 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the non-breeding season is 2,535 individuals and the predicted consequent mortality from being displaced is estimated at 25 individuals or 13.8 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has been calculated. Furness (2015) provides the population data from which those calculations can be carried out. On the basis of 13.8 adult birds predicted to suffer displacement consequent mortality being attributed to the SPA this represents a 0.18% increase in baseline mortality.

Scenario 2 Non-Breeding Season

- 12.4.3.18 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the non-breeding season is 6,759 individuals and the predicted consequent mortality from being displaced is estimated at 68 individuals or 37.5 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has been calculated. Furness (2015) provides the population data from which those calculations can be carried out. On the basis of 37.5 adult birds predicted to suffer displacement consequent mortality being attributed to the SPA this represents a 0.50% increase in baseline mortality.

- 12.4.3.19 With the exception of Scenario 2 for the breeding season, which is considered to be highly unlikely due to assumptions that are overly precautionary, there is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four in-combination and therefore, subject to natural change, guillemot will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement. However, as noted above, given the potential for an over estimate to be made of any potential effects during the breeding bio-season further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Flamborough and Filey Coast SPA - razorbill

- 12.4.3.20 Razorbill has been screened in to the in-combination assessment of the Hornsea Four O&M phase. The projects screened in are the proposed and operating offshore wind farms in the UK waters of the North Sea and English Channel. They have been screened in on the basis of the species' sensitivity to the presence of the WTGs, the activities which will take place within the array area during maintenance and the experience of the in-combination assessments carried out for offshore wind farms in recent years.
- 12.4.3.21 In order to assess the potential in-combination impact on this species, information was compiled on the abundances that were measured at each of the OWF projects included in the in-combination assessment.
- 12.4.3.22 A limitation in the available data for other offshore wind farm projects is that for some projects data are also not available for their array area plus 2 km buffer. In these instances the data have been scaled up or down based on data from the project area alone. The subsequent abundance estimates by bio-season are presented in Table 5.41 of the [Hornsea Four EIA PEIR Volume 2, Chapter 5, Section 5.12](#) and it is those values that are applied in this in-combination assessment. To account for that scaling process, a standardised approach has been taken to estimating the resulting number of individual birds displaced from the numbers of birds present (the abundance data). This was to apply a standard set of displacement rates across the array area and 2 km buffer for all projects and, as for the alone assessment, to establish two scenarios to apply with a range of displacement rates and consequential mortality.
- 12.4.3.23 In the in-combination assessment below:
- [Scenario 1](#) is assessed where displacement from the array area and the buffer in breeding season is 30% and consequential mortality is 2% and in the non-breeding season where displacement from the array area and the buffer is 30% and consequential mortality is 1%; and

- [Scenario 2](#) is assessed where displacement from the array area and the buffer in breeding season is 95% and consequential mortality is 10% and in the non-breeding season where displacement from the array area and the buffer is 95% and consequential mortality is 1%.

- 12.4.3.24 For the purpose of this assessment the use of a generic population age ratio of razorbills has been used of 0.613, which is based on the assumptions described in more detail within [Table 5.16 of Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (i.e. 61.3% of razorbills are determined to be adults) across all months of the year.
- 12.4.3.25 The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season contains a much higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance from Thaxter *et al* (2012) determines which breeding colonies the birds may be coming from and the contribution of that population to the total displaced is calculated using the SNH apportionment tool (SNH, 2018). In the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment.
- 12.4.3.26 The UK North Sea population during the return migration and post-breeding migration seasons is 591,874 individuals (Furness, 2015). One hundred percent of the breeding birds from the SPA remain in the UK North Sea in the return migration and post-breeding migration seasons, which is a population of 21,140 individuals (from the SPA citation) or 20,002 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015). This would mean that 20,002 breeding individuals would remain in the UK North Sea during the return migration and post-breeding migration seasons (based on 100% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 3.4% during the return migration and post-breeding migration seasons. The UK North Sea population during the non-migratory wintering season is 218,662 individuals (Furness, 2015). Only 30% of the breeding birds from the SPA remain in the UK North Sea in the non-migratory wintering season, which would mean that 6,001 breeding individuals would remain in the UK North Sea during the non-migratory wintering season (based on 30% Furness (2015) population). Accordingly the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 2.7% during the non-migratory wintering season.
- 12.4.3.27 The Hornsea Four array area is within the maximum foraging distance of 95 km to the Flamborough and Filey Coast SPA at 63 km distant. Accordingly this species is assessed for both the breeding and non-breeding season. There are no other colonies within the

maximum foraging distance to account for in the apportionment of breeding numbers to the Flamborough and Filey Coast SPA.

- 12.4.3.28 The calculation of the in-combination total of birds displaced are set out across three linked tables below in order to present the information for the four bio-seasons for which it was calculated. **Table 24** contains columns that present the abundance estimates, **Table 25** contains columns that identify whether or not a particular offshore wind farm project is included in the assessment, and if so, what percentage of displaced birds is apportioned to the Flamborough and Filey Coast SPA and **Table 26** has columns that identify the estimate for the number of birds displaced by each project.

Table 24: Abundance estimates for razorbill for four bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post-breeding Migration	Wintering
Beatrice Demonstrator	0	0	0	0
Blyth Demonstration Site	91	121	91	61
Dudgeon	346	256	346	745
EOWDC	26	161	64	7
Galloper	394	44	43	105
Greater Gabbard	84	0	0	387
Gunfleet Sands Demo	0	0	0	0
Gunfleet Sands I	0	0	0	0
Gunfleet Sands II	0	0	0	0
Humber Gateway	20	27	20	13
Kentish Flats I	0	0	0	0
Kentish Flats II	0	0	0	0
Lincs, Lynn & Inner Dowsing	34	45	34	22
London Array	20	14	20	14
Methil (Samsung) Demo	0	0	0	0
Race Bank	42	28	42	28
Rampion	0	0	0	0
Scroby Sands	0	0	0	0
Sheringham Shoal	30	106	1343	211
Teesside	20	16	61	2
Thanet	21	3	0	14
Westermest Rough	91	91	121	152
Beatrice	833	873	833	555
East Anglia One	336	16	26	155
Hornsea Project One	1803	1109	4812	1518

	Return Migration	Breeding	Post-breeding Migration	Wintering
Hornsea Project Two	1668	2511	4221	720
Dogger Bank Creyke Beck A	4149	1250	1576	1728
Dogger Bank Creyke Beck B	5119	1538	2097	2143
Dogger Bank Teesside A	1919	834	310	959
East Anglia Three	1524	1807	1122	1499
Hywind 2 Demonstration		30	719	10
Inch Cape		1436	2870	651
Moray East	168	2523	1103	30
Moray West	3585	2808	3544	184
Near na Gaoithe		331	5492	508
Seagreen Alpha		5876		1003
Seagreen Bravo		3698		1272
Sofia	2953	1153	592	1426
Triton Knoll	117	40	254	855
Hornsea Three	1236	630	2020	3694
Norfolk Boreas	345	630	263	1065
Norfolk Vanguard	924	879	866	627
Thanet Extension	50	0	0	34
Seasonal Total (Excl. Hornsea Four)	27,948	30,884	34,905	22,397
Annual Total (Excl. Hornsea Four)	116,134			
Hornsea Four	1,029	508	5,428	606
Seasonal Totals (Incl. Hornsea Four)	28,977	31,392	40,333	23,003
Annual Total (Incl. Hornsea Four)	123,705			

Table 25: Attribution of razorbill numbers to the FFC SPA for four bio-seasons for each offshore wind farm included in the in-combination assessment.

	Attributed in breeding season to	% attribution	Attributed in return migration	% attribution	Attributed in post-breeding	% attribution	Attributed in non-migratory	% attribution
Beatrice Demonstrator	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Blyth Demonstration Site	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Dudgeon	no	0	yes	3.4%	yes	3.4%	yes	2.7%

	Attributed in breeding season to	% attribution	Attributed in return migration	% attribution	Attributed in post- breeding	% attribution	Attributed in non- migratory	% attribution
EOWDC	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Galloper	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Greater Gabbard	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Gunfleet Sands Demo	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Gunfleet Sands I	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Gunfleet Sands II	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Humber Gateway	yes	100%	yes	3.4%	yes	3.4%	yes	2.7%
Kentish Flats I	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Kentish Flats II	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Lincs, Lynn & Inner Dowsing	no	0	yes	3.4%	yes	3.4%	yes	2.7%
London Array	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Methil (Samsung) Demo	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Race Bank	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Rampion	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Scroby Sands	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Sheringham Shoal	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Teesside	yes	100%	yes	3.4%	yes	3.4%	yes	2.7%
Thanet	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Westernmost Rough	yes	100%	yes	3.4%	yes	3.4%	yes	2.7%
Beatrice	no	0	yes	3.4%	yes	3.4%	yes	2.7%
East Anglia One	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Hornsea Project One	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Hornsea Project Two	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Dogger Bank Creyke Beck A	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Dogger Bank Creyke Beck B	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Dogger Bank Teesside A	no	0	yes	3.4%	yes	3.4%	yes	2.7%
East Anglia Three	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Hywind 2 Demonstration	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Inch Cape	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Moray East	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Moray West	no	0	yes	3.4%	yes	3.4%	yes	2.7%

	Attributed in breeding season to	% attribution	Attributed in return migration	% attribution	Attributed in post- breeding	% attribution	Attributed in non- migratory	% attribution
Neart na Gaoithe	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Seagreen Alpha	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Seagreen Bravo	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Sofia	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Triton Knoll	yes	100%	yes	3.4%	yes	3.4%	yes	2.7%
Hornsea Three	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Norfolk Boreas	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Norfolk Vanguard	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Thanet Extension	no	0	yes	3.4%	yes	3.4%	yes	2.7%
Hornsea Four	yes	100%	yes	3.4%	yes	3.4%	yes	2.7%

Table 26: Displacement estimates for razorbill for four bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post-breeding Migration	Wintering
Beatrice Demonstrator	0.0	0.0	0.0	0.0
Blyth Demonstration Site	3.1	0.0	3.1	1.7
Dudgeon	11.7	0.0	11.7	20.4
EOWDC	0.9	0.0	2.2	0.2
Gallopier	13.3	0.0	1.5	2.9
Greater Gabbard	2.8	0.0	0.0	10.6
Gunfleet Sands Demo	0.0	0.0	0.0	0.0
Gunfleet Sands I	0.0	0.0	0.0	0.0
Gunfleet Sands II	0.0	0.0	0.0	0.0
Humber Gateway	0.7	27.0	0.7	0.4
Kentish Flats I	0.0	0.0	0.0	0.0
Kentish Flats II	0.0	0.0	0.0	0.0
Lincs, Lynn & Inner Dowsing	1.1	0.0	1.1	0.6
London Array	0.7	0.0	0.7	0.4
Methil (Samsung) Demo	0.0	0.0	0.0	0.0
Race Bank	1.4	0.0	1.4	0.8
Rampion	0.0	0.0	0.0	0.0
Scroby Sands	0.0	0.0	0.0	0.0
Sheringham Shoal	1.0	0.0	45.4	5.8
Teesside	0.7	16.0	2.1	0.1

	Return Migration	Breeding	Post-breeding Migration	Wintering
Thanet	0.7	0.0	0.0	0.4
Westermest Rough	3.1	91.0	4.1	4.2
Beatrice	28.2	0.0	28.2	15.2
East Anglia One	11.4	0.0	0.9	4.3
Hornsea Project One	60.9	0.0	162.6	41.7
Hornsea Project Two	56.4	0.0	142.6	19.8
Dogger Bank Creyke Beck A	140.2	0.0	53.3	47.4
Dogger Bank Creyke Beck B	173.0	0.0	70.9	58.8
Dogger Bank Teesside A	64.9	0.0	10.5	26.3
East Anglia Three	51.5	0.0	37.9	41.1
Hywind 2 Demonstration	0.0	0.0	24.3	0.3
Inch Cape	0.0	0.0	97.0	17.9
Moray East	5.7	0.0	37.3	0.8
Moray West	121.2	0.0	119.8	5.0
Neart na Gaoithe	0.0	0.0	185.6	13.9
Seagreen Alpha	0.0	0.0	0.0	27.5
Seagreen Bravo	0.0	0.0	0.0	34.9
Sofia	99.8	0.0	20.0	39.1
Triton Knoll	4.0	40.0	8.6	23.5
Hornsea Three	41.8	0.0	68.3	101.4
Norfolk Boreas	11.7	0.0	8.9	29.2
Norfolk Vanguard	31.2	0.0	29.3	17.2
Thanet Extension	1.7	0.0	0.0	0.9
Seasonal Total (Excl. Hornsea Four)	928.8	174.0	1,162.7	592.3
Annual Total (Excl. Hornsea Four)	2,857.8			
Hornsea Four	34.8	508.0	183.4	16.6
Seasonal Totals (Incl. Hornsea Four)	963.6	682.0	1,346.1	608.9
Annual Total (Incl. Hornsea Four)	3,600.7			

- 12.4.3.29 To these in-combination totals the displacement and consequential mortality scenarios are applied as follows:

Scenario 1 Breeding Season

- 12.4.3.30 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 205 individuals and the predicted

consequent mortality from being displaced is estimated at 4 individuals or 2.4 adult birds. On a worst-case basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of 40,506 individuals, with an annual background mortality of this number of birds being 4,523 individuals) then this prediction of 2.4 adult birds suffering displacement consequent mortality would represent a 0.05% increase in baseline mortality.

Scenario 2 Breeding Season

- 12.4.3.31 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 648 individuals and the predicted consequent mortality from being displaced is estimated at 65 individuals or 39.8 adult birds. On a worst-case basis if all the birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of 40,506 individuals, with an annual background mortality of this number of birds being 4,523 individuals) then this prediction of 39.8 adult birds suffering displacement consequent mortality would represent a 0.88% increase in baseline mortality.

Scenario 1 Non-Breeding Season

- 12.4.3.32 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the three non-breeding bio-seasons is 239 individuals in return migration, 404 individuals in post-breeding migration and 183 individuals in the wintering bio-season. The predicted consequent mortality from being displaced is estimated respectively at 6, 8 and 4 individuals or 3.7, 4.9 and 2.5 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has been calculated. Furness (2015) provides the population data from which those calculations can be carried out. On the basis of 3.7, 4.9 and 2.5 adult birds predicted to suffer displacement consequent mortality being attributed to the SPA in the return migration, post-breeding migration and wintering bio-seasons respectively, this represents a 0.09%, 0.12% and 0.06% increase in baseline mortality respectively.

Scenario 2 Non-Breeding Season

- 12.4.3.33 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the three non-breeding bio-seasons is 915 individuals in return migration, 1,279 individuals in post-breeding migration and 578 individuals in the wintering bio-season. The predicted consequent mortality from being displaced is estimated respectively at 19, 26 and 12 individuals or 11.6, 15.9 and 7.4 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has been calculated.

Furness (2015) provides the population data from which those calculations can be carried out. On the basis of 11.6, 15.9 and 7.4 adult birds predicted to suffer displacement consequent mortality being attributed to the SPA in the return migration, post-breeding migration and wintering bio-seasons respectively, this represents a 0.27%, 0.37% and 0.17% increase in baseline mortality respectively.

- 12.4.3.34 There is, therefore, no potential for an AEol to the conservation objectives of the razorbill feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four in-combination and therefore, subject to natural change, razorbill will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement.

Flamborough and Filey Coast SPA - puffin

- 12.4.3.35 Puffin has been screened in to the in-combination assessment of the Hornsea Four O&M phase. The projects screened in are the proposed and operating offshore wind farms in the UK waters of the North Sea and English Channel. They have been screened in on the basis of the species' sensitivity to the presence of the WTGs, the activities which will take place within the array area during maintenance and the experience of the in-combination assessments carried out for offshore wind farms in recent years.
- 12.4.3.36 In order to assess the potential in-combination impact on this species, information was compiled on the abundances that were measured at each of the OWF projects included in the in-combination assessment.
- 12.4.3.37 Due to limitations in the available data for other offshore wind farm projects, seasonal population estimates have been collated for two separate bio-seasons covering the entire annual cycle, one for breeding and one for non-breeding. A further limitation is that for some projects data are also not available for their array area plus 2 km buffer. In these instances the data have been scaled up or down based on data from the project area alone. The subsequent abundance estimates by bio-season are presented in Table 5.42 of the [Hornsea Four EIA PEIR \(Volume 2, Chapter 5, Section 5.12\)](#) and it is those values that are applied in this in-combination assessment. To account for that scaling process, a standardised approach has been taken to estimating the resulting number of individual birds displaced from the numbers of birds present (the abundance data). This was to apply a standard set of displacement rates across the array area and 2 km buffer for all projects and, as for the alone assessment, to establish two scenarios to apply with a range of displacement rates and consequential mortality.
- 12.4.3.38 In the in-combination assessment below:
- [Scenario 1](#) is assessed where displacement from the array area and the buffer in breeding season is 50% and consequential mortality is 2% and in the non-breeding season where displacement from the array area and the buffer is 50% and consequential mortality is 1%; and

- [Scenario 2](#) is assessed where displacement from the array area and the buffer in breeding season is 70% and consequential mortality is 10% and in the non-breeding season where displacement from the array area and the buffer is 70% and consequential mortality is 1%.

- 12.4.3.39 For the purpose of this assessment the use of a generic population age ratio of puffins has been used of 0.57.7, which is based on the assumptions described in more detail within [Table 5.16 of Volume 2, Chapter 5](#) (i.e. 57.7% of puffins are determined to be adults) across all months of the year.
- 12.4.3.40 The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four during the breeding season may contain a higher proportion of adult birds (and potentially up to 100%) that can be attributed to a nearby breeding colony SPA. Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the breeding season the maximum foraging distance from Thaxter *et al* (2012) determines which breeding colonies the birds may be coming from and the contribution of that population to the total displaced is calculated using the SNH apportionment tool (SNH, 2018). For puffin there are two breeding colonies whose maximum foraging range extends to Hornsea Four: Flamborough and Filey Coast SPA and Coquet Island SPA. The latest colony counts for these sites have been applied in the SNH apportionment tool and the resulting value for apportionment to has been calculated as 31.0% in the breeding season.
- 12.4.3.41 In the non-breeding season the information on populations contained in Furness (2015) is applied for the same purpose of apportionment. The UK North Sea population outside the breeding season is 231,957 individuals (Furness, 2015). Fifty percent of the breeding birds from the SPA remain in the UK North Sea in the non-breeding season, which is a population of 980 individuals (from the SPA citation) or 1,916 breeding individuals when considering the colony count data used to underpin the UK North Sea population (Furness, 2015) would be 958 breeding individuals remaining in the UK North Sea (based on 50% Furness (2015) population). Accordingly, the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 0.41%.
- 12.4.3.42 The Hornsea Four array area is within the maximum foraging distance of 200 km to the Flamborough and Filey Coast SPA at 63 km distant (Thaxter *et al*, 2012). Accordingly this species is assessed for both the breeding and non-breeding season. As noted above Hornsea Four is also within maximum foraging range from the Coquet Island SPA and in the breeding season displaced birds are apportioned between these sites.
- 12.4.3.43 [Table 27](#) below sets out the calculation of the in-combination total of birds displaced. The first two columns present the abundances in the breeding season and non-breeding season respectively for each offshore wind farm included in the in-combination assessment. The subsequent columns identify whether or not a particular offshore wind farm project is

included in the assessment, and if so, what percentage of displaced birds is apportioned to the Flamborough and Filey Coast SPA. The last two columns identify the estimate for the number of birds displaced by each project.

Table 27: In-combination displacement totals for puffin attributed to the Flamborough and Filey Coast SPA.

	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
Blyth Demonstration Site	235	123	yes	31.0%	yes	0.41%	72.9	0.5
Dudgeon	1	3	yes	31.0%	yes	0.41%	0.3	0.0
EOWDC	42	82	no	0	yes	0.41%	0.0	0.3
Gallopier	0	1	no	0	yes	0.41%	0.0	0.0
Greater Gabbard	0	1	no	0	yes	0.41%	0.0	0.0
Gunfleet Sands Demo	0	0	no	0	yes	0.41%	0.0	0.0
Gunfleet Sands I	0	0	no	0	yes	0.41%	0.0	0.0
Gunfleet Sands II	0	0	no	0	yes	0.41%	0.0	0.0
Humber Gateway	15	10	yes	31.0%	yes	0.41%	4.7	0.0
Kentish Flats I	0	0	no	0	yes	0.41%	0.0	0.0
Kentish Flats II	0	0	no	0	yes	0.41%	0.0	0.0
Lincs, Lynn & Inner Dowsing	3	6	yes	31.0%	yes	0.41%	0.9	0.0
London Array	0	1	no	0	yes	0.41%	0.0	0.0
Methil (Samsung) Demo	0	0	no	0	yes	0.41%	0.0	0.0
Race Bank	1	10	yes	31.0%	yes	0.41%	0.3	0.0
Rampion	0	0	no	0	yes	0.41%	0.0	0.0
Scroby Sands	0	0	no	0	yes	0.41%	0.0	0.0
Sheringham Shoal	4	26	yes	31.0%	yes	0.41%	1.2	0.1
Teesside	35	18	yes	31.0%	yes	0.41%	10.9	0.1
Thanet	0	0	no	0	yes	0.41%	0.0	0.0
Westermose Rough	61	35	yes	31.0%	yes	0.41%	18.9	0.1
Beatrice	2,858	2,435	no	0	yes	0.41%	0.0	10.1

Hornsea 4



	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
East Anglia One	16	32	no	0	yes	0.41%	0.0	0.1
Hornsea Project One	1,070	1,257	yes	31.0%	yes	0.41%	331.7	5.2
Hornsea Project Two	468	2,039	yes	31.0%	yes	0.41%	145.1	8.4
Dogger Bank Creyke Beck A	37	295	yes	31.0%	yes	0.41%	11.5	1.2
Dogger Bank Creyke Beck B	102	743	yes	31.0%	yes	0.41%	31.6	3.1
Dogger Bank Teesside A	34	273	no	0	yes	0.41%	0.0	1.1
East Anglia Three	181	307	no	0	yes	0.41%	0.0	1.3
Hywind 2 Demonstration	119	85	no	0	yes	0.41%	0.0	0.4
Inch Cape	2,956	2,688	no	0	yes	0.41%	0.0	11.1
Moray East	2,795	656	no	0	yes	0.41%	0.0	2.7
Moray West	1,115	3,966	no	0	yes	0.41%	0.0	16.4
Near na Gaoithe	2,562	2,103	no	0	yes	0.41%	0.0	8.7
Seagreen Alpha	2,572	1,526	no	0	yes	0.41%	0.0	6.3
Seagreen Bravo	3,582	3,863	no	0	yes	0.41%	0.0	16.0
Sofia	35	329	yes	31.0%	yes	0.41%	10.9	1.4
Triton Knoll	23	71	yes	31.0%	yes	0.41%	7.1	0.3
Hornsea Three	253	127	yes	31.0%	yes	0.41%	78.4	0.5
Norfolk Boreas	0	23	no	0	yes	0.41%	0.0	0.1
Norfolk Vanguard	67	112	no	0	yes	0.41%	0.0	0.5
Thanet Extension	0	0	no	0	yes	0.41%	0.0	0.0
Seasonal Total (Excl. Hornsea Four)	21,242	23,244					653.2	95.1
Annual Total (Excl. Hornsea Four)	44,486		748.3					

Hornsea 4



	Breeding Season	Non-breeding Season	Attributed in breeding season to FFC SPA	% attribution	Attributed in non-breeding season to	% attribution	From FFC SPA in breeding Season	From FFC SPA in non-breeding Season
Hornsea Four	102	552	yes	31.0%	yes	0.41%	31.6	0.0
Seasonal Totals (Incl. Hornsea Four)	21,344	23,796					684.8	95.1
Annual Total (Incl. Hornsea Four)	45,140		779.9					

- 12.4.3.44 To these in-combination totals the displacement and consequential mortality scenarios are applied as follows:

Scenario 1 Breeding Season

- 12.4.3.45 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 342 individuals and the predicted consequent mortality from being displaced is estimated at 7 individuals or 4 adult birds. On a worst-case basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of 2,879 pairs (5,758 breeding adults), with an annual background mortality of this number of birds being 541 breeding adults) then this prediction of 4 adult birds suffering displacement consequent mortality would represent a 0.74% increase in baseline mortality.

Scenario 2 Breeding season

- 12.4.3.46 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, in the breeding season is 479 individuals and the predicted consequent mortality from being displaced is estimated at 48 individuals or 27.7 adult birds. On a worst-case basis if all the adult birds predicted to be displaced were breeding adult birds from the Flamborough and Filey Coast SPA (latest colony count of 2,879 pairs (5,758 breeding adults), with an annual background mortality of this number of birds being 541 breeding adults) then 27.7 adult birds may suffer displacement consequent mortality. As noted above, the assessment method applied for guillemot in Scenario 1 during the breeding season is considered likely to over-estimate the number of adult birds that show a disturbance response to Hornsea Four during the operational maintenance phase, with some individuals expected to show no response at all. Further, it is unlikely that the population within the offshore wind farms included in this in-combination assessment are as high as the mean peak throughout the entire breeding bio-season, 10% of all puffins displaced are highly unlikely to be subject to mortality and 100% of those adults potentially displaced are not likely to come from a single SPA (in this case the FFC SPA). Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Scenario 1 Non-Breeding Season

- 12.4.3.47 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the non-breeding season is 47.6 individuals and the predicted consequent mortality from being displaced is estimated at 0.48 individuals or 0.28 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast

SPA has been calculated. Furness (2015) provides the population data from which those calculations can be carried out. On the basis of less than one adult bird (0.28 of one adult bird) predicted to suffer displacement consequent mortality being attributed to the SPA, this represents a 0.05% increase in baseline mortality.

Scenario 2 Non-Breeding Season

- 12.4.3.48 The in-combination number predicted to be displaced from the offshore wind farms assessed, including Hornsea Four, that has been apportioned to Flamborough and Filey Coast SPA in the non-breeding season is 67 individuals and the predicted consequent mortality from being displaced is estimated at 0.67 individuals or 0.38 adult birds. This accounts for the fact that in the non-breeding season these birds will have come from a wide range of seabird breeding colonies in the UK and overseas and for the consequent mortality estimate the number which can be attributed to the Flamborough and Filey Coast SPA has been calculated. Furness (2015) provides the population data from which those calculations can be carried out. On the basis of less than one adult bird (0.28 of one adult bird) predicted to suffer displacement consequent mortality being attributed to the SPA, this represents a 0.05% increase in baseline mortality.
- 12.4.3.49 With the exception of Scenario 2 for the breeding season, which is considered to be highly unlikely due to assumptions that are overly precautionary, there is, therefore, no potential for an AEol to the conservation objectives of the puffin feature of Flamborough and Filey Coast SPA in relation to disturbance and displacement effects in the O&M phase from Hornsea Four in-combination and therefore, subject to natural change, puffin will be maintained as a feature in the long term with respect to the potential for adverse effects from disturbance and displacement. However, as noted above, given the potential for an over estimate to be made of any potential effects during the breeding bio-season further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to the refine mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Collision Risk

- 12.4.3.50 The potential for collision risk from offshore wind farms to result in an AEol in-combination with Hornsea Four relates to the following designated site and the relevant features:
- Flamborough and Filey Coast SPA; gannet and kittiwake.
- 12.4.3.51 This site and the relevant interest features identified were screened in for LSE for the project 'alone' and the attribution of the predicted collision mortality. With the project 'alone' collision mortality and attribution having been completed the assessment of potential in-combination impacts can be carried out on a quantitative basis.
- 12.4.3.52 The quantitative assessment of all other sites for collision mortality alone has identified that the Hornsea Four does not make a material contribution to in-combination collision

mortality rates for any of the sites that have been assessed. Accordingly, it can be concluded that there is no SPA, pSPA or Ramsar site where the Hornsea Four is considered to give rise to an in-combination adverse effect on integrity. Therefore, the Flamborough and Filey Coast SPA is considered the only site where LSE in-combination could not be ruled out.

12.4.3.53 The assessments provided within this RIAA include a number of assumptions that contribute to the predicted impacts and potential effects being considered overly precautionary, including;

- The population within other offshore wind farm array areas and / or buffers are likely to include non-breeding and migratory birds moving north and south during the months considered as being included in the breeding bio-season for this assessment;
- All sites being considered within the maximum foraging range is very precautionary, considering that many of offshore wind farm array areas and their buffers are beyond a reasonable distance to assume to be regularly used (if at all) by kittiwakes and gannets during the breeding bio-season from the FFC SPA;
- Not 100% of adult birds within the offshore wind farms included within the in-combination assessment during the breeding bio-season will be from Flamborough and Filey Coast SPA; and
- Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the offshore wind farms considered within this in-combination assessment throughout the year.

Flamborough and Filey Coast SPA – gannet

12.4.3.54 Gannet has been screened in to the in-combination assessment of the Hornsea Four O&M phase. The projects screened in are the proposed and operating offshore wind farms in the UK waters of the North Sea and English Channel. They have been screened in on the basis of this species flight behaviour that places it at risk of collision with the turning blades of the WTGs and the experience of the in-combination assessments carried out for offshore wind farms in recent years. Collisions may occur when birds fly through the offshore wind farms whilst foraging for food, commuting between breeding sites and foraging areas, or during migration.

12.4.3.55 In order to assess the potential in-combination impact on this species, information was compiled on the predicted collision mortality for each of the OWF projects included in the in-combination assessment. The projects included are those defined as being within Tier 1 (sub-tiers 1a to 1d) and Tier 2. The collision risk predictions from the other offshore wind farm projects have been extracted and collated based, where available, on Band Option 2 and if not available then on Band Option 1. The collision predictions have been standardised by the application of the avoidance rates most appropriate to each species, as described in [Appendix A of the Hornsea Four EIA Volume 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

- 12.4.3.56 This species has been screened in for both the breeding and the non-breeding bio-seasons. The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four changes through the seasons with birds breeding at sites remote from the north-east coast of England either passing through the area on spring and autumn migration or arriving in the area to spend the winter.
- 12.4.3.57 For the purpose of this assessment the use of a generic population age ratio of gannets has been used of 0.6, which is based on the assumptions described in more detail within [Table 5.16 of Volume 2, Chapter 5](#) (i.e. 60% of gannets are determined to be adults) across all months of the year.
- 12.4.3.58 During the breeding season, when birds are limited in the distance and number of days over which they can forage by the need to return regularly to the nest site, it can be expected that the area in and around Hornsea Four will contain a high proportion of adult birds that can be attributed to the SPA. The evidence gained from tracking adult gannets during the breeding season across a series of colonies is that gannets show 'space partitioning', that is adjacent colonies do not have overlapping foraging areas in the breeding season (Wakefield *et al*, 2013). The consequence of this is that 100% of the breeding adult birds in and around the Hornsea Four array area and in and around other OWFs that are within foraging range are attributable to the Flamborough and Filey Coast SPA.
- 12.4.3.59 Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season the information on populations contained in Furness (2015) is applied for purpose of apportionment of birds to the SPA.
- 12.4.3.60 The UK North Sea population outside the breeding season is 248,385 individuals in the return migration bio-season and 456,298 individuals in the post-breeding bio-season. Seventy percent of the breeding birds from the SPA are present in the UK North Sea in the return migration bio-season and all of the breeding birds from the SPA are present in the UK North Sea in the post-breeding migration bio-season. The result is that based on the SPA citation population (16,938 individuals) there are 11,857 individuals from the SPA in the UK North Sea in the return migration bio-season and 16,938 individuals in the post-breeding migration bio-season. If the SPA breeding population of 22,122 individuals from Furness (2015) is considered (which is preferred given that it was the population that informed the calculation of the UK North Sea population so avoiding invalid comparisons of populations from distinctly different years in a process that is calculating proportions) then there are 15,485 individuals from the SPA in the UK North Sea in the return migration bio-season and 22,122 individuals in the post-breeding migration bio-season. From these figures, the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 6.2% in the return migration bio-season and 4.8% in the post-breeding migration bio-season.

- 12.4.3.61 The calculation of the in-combination total of birds predicted to suffer collision consequent mortality are set out across three linked tables in order to present the information for the three bio-seasons for which it was calculated. **Table 28** contains columns that present the mortality estimates, **Table 29** contains columns that identify whether or not a particular offshore wind farm project is included in the assessment, and if so, what percentage of birds are apportioned to the Flamborough and Filey Coast SPA (applying the calculated apportionment figures for the non-breeding bio-seasons as described above) and **Table 30** have columns that identify the estimate for the predicted number of collisions attributed to the SPA by each project.

Table 28: Predicted collision estimates for gannet for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post-breeding Migration
Beatrice Demonstrator	0.7	0.6	0.9
Blyth Demonstration Site	2.8	3.5	2.1
Dudgeon	19.1	22.3	38.9
EOWDC	0.1	4.2	5.1
Galloper	12.6	18.1	30.9
Greater Gabbard	4.8	14.0	8.8
Gunfleet Sands	0.0	0.0	0.0
Humber Gateway	1.5	1.9	1.1
Kentish Flats	1.1	1.4	0.8
Lincs, Lynn & Inner Dowsing	1.9	2.3	1.4
London Array	1.8	2.3	1.4
Methil (Samsung) Demo			
Race Bank	4.1	33.7	11.7
Rampion	2.1	36.2	63.5
Scroby Sands	0.0	0.0	0.0
Sheringham Shoal	0.0	14.1	3.5
Teesside	0.0	4.9	1.7
Thanet	0.0	1.1	0.0
Westernmost Rough	0.2	0.2	0.1
Beatrice	9.5	37.4	48.8
East Anglia One	6.3	3.4	131.0
Hornsea Project One	22.5	11.5	32.0
Hornsea Project Two	6.0	7.0	14.0
Dogger Bank Creyke Beck A & B	4.3	5.6	6.6
Dogger Bank Teesside A & Sofia	10.8	14.8	10.1

	Return Migration	Breeding	Post-breeding Migration
East Anglia Three	9.6	6.1	33.3
Hywind 2 Demonstration	0.8	5.6	0.8
Inch Cape	5.2	336.9	29.2
Moray East	8.9	80.6	35.4
Moray West	1.2	8.8	8.6
Neart na Gaoithe	23.0	143.0	47.0
Seagreen Alpha & Bravo	31.0	330.0	31.0
Triton Knoll	30.1	26.8	64.1
East Anglia ONatural England North	1.0	10.0	2.0
East Anglia TWO	1.3	8.8	5.5
Hornsea Three	8.0	18.0	12.0
Norfolk Boreas	15.0	54.1	48.5
Norfolk Vanguard	9.3	21.6	48.5
Thanet Extension	9.1	0.0	4.4
Seasonal Total (Excl. Hornsea Four)	265.7	1,290.8	784.7
Annual Total (Excl. Hornsea Four)	2,341.2		
Hornsea Four	7.1	33.8	9.3
Seasonal Totals (Incl. Hornsea Four)	272.8	1,324.6	794.0
Annual Total (Incl. Hornsea Four)	2,391.4		

Table 29: Attribution of gannet numbers to the FFC SPA for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Attributed in breeding season to FFC SPA	% attribution	Attributed in return migration to FFC SPA	% attribution	Attributed in post-breeding migration to FFC SPA	% attribution
Beatrice Demonstrator	no	0	yes	6.2%	yes	4.8%
Blyth Demonstration Site	yes	100%	yes	6.2%	yes	4.8%
Dudgeon	yes	100%	yes	6.2%	yes	4.8%
EOWDC	no	0	yes	6.2%	yes	4.8%
Gallopier	yes	100%	yes	6.2%	yes	4.8%
Greater Gabbard	yes	100%	yes	6.2%	yes	4.8%
Gunfleet Sands	yes	100%	yes	6.2%	yes	4.8%
Humber Gateway	yes	100%	yes	6.2%	yes	4.8%
Kentish Flats	yes	100%	yes	6.2%	yes	4.8%
Lincs, Lynn & Inner Dowsing	yes	100%	yes	6.2%	yes	4.8%
London Array	yes	100%	yes	6.2%	yes	4.8%

	Attributed in breeding season to FFC SPA	% attribution	Attributed in return migration to FFC SPA	% attribution	Attributed in post- breeding migration to FFC SPA	% attribution
Methil (Samsung) Demo	no	0	yes	6.2%	yes	4.8%
Race Bank	yes	100%	yes	6.2%	yes	4.8%
Rampion	yes	100%	yes	6.2%	yes	4.8%
Scroby Sands	yes	100%	yes	6.2%	yes	4.8%
Sheringham Shoal	yes	100%	yes	6.2%	yes	4.8%
Teesside	yes	100%	yes	6.2%	yes	4.8%
Thanet	yes	100%	yes	6.2%	yes	4.8%
Westernmost Rough	yes	100%	yes	6.2%	yes	4.8%
Beatrice	no	0	yes	6.2%	yes	4.8%
East Anglia One	yes	100%	yes	6.2%	yes	4.8%
Hornsea Project One	yes	100%	yes	6.2%	yes	4.8%
Hornsea Project Two	yes	100%	yes	6.2%	yes	4.8%
Dogger Bank Creyke Beck A & B	yes	100%	yes	6.2%	yes	4.8%
Dogger Bank Teesside A & Sofia	yes	100%	yes	6.2%	yes	4.8%
East Anglia Three	yes	100%	yes	6.2%	yes	4.8%
Hywind 2 Demonstration	no	0	yes	6.2%	yes	4.8%
Inch Cape	no	0	yes	6.2%	yes	4.8%
Moray East	no	0	yes	6.2%	yes	4.8%
Moray West	no	0	yes	6.2%	yes	4.8%
Neart na Gaoithe	no	0	yes	6.2%	yes	4.8%
Seagreen Alpha & Bravo	no	0	yes	6.2%	yes	4.8%
Triton Knoll	yes	100%	yes	6.2%	yes	4.8%
East Anglia ONatural England North	yes	100%	yes	6.2%	yes	4.8%
East Anglia TWO	yes	100%	yes	6.2%	yes	4.8%
Hornsea Three	yes	100%	yes	6.2%	yes	4.8%
Norfolk Boreas	yes	100%	yes	6.2%	yes	4.8%
Norfolk Vanguard	yes	100%	yes	6.2%	yes	4.8%
Thanet Extension	yes	100%	yes	6.2%	yes	4.8%
Hornsea Four	yes	100%	yes	6.2%	yes	4.8%

Table 30: Collision estimates for gannet attributed to the FFC SPA for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post-breeding Migration
Beatrice Demonstrator	0.0	0.0	0.0
Blyth Demonstration Site	0.2	3.5	0.1
Dudgeon	1.2	22.3	1.9
EOWDC	0.0	0.0	0.2
Galloper	0.8	18.1	1.5
Greater Gabbard	0.3	14.0	0.4
Gunfleet Sands	0.0	0.0	0.0
Humber Gateway	0.1	1.9	0.1
Kentish Flats	0.1	1.4	0.0
Lincs, Lynn & Inner Dowsing	0.1	2.3	0.1
London Array	0.1	2.3	0.1
Methil (Samsung) Demo			
Race Bank	0.3	33.7	0.6
Rampion	0.1	36.2	3.1
Scroby Sands	0.0	0.0	0.0
Sheringham Shoal	0.0	14.1	0.2
Teesside	0.0	4.9	0.1
Thanet	0.0	1.1	0.0
Westermest Rough	0.0	0.2	0.0
Beatrice	0.6	0.0	2.4
East Anglia One	0.4	3.4	6.4
Hornsea Project One	1.4	11.5	1.6
Hornsea Project Two	0.4	7.0	0.7
Dogger Bank Creyke Beck A & B	0.3	5.6	0.3
Dogger Bank Teesside A & Sofia	0.7	14.8	0.5
East Anglia Three	0.6	6.1	1.6
Hywind 2 Demonstration	0.0	0.0	0.0
Inch Cape	0.3	0.0	1.4
Moray East	0.6	0.0	1.7
Moray West	0.1	0.0	0.4
Neart na Gaoithe	1.4	0.0	2.3
Seagreen Alpha & Bravo	1.9	0.0	1.5
Triton Knoll	1.9	26.8	3.1
East Anglia ONatural England North	0.1	10.0	0.1

	Return Migration	Breeding	Post-breeding Migration
East Anglia TWO	0.1	8.8	0.3
Hornsea Three	0.5	18.0	0.6
Norfolk Boreas	0.9	54.1	2.4
Norfolk Vanguard	0.6	21.6	2.4
Thanet Extension	0.6	0.0	0.2
Seasonal Total (Excl. Hornsea Four)	16.6	343.7	38.0
Annual Total (Excl. Hornsea Four)			398.3
Hornsea Four	0.4	33.8	0.5
Seasonal Totals (Incl. Hornsea Four)	17.0	377.5	38.5
Annual Total (Incl. Hornsea Four)			433.0

12.4.3.62 As noted above, the in-combination assessment has drawn on figures from other projects that have applied either the Band CRM Option 1 or Band CRM Option 2, the latter used in preference where both figures are available. The result is a single set of in-combination values for the breeding and non-breeding bio-seasons, there are no scenarios to apply.

12.4.3.63 Those mortality predictions by bio-season are provided below expressed as the number of individuals and also as the number of adult birds based on the proportion of adults in the UK North Sea population being 60%.

Breeding Season

12.4.3.64 The in-combination predicted collision resultant mortality in the breeding season from the operating, consented and proposed OWFs, including Hornsea Four, is 377 individuals or 226 adult birds. For the reason identified above, 100% of those adult birds in the breeding season have been assessed as coming from the Flamborough and Filey Coast SPA as a worst-case. The breeding adult population of the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals) has an annual background mortality of 1,491 adult birds. However, as the population of gannets has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 13,392 apparently occupied nests (or 26,784 breeding adults). As noted above, the assessment method applied for gannet during the breeding season is considered almost certainly to over-estimate the number of adult birds that may suffer collision consequent mortality during the operational maintenance phase. Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Non-Breeding Season

- 12.4.3.65 The in-combination predicted collision resultant mortality attributed to the Flamborough and Filey Coast SPA in the return migration bio-season from the operating, consented and proposed OWFs, including Hornsea Four, is 17 individuals, or 10 adult birds, and in the post-breeding migration bio-season the attributed prediction is 39 individuals, or 23 adult birds (there is no migration free winter bio-season). In total 56 individuals, or 33 adult birds, attributed to the Flamborough and Filey Coast SPA are predicted to suffer collision related mortality during the non-breeding season. The breeding adult population of the Flamborough and Filey Coast SPA (classified gannet population of 16,938 individuals) has an annual background mortality of 1,491 adult birds. However, as the population of gannets has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017. This was of 13,392 apparently occupied nests (or 26,784 breeding adults) with this population having an annual background mortality of 2,357 adult birds. As noted above, the assessment method applied for gannet in during the non-breeding season is considered almost certainly to over-estimate the number of adult birds that may suffer collision consequent mortality during the operational maintenance phase. Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.
- 12.4.3.66 The impact of in-combination collision related mortality to breeding birds from the Flamborough and Filey Coast SPA, which would occur throughout the operational life of the assessed OWFs in the UK North Sea, is for mortality ranging of 226 adult birds from the SPA in the breeding season and 33 adult birds in the non-breeding season. Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Flamborough and Filey Coast SPA – kittiwake

- 12.4.3.67 Kittiwake has been screened in to the in-combination assessment of the Hornsea Four O&M phase. The projects screened in are the proposed and operating offshore wind farms in the UK waters of the North Sea and English Channel. They have been screened in on the basis of this species flight behaviour that places it at risk of collision with the turning blades of the WTGs and the experience of the in-combination assessments carried out for offshore wind farms in recent years. Collisions may occur when birds fly through the offshore wind farms whilst foraging for food, commuting between breeding sites and foraging areas, or during migration.
- 12.4.3.68 In order to assess the potential in-combination impact on this species, information was compiled on the predicted collision mortality for each of the OWF projects included in the

in-combination assessment. The projects included are those defined as being within Tier 1 (sub-tiers 1a to 1d) and Tier 2. The collision risk predictions from the other offshore wind farm projects have been extracted and collated based, where available, on Band Option 2 and if not available then on Band Option 1. The collision predictions have been standardised by the application of the avoidance rates most appropriate to each species, as described in [Appendix A of the Hornsea Four EIA PEIR Volume 5, Annex 5.3: Offshore Ornithology Collision Risk Modelling](#).

- 12.4.3.69 This species has been screened in for both the breeding and the non-breeding bio-seasons. The potential for impact on the Flamborough and Filey Coast SPA varies by season and accordingly the assessment is carried out on a seasonal basis. This is because the population of birds in the area in and around Hornsea Four changes through the seasons with birds breeding at sites remote from the north-east coast of England either passing through the area on spring and autumn migration or arriving in the area to spend the winter.
- 12.4.3.70 For the purpose of this assessment the use of a generic population age ratio of kittiwakes has been used of 0.53, which is based on the assumptions described in more detail within [Table 5.16 of the Hornsea Four EIA PEIR Volume 2, Chapter 5](#) (i.e. 53% of kittiwakes are determined to be adults) across all months of the year.
- 12.4.3.71 During the breeding season, when birds are limited in the distance and number of days over which they can forage by the need to return regularly to the nest site, it can be expected that the area in and around Hornsea Four will contain adult birds that are a mix of those from the SPA and other breeding colonies along the north east coast that are within foraging range. Accordingly a calculation has to be made to determine the proportion of breeding adult kittiwakes in the area that should be attributed to the SPA. This was carried out using the SNH apportionment tool (SNH, 2018). The JNCC Seabird Monitoring Programme Online Database of colony count data (<http://archive.jncc.gov.uk/smp/>) was accessed and all those kittiwake breeding colonies within 231 km of the Hornsea Four array area were identified (this foraging distance of 231 km was taken from the results of the tracking studies carried out at the SPA). This process identified 43 sites (grouped into 16 master sites) in the database (in addition to the SPA) that contributed 31,491 adult birds to the pool of birds potentially foraging across the Hornsea Four array area. To this was added the latest colony count for the FFC SPA of 103,070 adult birds (it would be an invalid process to use the SPA classification population from 2008-11 when the other counts are of the recent populations co-incident with the period that the aerial surveys were carried out of the Hornsea Four array area). These colony counts with their distance to the Hornsea Four array area were applied in the SNH apportionment tool and the resulting value for apportionment has been calculated as 93.7% in the breeding season.
- 12.4.3.72 Outside the breeding season, when the population contains a mix of birds from UK breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be attributed to any particular breeding colony SPA population. In the non-breeding season the information on populations contained in Furness (2015) is applied for purpose of apportionment of birds to the SPA.

- 12.4.3.73 The UK North Sea population outside the breeding season is 627,816 individuals in the return migration bio-season and 829,937 individuals in the post-breeding bio-season. Sixty percent of the breeding birds from the SPA are present in the UK North Sea in both the return migration bio-season and the post-breeding migration bio-season. The result is that based on the SPA citation population (89,040 individuals) there are 53,424 individuals from the SPA in the UK North Sea in the return migration bio-season and in the post-breeding migration bio-season. If the SPA breeding population of 75,234 individuals from Furness (2015) is considered (which is preferred given that it was the population that informed the calculation of the UK North Sea population so avoiding invalid comparisons of populations from distinctly different years in a process that is calculating proportions) then there are 45,140 individuals from the SPA in the UK North Sea in the return migration bio-season and in the post-breeding migration bio-season. From these figures, the proportion of birds in the UK North Sea that can be attributed to the SPA, based on the Furness (2015) population data is 7.2% in the return migration bio-season and 5.4% in the post-breeding migration bio-season.
- 12.4.3.74 The calculation of the in-combination total of birds predicted to suffer collision consequent mortality are set out across three linked tables below in order to present the information for the three bio-seasons for which it was calculated. **Table 31** contains columns that present the mortality estimates, **Table 32** contains columns that identify whether or not a particular offshore wind farm project is included in the assessment, and if so, what percentage of birds is apportioned to the Flamborough and Filey Coast SPA (applying the calculated apportionment figures for the bio-seasons as described above) and **Table 33** has columns that identify the estimate for the predicted number of collisions attributed to the SPA by each project.

Table 31: Predicted collision estimates for kittiwake for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post-breeding Migration
Beatrice Demonstrator	1.7	0.0	2.1
Blyth Demonstration Site	1.4	1.4	2.3
Dudgeon	0.0	0.0	0.0
EOWDC	1.1	11.8	5.8
Galloper	31.8	6.3	27.8
Greater Gabbard	11.4	1.1	15.0
Gunfleet Sands	0.0	0.0	0.0
Humber Gateway	1.9	1.9	3.2
Kentish Flats	0.7	0.0	0.9
Lincs, Lynn & Inner Dowsing	0.7	0.7	1.2
London Array	1.8	1.4	2.3
Methil (Samsung) Demo			

	Return Migration	Breeding	Post-breeding Migration
Race Bank	5.6	1.9	23.9
Rampion	29.7	54.4	37.4
Scroby Sands	0.0	0.0	0.0
Sheringham Shoal	0.0	0.0	0.0
Teesside	2.5	38.4	24.0
Thanet	0.4	0.3	0.5
Westernmost Rough	0.1	0.1	0.2
Beatrice	39.8	94.7	10.7
East Anglia One	46.8	1.8	160.4
Hornsea Project One	20.9	44.0	55.9
Hornsea Project Two	3.0	16.0	9.0
Dogger Bank Creyke Beck A & B	295.0	288.0	135.0
Dogger Bank Teesside A & Sofia	216.9	136.9	90.7
East Anglia Three	37.6	6.1	69.0
Hywind 2 Demonstration	0.9	16.6	0.9
Inch Cape	63.5	13.1	224.8
Moray East	19.3	43.6	2.0
Moray West	7.0	79.0	24.0
Neart na Gaoithe	4.4	32.9	56.1
Seagreen Alpha & Bravo	58.0	159.0	117.0
Triton Knoll	45.4	24.6	139.0
East Anglia ONatural England North	17.4	6.0	4.3
East Anglia TWO	9.3	13.6	2.9
Hornsea Three	40.0	121.0	76.0
Norfolk Boreas	56.3	29.9	116.6
Norfolk Vanguard	150.5	31.3	134.1
Thanet Extension	9.8	1.5	3.4
Seasonal Total (Excl. Hornsea Four)	1,232.6	1,279.3	1,578.4
Annual Total (Excl. Hornsea Four)	4,090.3		
Hornsea Four	1.4	3.0	2.5
Seasonal Totals (Incl. Hornsea Four)	1,234.0	1,282.3	1,580.9
Annual Total (Incl. Hornsea Four)	4,097.2		

Table 32: Attribution of kittiwake numbers to the FFC SPA for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Attributed in breeding season to FFC SPA	% attribution	Attributed in return migration to FFC SPA	% attribution	Attributed in post-breeding migration to FFC SPA	% attribution
Beatrice Demonstrator	no	0	yes	7.2%	yes	5.4%
Blyth Demonstration Site	yes	93.7%	yes	7.2%	yes	5.4%
Dudgeon	yes	93.7%	yes	7.2%	yes	5.4%
EOWDC	no	0	yes	7.2%	yes	5.4%
Gallopier	no	0	yes	7.2%	yes	5.4%
Greater Gabbard	no	0	yes	7.2%	yes	5.4%
Gunfleet Sands	no	0	yes	7.2%	yes	5.4%
Humber Gateway	yes	93.7%	yes	7.2%	yes	5.4%
Kentish Flats	no	0	yes	7.2%	yes	5.4%
Lincs, Lynn & Inner Dowsing	yes	93.7%	yes	7.2%	yes	5.4%
London Array	no	0	yes	7.2%	yes	5.4%
Methil (Samsung) Demo	no	0	yes	7.2%	yes	5.4%
Race Bank	yes	93.7%	yes	7.2%	yes	5.4%
Rampion	no	0	yes	7.2%	yes	5.4%
Scroby Sands	no	0	yes	7.2%	yes	5.4%
Sheringham Shoal	yes	93.7%	yes	7.2%	yes	5.4%
Teesside	yes	93.7%	yes	7.2%	yes	5.4%
Thanet	no	0	yes	7.2%	yes	5.4%
Westermost Rough	yes	93.7%	yes	7.2%	yes	5.4%
Beatrice	no	0	yes	7.2%	yes	5.4%
East Anglia One	no	0	yes	7.2%	yes	5.4%
Hornsea Project One	yes	93.7%	yes	7.2%	yes	5.4%
Hornsea Project Two	yes	93.7%	yes	7.2%	yes	5.4%
Dogger Bank Creyke Beck A & B	yes	93.7%	yes	7.2%	yes	5.4%
Dogger Bank Teesside A & Sofia	yes	93.7%	yes	7.2%	yes	5.4%
East Anglia Three	no	0	yes	7.2%	yes	5.4%
Hywind 2 Demonstration	no	0	yes	7.2%	yes	5.4%
Inch Cape	no	0	yes	7.2%	yes	5.4%
Moray East	no	0	yes	7.2%	yes	5.4%
Moray West	no	0	yes	7.2%	yes	5.4%
Neart na Gaoithe	no	0	yes	7.2%	yes	5.4%
Seagreen Alpha & Bravo	no	0	yes	7.2%	yes	5.4%
Triton Knoll	yes	93.7%	yes	7.2%	yes	5.4%

	Attributed in breeding season to FFC SPA	% attribution	Attributed in return migration to FFC SPA	% attribution	Attributed in post- breeding migration to FFC SPA	% attribution
East Anglia ONatural England North	no	0	yes	7.2%	yes	5.4%
East Anglia TWO	no	0	yes	7.2%	yes	5.4%
Hornsea Three	yes	93.7%	yes	7.2%	yes	5.4%
Norfolk Boreas	yes	93.7%	yes	7.2%	yes	5.4%
Norfolk Vanguard	yes	93.7%	yes	7.2%	yes	5.4%
Thanet Extension	no	0	yes	7.2%	yes	5.4%
Hornsea Four	yes	93.7%	yes	7.2%	yes	5.4%

Table 33: Collision estimates for kittiwake attributed to the FFC SPA for three bio-seasons for each offshore wind farm included in the in-combination assessment.

	Return Migration	Breeding	Post- breeding Migration
Beatrice Demonstrator	0.1	0.0	0.1
Blyth Demonstration Site	0.1	1.3	0.1
Dudgeon	0.0	0.0	0.0
EOWDC	0.1	0.0	0.3
Galloper	2.3	0.0	1.5
Greater Gabbard	0.8	0.0	0.8
Gunfleet Sands	0.0	0.0	0.0
Humber Gateway	0.1	1.8	0.2
Kentish Flats	0.1	0.0	0.0
Lincs, Lynn & Inner Dowsing	0.1	0.7	0.1
London Array	0.1	0.0	0.1
Methil (Samsung) Demo	0.0	0.0	0.0
Race Bank	0.4	1.8	1.3
Rampion	2.1	0.0	2.0
Scroby Sands	0.0	0.0	0.0
Sheringham Shoal	0.0	0.0	0.0
Teesside	0.2	36.0	1.3
Thanet	0.0	0.0	0.0
Westermost Rough	0.0	0.1	0.0
Beatrice	2.9	0.0	0.6
East Anglia One	3.4	0.0	8.7
Hornsea Project One	1.5	41.2	3.0
Hornsea Project Two	0.2	15.0	0.5

	Return Migration	Breeding	Post-breeding Migration
Dogger Bank Creyke Beck A & B	21.2	269.9	7.3
Dogger Bank Teesside A & Sofia	15.6	128.3	4.9
East Anglia Three	2.7	0.0	3.8
Hywind 2 Demonstration	0.1	0.0	0.0
Inch Cape	4.6	0.0	12.2
Moray East	1.4	0.0	0.1
Moray West	0.5	0.0	1.3
Neart na Gaoithe	0.3	0.0	3.1
Seagreen Alpha & Bravo	4.2	0.0	6.4
Triton Knoll	3.3	23.1	7.6
East Anglia ONatural England North	1.3	0.0	0.2
East Anglia TWO	0.7	0.0	0.2
Hornsea Three	2.9	113.4	4.1
Norfolk Boreas	4.0	28.0	6.3
Norfolk Vanguard	10.8	29.3	7.3
Thanet Extension	0.7	0.0	0.2
Seasonal Total (Excl. Hornsea Four)	88.6	689.7	85.8
Annual Total (Excl. Hornsea Four)	864.2		
Hornsea Four	0.1	2.8	0.1
Seasonal Totals (Incl. Hornsea Four)	88.7	692.5	86.0
Annual Total (Incl. Hornsea Four)	867.2		

12.4.3.75 As noted above, the in-combination assessment has drawn on figures from other projects that have applied either the Band CRM Option 1 or Band CRM Option 2, the latter used in preference where both figures are available. The result is a single set of in-combination values for the breeding and non-breeding bio-seasons, there are no scenarios to apply.

12.4.3.76 Those mortality predictions by bio-season are provided below expressed as the number of individuals and also as the number of adult birds based on the proportion of adults in the UK North Sea population being 53%.

Breeding Season

12.4.3.77 The in-combination predicted collision resultant mortality in the breeding season from the operating, consented and proposed OWFs, including Hornsea Four, is 693 individuals or 367 adult birds that are attributed to the Flamborough and Filey Coast SPA. The breeding adult population of the Flamborough and Filey Coast SPA (classified kittiwake population of 89,040 individuals) has an annual background mortality of 13,000 adult birds. However, as the population of kittiwakes has increased since the citation population count the potential

impact on the population is more reasonably assessed against the latest population count undertaken in 2017, which was of 51,535 apparently occupied nests (or 103,070 breeding adults). On this basis those adult birds predicted to suffer from collision mortality attributed to the Flamborough and Filey Coast SPA (with an annual background mortality of this number of adult birds being 15,048 breeding individuals) then 367 adult birds may suffer collision consequent mortality. As noted above, the assessment method applied for kittiwake during the breeding season is considered almost certainly to over-estimate the number of adult birds that may suffer collision consequent mortality during the operational maintenance phase. Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.

Non-Breeding Season

- 12.4.3.78 The in-combination predicted collision resultant mortality attributed to the Flamborough and Filey Coast SPA in the return migration bio-season from the operating, consented and proposed OWFs, including Hornsea Four, is 89 individuals, or 47 adult birds, and in the post-breeding migration bio-season the attributed prediction is 86 individuals, or 46 adult birds (there is no migration free winter bio-season). In total 175 individuals, or 93 adult birds, attributed to the Flamborough and Filey Coast SPA are predicted to suffer collision related mortality during the non-breeding season. The breeding adult population of the Flamborough and Filey Coast SPA (classified kittiwake population of 89,040 individuals) has an annual background mortality of 13,000 adult birds. However, as the population of kittiwakes has increased since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017. This was of 51,535 apparently occupied nests (or 103,070 breeding adults) with this population having an annual background mortality of 15,048 adult birds. The prediction of 93 adults in the non-breeding season suffering collision consequent mortality would represent a 0.6% increase in baseline mortality.
- 12.4.3.79 The impact of in-combination collision related mortality to breeding birds from the Flamborough and Filey Coast SPA, which would occur throughout the operational life of the assessed OWFs in the UK North Sea, is for mortality ranging of 367 adult birds from the SPA in the breeding season and 93 adult birds in the non-breeding season. Given the potential for an over estimate to be made, further consideration of this issue will be made in consultation with Natural England and the RSPB, including any use of PVA analysis to refine the mortality predictions and to re-assess the impact at the FFC SPA population level, with that further consultation and analysis reported on within the final RIAA submitted at Application.
- 12.4.3.80 For the non-breeding season there is, therefore, no potential for an AEoI to the conservation objectives of the kittiwake feature of the Flamborough and Filey Coast SPA in relation to collision mortality effects in the O&M phase from Hornsea Four in-combination with other operational, planned and proposed OWFs in the UK North Sea and therefore, subject to

natural change, kittiwake will be maintained as a feature in the long term with respect to the potential for adverse effects from collision mortality.

12.5 Onshore Ecology

- 12.5.1.1 All potential adverse effects alone that are related to onshore ecology have been screened out, as confirmed with Stakeholders within the updated Hornsea Four Screening Report ([Appendix B](#)) and as presented within [Section 11](#) and the screening matrices supporting this RIAA ([Appendix C](#)).
- 12.5.1.2 An assessment of in-combination effects has not been undertaken with regard to onshore ecology at the time of submitting this PEIR. This is due to a lack of complete baseline on which to assess in-combination effects, as described with [Section 1.3](#). This will be reported within the Hornsea Four Environmental Statement, to be submitted with the DCO application in 2020.

12.6 Migratory Fish

12.6.1 Construction and Decommissioning

Accidental Pollution

- 12.6.1.1 The potential for an AEol in-combination as a result of accidental pollution on migratory fish during construction and decommissioning relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.
- River Derwent SAC (river lamprey and sea lamprey);
 - River Humber SAC (river lamprey and sea lamprey); and
 - River Humber Ramsar (river lamprey and sea lamprey).
- 12.6.1.2 As noted in [Section 11](#), accidental pollution to affect migratory fish was scoped out from the PEIR ([Volume 2, Chapter 3: Fish and Shellfish Ecology](#)), given the project specific mitigation (contained within [Table 3.9](#) of that chapter) and conclusion of no likely significant effect, which enabled the effect to be scoped out from assessment in the PEIR. The implementation of the PEMMP, produced in consultation with Natural England and provided for in the DCO as part of the standard dML requirements, enabled the conclusion in [Section 11](#), for the project alone, that there is, therefore, no AEol to the migratory fish in relation to accidental pollution from Hornsea Four.
- 12.6.1.3 The requirements of the above mitigation, together with an assumed requirement for similar compliance for all other consents considered in-combination, mean that it can therefore be concluded that subject to natural change, no AEol will result with respect to migratory fish, and that the migratory fish features will be maintained in the long term.

12.6.2 Operation and maintenance

Accidental pollution

- 12.6.2.1 The potential for an AEol in-combination as a result of accidental pollution on migratory fish during operation and maintenance relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE). The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.
- River Derwent SAC (river lamprey and sea lamprey);
 - River Humber SAC (river lamprey and sea lamprey); and
 - River Humber Ramsar (river lamprey and sea lamprey).
- 12.6.2.2 As noted in [Section 11](#), accidental pollution to affect migratory fish was scoped out from the PEIR ([Volume 2, Chapter 3: Fish and Shellfish Ecology](#)), given the project specific mitigation (contained within [Table 3.9](#) of that chapter) and conclusion of no likely significant effect, which enabled the effect to be scoped out from assessment in the PEIR. The implementation of the PEMMP, produced in consultation with Natural England and provided for in the DCO as part of the standard dML requirements, enabled the conclusion in [Section 11](#), for the project alone, that there is, therefore, no AEol to the migratory fish in relation to accidental pollution from Hornsea Four.
- 12.6.2.3 The requirements of the above mitigation, together with an assumed requirement for similar compliance for all other consents considered in-combination, mean that it can therefore be concluded that subject to natural change, no AEol will result with respect to migratory fish, and that the migratory fish features will be maintained in the long term.

13 Transboundary statement

- 13.1.1.1 The screening process has identified twelve transboundary sites for assessment, with these sites being as follows (including the relevant designated species screened in):
- Doggersbank (Dutch) SAC (grey seal and harbour seal);
 - Klaverbank (Netherlands) SAC (grey seal and harbour seal);
 - Bancs des Flandres (France) SCI (grey seal);
 - Vlaamse Banken SCI (Belgium) (grey seal);
 - SBZ 1 SCI (Belgium) (grey seal);
 - SBZ 2 SCI (Belgium) (grey seal);
 - SBZ 3 SCI (Belgium) (grey seal);
 - Vlake van de Raan (Netherlands) SCI (grey seal);
 - Westerschelde & Saeftinghe (Netherlands) SCI (grey seal);
 - Voordelta (Netherlands) SCI (grey seal);
 - Noordzeekustzone SCI (Netherlands) (grey seal); and
 - Waddenzee SCI (Netherlands) (grey seal).

- 13.1.1.2 No transboundary comments have been received to date (July 2019).
- 13.1.1.3 Consideration of the potential for an AEol alone has been addressed in [Section 11](#) for marine mammals, including in relation to the above sites where marine mammals are highlighted, with all conclusions being no AEol. The assessment in-combination with other plans or projects (including transboundary projects) has been addressed in [Section 12](#) for marine mammals, with all conclusions similarly being no AEol.
- 13.1.1.4 It can therefore be concluded that no AEol exists for a transboundary effect from Hornsea Four alone or in-combination.

14 Conclusion of the Assessment

- 14.1.1.1 A summary of the assessment is presented below, firstly identifying in [Table 34](#) the designated sites (together with the relevant feature(s)) screened in for effect in relation to Hornsea Four alone, including the conclusion on AEol. The determination of AEol in-combination is summarised in [Table 35](#).

Table 34: Summary of the Potential for Adverse Effect from Hornsea Four Alone.

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Sites primarily designated for subtidal and intertidal benthic ecology					
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Temporary increases in suspended sediment concentrations (SSC)/ smothering	No potential for AEol	No potential for AEol	No potential for AEol
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Invasive non-native species	No potential for AEol	No potential for AEol	No potential for AEol
Flamborough Head SAC	Reefs	Changes to physical processes	N/A	No potential for AEol	N/A
Humber Estuary SAC	Atlantic saltmeadows; and <i>Salicornia</i> and other colonising species	Nitrogen deposition	No potential for AEol	N/A	No potential for AEol
Humber Estuary Ramsar	Saltmarsh	Nitrogen deposition	No potential for AEol	N/A	No potential for AEol
Sites primarily designated for Marine Mammals					

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Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Southern North Sea SAC	Harbour porpoise	Underwater noise	No potential for AEol	No potential for AEol	No potential for AEol
The Wash and North Norfolk Coast SAC	Harbour seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Humber Estuary SAC	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Humber Estuary Ramsar	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Berwickshire and North Northumberland Coast SAC	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Doggersbank (Dutch) SAC	Harbour seal; and Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Klaverbank SCI	Harbour seal; and Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Bancs de Flandres	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Vlaamse Banken	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 1	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 2	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 3	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Vlakte van d Raan	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Westerschelde & Saeftinghe	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Voordelta	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Noordzeekustzone	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol

Hornsea 4



Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Waddenzee	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Southern North Sea SAC	Harbour porpoise	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
The Wash and North Norfolk Coast SAC	Harbour seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Humber Estuary SAC	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Humber Estuary Ramsar	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Berwickshire and North Northumberland Coast SAC	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Transboundary sites (two)	Harbour seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Transboundary sites (12)	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol

Sites primarily designated for Offshore Ornithology

Greater Wash SPA	Little gull	Collision Risk	-	No LSE	-
	Red-throated diver Common scoter	Disturbance and displacement	No potential for AEol	No potential for AEol	No potential for AEol
	Gannet Kittiwake	Collision Risk	-	No potential for AEol	-
Flamborough and Filey Coast SPA	Gannet	Disturbance and displacement	-	No potential for AEol	-
	Guillemot Razorbill Puffin	Disturbance and displacement	No potential for AEol	No potential for AEol	No potential for AEol

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Guillemot Razorbill Puffin	Barrier effect	-	No potential for AEol	-
	Avocet Golden plover Black-tailed godwit Bar-tailed godwit Ruff Shelduck Dunlin Redshank Knot	Risk of Collision	-	No potential for AEol	-
Humber Estuary SPA	Golden plover Black-tailed godwit Bar-tailed godwit Shelduck Dunlin Redshank Knot	Risk of Collision	-	No potential for AEol	-
Humber Estuary Ramsar	Arctic tern Little tern	Risk of Collision	-	No potential for AEol	-
Northumbria Coast SPA	Kittiwake Common tern Arctic tern Roseate tern	Risk of Collision	-	No potential for AEol	-

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Sandwich tern				
Coquet Island SPA	Puffin	Disturbance and displacement	No potential for AEol	No potential for AEol	No potential for AEol
	Kittiwake	Risk of Collision	-	No potential for AEol	-
	Common tern				
	Arctic tern				
Farne Islands SPA	Roseate tern				
	Sandwich tern				
	Guillemot	Disturbance and displacement	No potential for AEol	No potential for AEol	No potential for AEol
	Puffin				
	Gannet	Risk of Collision	-	No potential for AEol	-
	Common tern				
	Arctic tern				
	Roseate tern				
Forth Islands (UK) SPA	Sandwich tern				
	Guillemot	Disturbance and displacement	-	No potential for AEol	-
	Razorbill				
	Puffin				
	Gannet	Risk of Collision	-	No potential for AEol	-
Outer Firth of Forth and St. Andrew's Complex pSPA	Guillemot	Disturbance and displacement	-	No potential for AEol	-
	Razorbill				
	Puffin				
	Kittiwake	Risk of Collision	-	No potential for AEol	-
	Guillemot	Disturbance and displacement	-	No potential for AEol	-
Fowlsheugh SPA	Razorbill				
	Kittiwake	Risk of Collision	-	No potential for AEol	-

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Buchan Ness to Collieston Coast SPA	Guillemot	Disturbance and displacement	-	No potential for AEol	-
	Kittiwake	Risk of Collision	-	No potential for AEol	-
Troup, Pennan and Lion's Heads SPA	Guillemot Razorbill	Disturbance and displacement	-	No potential for AEol	-
	Kittiwake Great black-backed gull	Risk of Collision	-	No potential for AEol	-
East Caithness Cliffs SPA	Guillemot Razorbill	Disturbance and displacement	-	No potential for AEol	-
	Kittiwake	Risk of Collision	-	No potential for AEol	-
North Caithness Cliffs SPA	Guillemot Razorbill Puffin	Disturbance and displacement	No potential for AEol	No potential for AEol	-

Sites primarily designated for Onshore Ecology

All potential effects alone that are related to onshore ecology have been screened out, as confirmed by Natural England following the updated Hornsea Four Screening Report (see [Appendix B](#)).

Table 35: Summary of the Potential for Adverse Effect from Hornsea Four In-combination.

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Sites primarily designated for subtidal and intertidal benthic ecology					
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Temporary increase in suspended sediment concentration	No potential for AEol	N/A	No potential for AEol
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Invasive non-native species	No potential for AEol	No potential for AEol	No potential for AEol
Flamborough Head SAC	Reefs; and Submerged or partially submerged sea caves	Changes to physical processes	N/A	No potential for AEol	N/A
Sites primarily designated for Marine Mammals					
Southern North Sea SAC	Harbour porpoise	Underwater noise	No potential for AEol	No potential for AEol	No potential for AEol
The Wash and North Norfolk Coast SAC	Harbour seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Humber Estuary SAC	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Humber Estuary Ramsar	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Berwickshire and North Northumberland Coast SAC	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Doggersbank (Dutch) SAC	Grey seal; and Harbour seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Klaverbank SCI	Grey seal; and Harbour seal	Underwater noise	No potential for AEol	N/A	No potential for AEol

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Bancs de Flandres	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Vlaamse Banken	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 1	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 2	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
SBZ 3	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Vlakte van d Raan	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Westerschelde & Saeftinghe	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Voordelta	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Noordzeekustzone	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Waddenzee	Grey seal	Underwater noise	No potential for AEol	N/A	No potential for AEol
Southern North Sea SAC	Harbour porpoise	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
The Wash and North Norfolk Coast SAC	Harbour seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Humber Estuary SAC	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Humber Estuary Ramsar	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Berwickshire and North Northumberland Coast SAC	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Transboundary sites (two)	Harbour seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Transboundary sites (12)	Grey seal	Vessel disturbance	No potential for AEol	No potential for AEol	No potential for AEol
Southern North Sea SAC	Harbour porpoise	Collision risk	No potential for AEol	No potential for AEol	No potential for AEol

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Humber Estuary SAC	Grey seal	Collision risk	No potential for AEol	No potential for AEol	No potential for AEol
Humber Estuary Ramsar	Grey seal	Collision risk	No potential for AEol	No potential for AEol	No potential for AEol

Sites primarily designated for Offshore Ornithology

Flamborough and Filey Coast SPA	Gannet Kittiwake	Collision Risk	-	No LSE	-
	Guillemot Razorbill Puffin	Disturbance and displacement	No LSE	No LSE	No LSE

Sites primarily designated for Onshore Ecology

All potential effects in-combination that are related to onshore ecology have been screened out, as confirmed by Natural England following the updated Hornsea Four Screening Report (see [Appendix B](#)).

15 References

Aarts, G., S. Brasseur, and R. Kirkwood. 2018. Behavioural response of grey seals to pile-driving. Wageningen Marine Research report C006/18.

Aitken, D., Babcock, M., Barratt, A., Clarkson, C. and Prettyman, S. (2017). Flamborough and Filey Coast pSPA Seabird Monitoring Programme – 2017 Report. RSPB Bempton Cliffs, East Riding of Yorkshire

BERR, and DEFRA. 2008. Review of cabling techniques and environmental effects applicable to the offshore wind farm industry. This report was prepared by consultants from Royal Haskoning and BOMEL Ltd.

Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller R.J. (2013). Bird Atlas 2007–11: the Breeding and Wintering Birds of Britain and Ireland. BTO, Thetford.

Band, W. (2012). Using a collision risk model to assess bird collision risks for offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. SOSS Website. Original published Sept 2011, extended to deal with flight height distribution data March 2012.

Boorman, L.A. and Hazelden, J. (2012). Impacts of additional aerial inputs of nitrogen to salt marsh and transitional habitats. CCW Science Report No: 995, pp44, Countryside Council for Wales, Bangor, Wales.

Booth, C. G., F. Heinis, and H. J. 2019. Updating the Interim PCoD Model: Workshop Report - New transfer functions for the effects of disturbance on vital rates in marine mammal species. Report Code SMRUC-BEI-2018-011, submitted to the Department for Business, Energy and Industrial Strategy (BEIS), February 2019 (unpublished).

Braasch, A., Joost, M., and Ketzer, C. (2013). Responses of harbour porpoises to pile driving on a temporal and spatial scale. Poster to conference on windpower and environmental impacts, Stockholm.

Bradbury, G., Trinder, M., Furness, B., Banks, A., Caldow, R. and Hume, D. (2014). Mapping Seabird Sensitivity to Offshore Wind Farms. PLoS ONatural England 9(9): e103366. Doi:10.1371/journal.pone.0106366.

Brandt, M.J., Diederichs, A., Betke, K. and Nehls, G. (2011). Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Marine Ecology Progress Series. 421, pp.205 – 216.

Brandt, M. J., A.-C. Dragon, A. Diederichs, M. A. Bellmann, V. Wahl, W. Piper, J. Nabe-Nielsen, and G. Nehls. 2018. Disturbance of harbour porpoises during construction of the first seven offshore wind farms in Germany. Marine Ecology Progress Series 596:213-232.

Brasseur, S., G. Aarts, E. Meesters, T. van Polanen Petel, E. Dijkman, J. Cremer, and P. Reijnders. 2012. Habitat preference of harbour seals in the Dutch coastal area: analysis and estimate of effects of offshore wind farms.

CEFAS (2009). Cefas contract report: SLAB5 Dredged Material Disposal Site Monitoring Around the Coast of England: Results of Sampling (2009) Authors: Bolam, S.G., Mason, C., Bolam, T., Whomersley, P., Birchenough, S.N.R, Curtis, M., Birchenough, A., Rumney, H., Barber, J., Rance, J., Law, R., and Griffith, A. Issue date: April 2011

CEFAS. 2010. Strategic review of offshore wind farm monitoring data associated with FEPA licence conditions – annex 4: underwater noise., Cefas report ME1117.

CIEEM, 2016. Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial. Freshwater and coastal.

Cook, A.S.C.P., Wright, L.J., and Burton, N.H.K. (2012) A review of flight heights and avoidance rates of birds in relation to offshore windfarms. The Crown Estate Strategic Ornithological Support Services (SOSS). <http://www.bto.org/science/wetland-and-marine/soss/projects>.

Cook, A.S.C.P., Humphries, E.M., Masden, E.A. and Burton, N.H.K. (2014). The avoidance rates of collision between birds and offshore turbines (Thetford: British Trust for Ornithology).

Dahne, M., Gilles, A., Peschko, V., Krugel, K., Sundermeyer, J. and Siebert, U. (2013). Effects of pile-driving on harbour porpoises (*Phocoena phocoena*) at the first offshore wind farm in Germany. *Environmental Research Letters*, Volume 8, Number 2.

De-Bastos, E.S.R. and Hill, J. (2016) *Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand. In: Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. [Online] Plymouth: Marine Biological Association of the United Kingdom. Available from: <http://www.marlin.ac.uk/habitat/detail/124> [Accessed July 2019].

DECC (2016). Guidance on when new marine Natura 2000 sites should be taken into account in offshore renewable energy consents and licences.

Diederichs, A., G. Nehls, M. Dähne, S. Adler, S. Koschinski, and U. Verfuß. 2008. Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms.

Dierschke, V., Furness, R.W. & Garthe, S. (2016). Seabirds and offshore wind farms in European waters: Avoidance and attraction. *Biological Conservation*, 202, 59-68.

Furness, R.W., Wade, H. and Masden, E.A. (2013). Assessing vulnerability of seabird populations to offshore wind farms. *Journal of Environmental Management* 119: 56-66.

Hastie, G., N. D. Merchant, T. Götz, D. J. Russell, P. Thompson, and V. M. Janik. 2019. Effects of impulsive noise on marine mammals: investigating range-dependent risk. *Ecological Applications*.

Highways Agency (2007) Design Manual for Roads and Bridges Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques Part 1 HA207/07 Air Quality

Highways Agency (2007) Design Manual for Roads and Bridges HA207/07 Air Quality

IAMMWG (2015) Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, March 2015, 42 pp.

JNCC (2010). The protection of marine European Protected Species from injury and disturbance – Draft guidance for the marine area in England and Wales and the UK offshore marine area. March 2010. JNCC, Natural England and Countryside Council for Wales (CCW).

JNCC, Natural England, and CCW. 2010. The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area.

Joint Nature Conservation Committee, Natural England, Northern Ireland Environment Agency, Natural Resources Wales and Scottish Natural Heritage. (2014). Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review (Peterborough, JNCC).

Johnston, A., Cook, A.S.C.P., Wright, L.J., Humphreys, E.M. and Burton, E.H.K. (2014) Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology* 51: 31-41.

JNCC (2017). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys.

King, S., Maclean, I., Norman, T. and Prior, A. (2009). Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers (London: COWRIE Ltd).

Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beuker, D. & Dirksen, S. (2011). Effect Studies Offshore Wind Farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds. Bureau Waardenburg Report No 10-219.

Langston, R.H.W., Teuten, E. & Butler, A. (2013). Foraging ranges of northern gannets *Morus bassanus* in relation to proposed offshore wind farms in the North Sea: 2010-2012. RSPB Report to DECC. RSPB, Sandy.

Lawson, J., Kober, K., Win, I., Allcock, Z., Black, J., Reid, J.B., Way, L. and O'Brien, S.H. (2015) An assessment of the numbers and distributions of wintering red-throated diver, little gull and common scoter in the Greater Wash. JNCC Report 574. Peterborough: JNCC.

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K. L. Krijgsveld, M. Leopold, and M. Scheidat. 2011. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. *Environmental Research Letters* 6:1-13.

Lusseau, D. 2003. Male and female bottlenose dolphins *Tursiops* spp. have different strategies to avoid interactions with tour boats in Doubtful Sound, New Zealand. *Marine Ecology Progress Series* 257:267-274.

Lusseau, D. 2006. The short-term behavioral reactions of bottlenose dolphins to interactions with boats in Doubtful Sound, New Zealand. *Marine Mammal Science* 22:802-818.

MacArthur Green (2016). Quantifying impact assessments for selected seabird populations: A review of recent literature and understanding. Report commissioned by Vattenfall, Statkraft and ScottishPower Renewables.

Maclean, I.M.D., Wright, L.J., Showler, D.A. and Rehfisch, M.M. (2009). A Review of Assessment Methodologies for Offshore Windfarms (Thetford: British Trust for Ornithology).

Madsen, P. T., M. Wahlberg, J. Tougaard, K. Lucke, and P. Tyack. 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. *Marine Ecology Progress Series* 309:279-295.

Maclean, I.M.D., Wright, L.J., Showler, D.A., and Rehfisch, M.M. (2009). A review of assessment methodologies for offshore wind farms. British Trust for Ornithology Report, commissioned by COWRIE Ltd.

MMO. 2014. Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Marine Licence Conditions. A report produced for the Marine Management Organisation, pp 194. MMO Project No: 1031. ISBN: 978-1-909452-24-4.

Nowacek, S. M., R. S. Wells, and A. R. Solow. 2001. Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Marine Mammal Science* 17:673-688.

PINS (2013). Habitat Regulations Assessment relevant to nationally significant infrastructure projects.

PINS (2018). Advice Note 9: Rochdale Envelope.

PINS (2017) Habitats Regulations Assessment. [Online] Available from: <http://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/06/Advice-note-10v4.pdf> [Accessed July 2019].

PINS (2015) Cumulative Effects Assessment. [Online] Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/12/Advice-note-17V4.pdf>. [Accessed July 2019].

Popper, A.N. and Hawkins, A. (2012). The effects of noise on aquatic life, Advances in Experimental Medicine and Biology, Vol. 730. Springer, New York.

RenewableUK (2013). Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms.

Robertson G. S., Bolton M., Grecian W. J., & Monaghan P. (2014). Inter- and intra-year variation in foraging areas of breeding kittiwakes (*Rissa tridactyla*). Marine Biology, 161, 1973–1986;

Royal HaskoningDHV (2013). Thanet Offshore Wind Farm Ornithological Monitoring 2012-2013 (Post-construction Year 3). Royal HaskoningDHV Report for Vattenfall Wind Power Limited;

Scheidat, M., J. Tougaard, S. Brasseur, J. Carstensen, T. van Polanen Petel, J. Teilmann, and P. Reijnders. 2011. Harbour porpoises (*Phocoena phocoena*) and wind farms: a case study in the Dutch North Sea. Environmental Research Letters 6:1-10.

Sea Mammal Research Unit (SMRU), 2011. Summary of seal count and telemetry data from the Humber area. Report to SMart Wind.

SNH 2018. Interim Guidance on Apportioning Impacts from Marine Renewable Developments to Breeding Seabird Populations in Special Protection Areas. [Version: Updated November 2018]. SNH, Inverness.

Tasker, M., Amundin, M., Andre, M., Hawkins, A.D., Lang, W., Mercj, T., Scholik-Scholmer, A., Teilmann, J., Thomsen, F., Werner, S. and Zakharia, M. 2010). Managing underwater noise in European Waters.

Teilmann, J., J. Tougaard, J. Carstensen, R. Dietz, and S. Tougaard. 2006. Summary on seal monitoring 1999-2005 around Nysted and Horns Rev Offshore Wind Farms.

Thaxter, C. B., Lascelles, B., Sugar, K., Cook A., Roos, S., Bolton, M., Langston, R. and Burton, N. (2012), Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61.

Thompson, P.M., McConnell, B.J., Tollit, D.J., MacKay, A., Hunters, C. Racey, P.A., 1996. Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, N.E. Scotland. Journal of Applied Ecology, 33, pp. 1572-1584.

Thompson, P.M., Lusseau, D., Barton, T., Simmons, D., Rusin, J. and Bailey, H. (2010). Assessing the responses of coastal cetaceans to the construction of offshore wind turbines. Marine Pollution Bulletin 60: 1200-1208.

Tillin, H.M. and Hill, J.M. (2016) Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and

Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available at: <http://www.marlin.ac.uk/habitat/detail/152>

Tougaard, J., Buckland, S., Robinson, S. and Southall, B. (2014). An analysis of potential broad-scale impacts on harbour porpoise from proposed pile driving activities in the North Sea. Report of an expert group convened under the Habitats and Wild Birds Directives – Marine Evidence Group.

Tyler-Walters, H., Tillin, H.M., d'Avack, E.A.S., Perry, F., Stamp, T. (2018). Marine Evidence-based Sensitivity Assessment (MarESA) – A Guide. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, p.91

Wakefield, E.D., Bodey, T.W., Bearhop, S., Blackburn, J., Colhoun, K., Davies, R., Dwyer, R.G., Green, J.A., Grémillet, D., Jackson, A.L., Jessopp, M.J., Kane, A., Langston, R.H., Lescroël, A., Murray, S., Le Nuz, M., Patrick, S.C., Péron, C., Soanes, L.M., Wanless, S., Votier, S.C. and Hamer, K.C. Space Partitioning Without Territoriality in Gannets. *Science* 341: 68-70;

Wakefield E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., Guilford, T., Mavor, R.A., Miller, P.I., Newell, M.A., Newton, S.F., Robertson, G.S., Shoji, A., Soanes, L.M., Votier, S.C., Wanless, S. and Bolton, M. (2017). Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species. *Ecological Applications* 27: 2074-91;

Walls, R., Canning, S., Lye, G., Givens, L., Garrett, C. & Lancaster, J. (2013). Analysis of marine environmental monitoring plan data from the Robin Rigg offshore wind farm, Scotland. Natural Power Technical Report to E.ON Climate & Renewables. Natural Power, Castle Douglas;

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. and Baillie, S.R. (eds). (2002). *The Migration Atlas: Movements of the birds of Britain and Ireland*. T. and A.D. Poyser, London;

Wright, L.J., Ross-Smith, V.H., Massimino, D., Dadam, D., Cook, A.S.C.P. and Burton, N.H.K. (2012). Assessing the risk of offshore windfarm development to migratory birds designated as features of UK Special Protection Areas (and other Annex I species). (Thetford: British Trust for Ornithology).

Appendix A - Screening Report

Hornsea 4

Ørsted



Habitats Regulations Assessment Screening Report

Prepared	ERM and GoBe
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Date	8 th October 2018

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1 Introduction

1.1 Purpose of this Report

- 1.1.1.1 This document has been produced to inform the Habitats Regulations Assessment (HRA) process for the Hornsea Four Offshore Wind Farm (hereafter referred to as Hornsea Four). It provides information to enable the screening of the project with respect to its potential to have a likely significant effect (LSE) on European and Ramsar sites of nature conservation importance. This step in the process and associated reporting requirements are further described in the following sections.
- 1.1.1.2 The assessment provided in this document is based on the current understanding of the baseline environment and the scope and nature of the proposed project activities. Consultation on the Screening Report has been managed through the Evidence Plan Process, as agreed with statutory bodies through the Evidence Plan Terms of Reference (Ørsted, 2018). This HRA Screening Report is based on the project and site-specific information currently available. It should be noted, however, that further environmental survey and assessment work, consultee and advisor responses to this document, as well as refinements to the project design may change this assessment. These changes will be recorded and reflected in the full Report to Inform Appropriate Assessment (RIAA) to be submitted with the Development Consent Order (DCO) application for Hornsea Four.

1.2 Project Overview

1.2.1 Former Hornsea Zone

- 1.2.1.1 The former Hornsea Zone is situated in the southern North Sea east of the Yorkshire Coast. The Hornsea Zone was one of several offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during the third round of wind licensing.
- 1.2.1.2 DONG Energy Wind Power A/S (now Ørsted) acquired the rights to develop Hornsea Project One in early 2015 and later that year, DONG Energy Power (UK) Ltd. acquired the Hornsea Zone. This was accompanied by the acquisition of development rights for Hornsea Project Two, Hornsea Three and Hornsea Four. As of March 2016, the previous Hornsea Zone Development Agreement (initiated between Smart Wind Ltd. and TCE) was dissolved and new project specific agreements (known as Agreement for Leases (Afls)) were created in agreement with TCE for all four projects. The Hornsea Zone has therefore been dissolved and is referred to as the former Hornsea Zone in this document.
- 1.2.1.3 Hornsea Project One was the first project to be granted development consent in the former Hornsea Zone on the 10th December 2014 and consists of up to three wind farm arrays with 174 wind turbine generators (WTG). Offshore construction on Hornsea Project One commenced in January 2018. Hornsea Project Two was the second project to be granted consent (16th August 2016) and comprises of two offshore wind farm arrays with 165 WTG. Hornsea Three was submitted by Ørsted on the 14th May 2018 for Examination by the Planning Inspectorate (PINS) and was accepted on 8th June 2018. Project Three will have a maximum of up to 300 WTG. Hornsea Four is the fourth proposed project being

brought forward in the former Hornsea Zone by Ørsted and is explained in further detail below.

1.2.2 Hornsea Four



- 1.2.2.1 Hornsea Four which will be situated approximately 65 km from the Yorkshire coastline (at its closest point) and will consist of a maximum 180 WTG. Electricity generated will be transported to the coastline via offshore export cables which will be installed within the offshore export cable corridor (ECC) to a landfall site within the cable corridor, to be located as close as practical to the National Grid substation at Creyke Beck, shown below in [Figure 1.1](#).

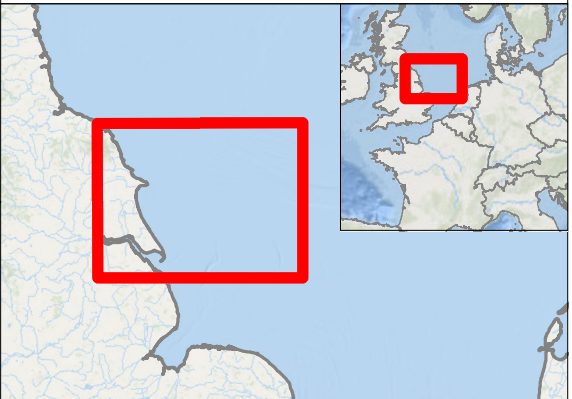


Hornsea Four

Habitat Regulations Assessment

Figure 1.1

-  Scoping Boundary
-  Array Area



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:653000

0 4 8 16 24 32 Kilometres

0 2 4 8 12 Nautical Miles

Habitat Regulations Assessment
Document no: H4SR_HR01
Created by: LS
Checked by: CC
Approved by: LK



1.4 Project Description

- 1.4.1.1 This section of the HRA Screening Report provides an outline description of the potential design of Hornsea Four, based on preliminary conceptual design information and as described in the Scoping Report Project Description [Chapter 5](#). It sets out the Hornsea Four design and components for both the onshore and offshore infrastructure, as well as the activities associated with the construction, operation and maintenance, and decommissioning of the project.
- 1.4.1.2 At this early stage, the Hornsea Four project description is indicative and, like all offshore wind farms, the final design may not be confirmed until after consent has been granted. Consequently the 'Design Envelope' (also referred to as a Rochdale Envelope) includes sufficient flexibility to allow the detailed design to vary within the envelope whilst ensuring that the project eventually constructed has been properly assessed¹. This section therefore sets out a series of options and parameters for which (unless otherwise noted as minimum values) maximum values are shown. From these values the "worst case scenarios" for impact assessment (for both HRA and Environmental Impact Assessment (EIA)) are developed. The envelope values may change as the final design is developed but should not be exceeded. It should also be noted that the relevant worst case scenario may differ between receptors, with this to be clearly stated within the RIAA.
- 1.4.1.3 A further refined and detailed project description will be provided in the Hornsea Four Preliminary Environmental Information Report (PEIR) issued during pre-application consultation, and the Environmental Statement (ES) that will accompany the application for a DCO. The final RIAA, to be submitted with the application for a DCO, will draw on the final project description contained within the ES.

1.5 Proposed Hornsea Four boundary

- 1.5.1.1 The Hornsea Four scoping boundary ([Figure 1.1](#)) covers approximately 846 km² and is located in the western end of the former Hornsea Zone. The Project boundary is approximately 65 km from the Yorkshire coastline (at its closest point) and will specifically consist of:
- Hornsea Four array area – The location of the offshore wind farm and will include the turbines, array cables, offshore accommodation platform and offshore substations along with offshore interconnector cables;
 - Hornsea Four offshore ECC – The location of the offshore electrical infrastructure which will include offshore export cables and any offshore High Voltage Alternating Current (HVAC) booster substation(s); and

¹ National Policy Statement for Renewable Energy Infrastructure (EN-3) refers, see EN-3 section 2.6.43 Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf

- Hornsea Four onshore cable corridor - The location of the permanent onshore electrical infrastructure which will include onshore export cables, onshore substation and connections to the National Grid.

1.6 Offshore infrastructure

1.6.1.1 The type and design of WTCs, offshore substations and offshore accommodation platform will depend on the final site investigations and procurement negotiations which will be undertaken post-consent. As this Screening report is based on various Scoping chapters, there is limited information on project infrastructure at this stage. Further information regarding this will follow this Screening report during the RIAA / EIA phase of Hornsea Four. However, based on current information, the key offshore components of Hornsea Four will include the following:

- A maximum of 180 WTCs and associated foundations (of which a number are being currently considered, see below);
- A maximum number of 10 platform (inc. accommodation platform);
- A maximum of 3 HVAC booster stations (if required for the HVAC system)
- Up to 6 offshore export cables;
- Array cables and interlink cables between the WTCs;
- Scour and cable protection.

1.6.1.2 The Hornsea Four EIA and RIAA will consider the following foundation types for offshore infrastructure:

- monopile;
- monopod suction caisson;
- suction caisson jacket;
- piled jacket; and
- gravity base structure.

1.6.1.3 Consideration of substation and accommodation platform foundation types will follow those presented for wind turbines however, they could be proportionately scaled up in size to accommodate larger offshore infrastructure.

1.6.1.4 The Hornsea Four electrical transmission system will consist of a number of offshore cables which will collect and transport the power produced at the WTC, to the landfall site and the associated onshore cables, ultimately connecting to the UK National Grid. Two main transmission technologies are currently being considered based upon a range of factors including project economics and technology risk; HVAC and High Voltage Direct Current (HVDC). The decision on which transmission type will be utilised will be decided post-consent. Offshore booster substations will be required to extend the distance over which HVAC electrical export infrastructure can operate, based on the large distance from the wind farm to the landfall site.

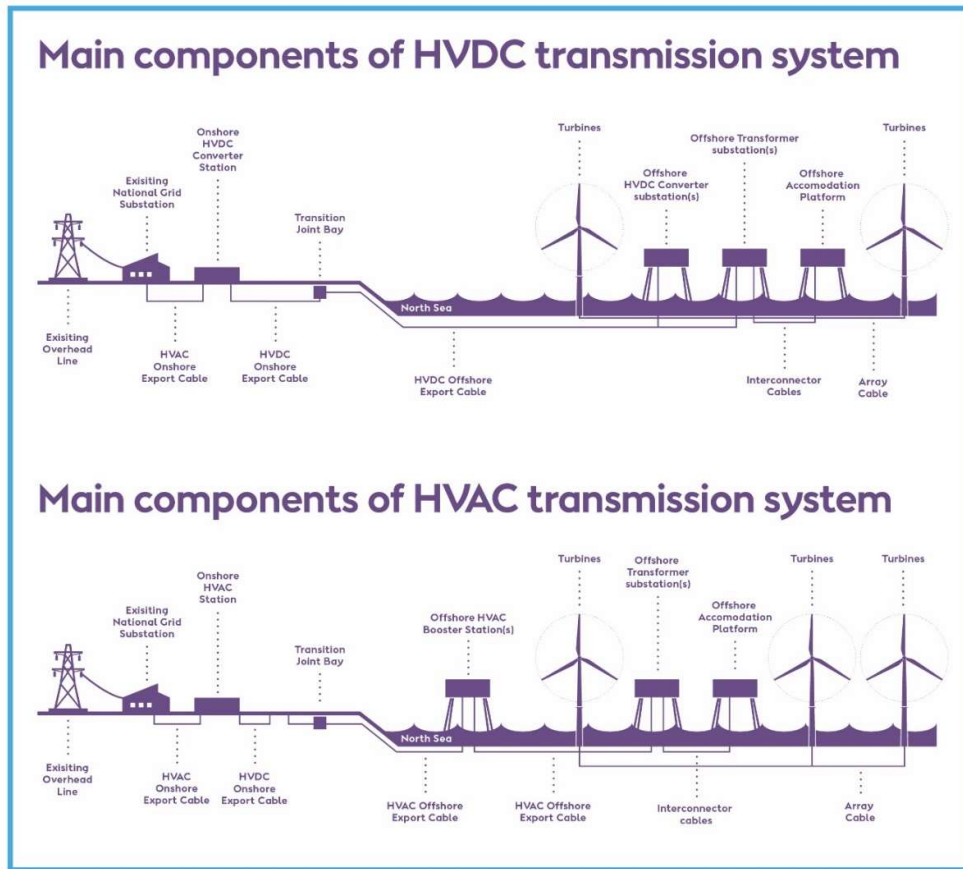


Figure 1.2 - Overview of Hornsea Four Infrastructure

- 1.6.1.5 In addition to the array cables which will connect the WTGs to each other, and to one of the offshore substations, interlink cables will be used to improve the reliability of the transmission system by interconnecting offshore substations. Additionally, a cable may be used to provide the offshore accommodation platform with power. Offshore export cables will connect the offshore substation to the landfall.

1.7 Onshore infrastructure

- 1.7.1.1 With regard to onshore infrastructure, key elements of Hornsea Four will include export cables and the onshore substation. Onshore export cables will connect the landfall to the onshore substation which subsequently connects to, and will be located as close as practicable to, the National Grid substation at Creyke Beck. The routing of onshore export cables from the landfall site will be further developed to minimise potential impact and where possible and practical, will employ less intrusive construction methods (for example Horizontal Directional Drilling (HDD)).

- 1.7.1.2 There will be a maximum number of 6 onshore export cables which will be installed in direct-lay in trenches or pulled through pre-installed ducting. An indicative onshore cable arrangement illustration is available in the Hornsea Four Scoping Report – Project Description. A temporary construction corridor of 80 m will be required which will reduce to a permanent corridor of 60 m once construction works are complete.
- 1.7.1.3 The onshore substation area of 160,000 m² will be accompanied by a temporary area of construction of 100,000 m². The 1-5 main buildings will not exceed a height of 30 m.
- 1.7.1.4 As mentioned above, there is limited information on project infrastructure for Hornsea Four at this stage. Further information regarding this will follow this Screening Report during the RIAA / EIA phase of Hornsea Four.

1.8 Construction programme

- 1.8.1.1 An indicative high-level construction programme is shown below to provide an overview of installation duration of the main project elements. The programme ([Figure 1.3](#)) assumes that the project will be built out to its extent in a single construction campaign.

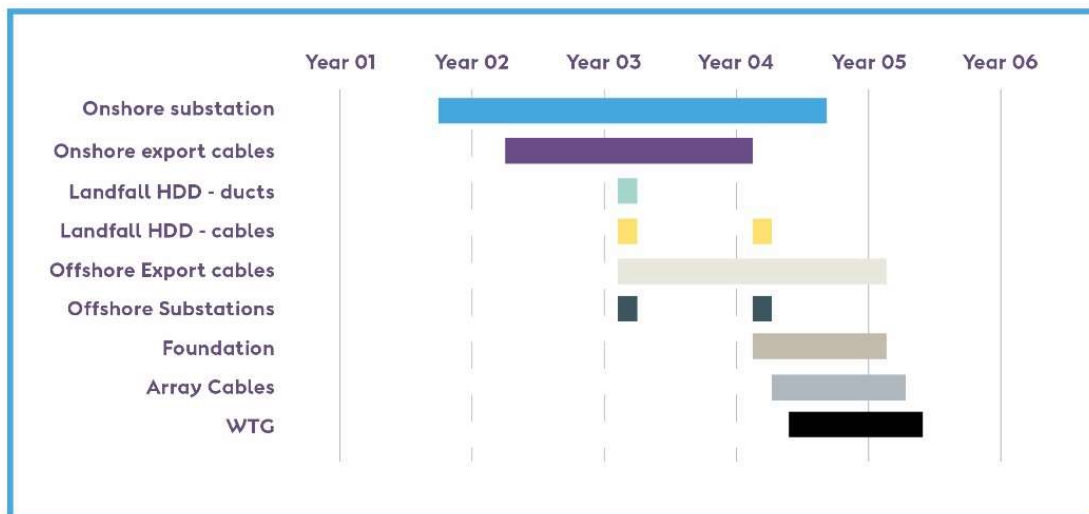


Figure 1.3 - Indicative Construction Programme

1.9 Outline of the Structure and Contents of this Report

- 1.9.1.1 This document is set out in a number of stages that mirror the HRA process and the following is provided:
- a brief summary of the main components of Hornsea Four ([section 1](#));
 - a brief summary of the Habitats Regulations Assessment Process ([section 2](#));
 - a summary description of the environmental baseline relevant to the screening process ([section 3](#));

- initial screening of sites and features which may potentially be affected by Hornsea Four ([section 4](#));
- screening - an assessment of the potential for LSE to arise with regard to the designated features of the European sites under consideration ([section 5](#));
- approach to in-combination assessment ([section 6](#));
- a summary of the European sites and features for which the screening process has identified potential for a LSE ([section 7](#)); and
- references ([section 8](#)).

1.9.1.2 At this stage in the assessment, it is important to note that the screening of sites into the HRA process and the determination of LSE is provisional. As environmental assessment outcomes for Hornsea Four are presently unavailable and the information available to relevant parties, including the Statutory Nature Conservation Bodies (SNCBs, notably Natural England), is largely limited to a description of parameters at the Hornsea Zone level, a precautionary stance has been adopted. The final RIAA will not reproduce the screening presented here (instead the current report will be appended to the RIAA), but the RIAA will clearly identify any changes to the screening process, specifically any changes to the determination of LSE, in the intervening time.

2 The Habitats Regulations Assessment Process

2.1 Legislative Context

- 2.1.1.1 European designated sites referred to here are defined as Special Areas of Conservation (SACs) and Sites of Community Importance (SCIs) and Candidate SACs (cSACs), which are designated under the Habitats Directive (92/43/EEC), and Special Protection Areas (SPAs), which are designated under Council Directive (2009/147/EC) on the conservation of wild birds (the 'Birds Directive'). In addition to sites designated under European nature conservation legislation, UK Government policy (ODPM Circular 06/2005) states that proposed and potential SPAs and SACs and internationally important wetlands designated under the Ramsar Convention (Ramsar sites) are afforded the same protection as SPAs and SACs, for the purpose of considering development proposals that may affect them (and so are considered in this report as "European sites").
- 2.1.1.2 The Habitats Directive, with respect to terrestrial areas of the UK and territorial waters out to 12 nautical miles (nm), is transposed into UK law through The Conservation of Habitats and Species Regulations 2017 (herein referred to as the Habitats Regulations). The Habitats Regulations incorporate all SPAs into the definition of 'European sites' and, consequently, the protections afforded to European sites under the Habitats Directive apply to SPAs designated under the Birds Directive.
- 2.1.1.3 The Conservation of Offshore Marine Habitats and Species Regulations 2017 (the Offshore Habitats Regulations) transpose the Habitats and Birds Directives into national law, covering waters beyond 12 nm, to the extent of the British Fishery Limits and UK Continental Shelf Designated Area.

2.2 The Habitats Regulations Process

- 2.2.1.1 The Habitats Regulations require that wherever a project that is not directly connected to, or necessary for, the management of a Natura 2000 site is likely to have a significant effect on the conservation objectives of the site (directly, indirectly, alone or in combination with other plans or projects) then an 'Appropriate Assessment' (AA) must be undertaken by the Competent Authority (Regulation 61 of the Habitats Regulations). The Appropriate Assessment must be carried out before consent or authorisation can be given for the project.
- 2.2.1.2 The Planning Inspectorate (PINS) Advice Note Ten 'Habitats Regulations Assessment relevant to nationally significant infrastructure projects' (Version 8, November 2017), defines HRA as a step by step process which determines LSE and (where appropriate) assesses adverse impact on the integrity of a European site, examines alternative solutions, and provides justification of Imperative Reason for Overriding Public Interest (IROPI). This constitutes a 4 stage process as summarised below in [Figure 2.1](#).

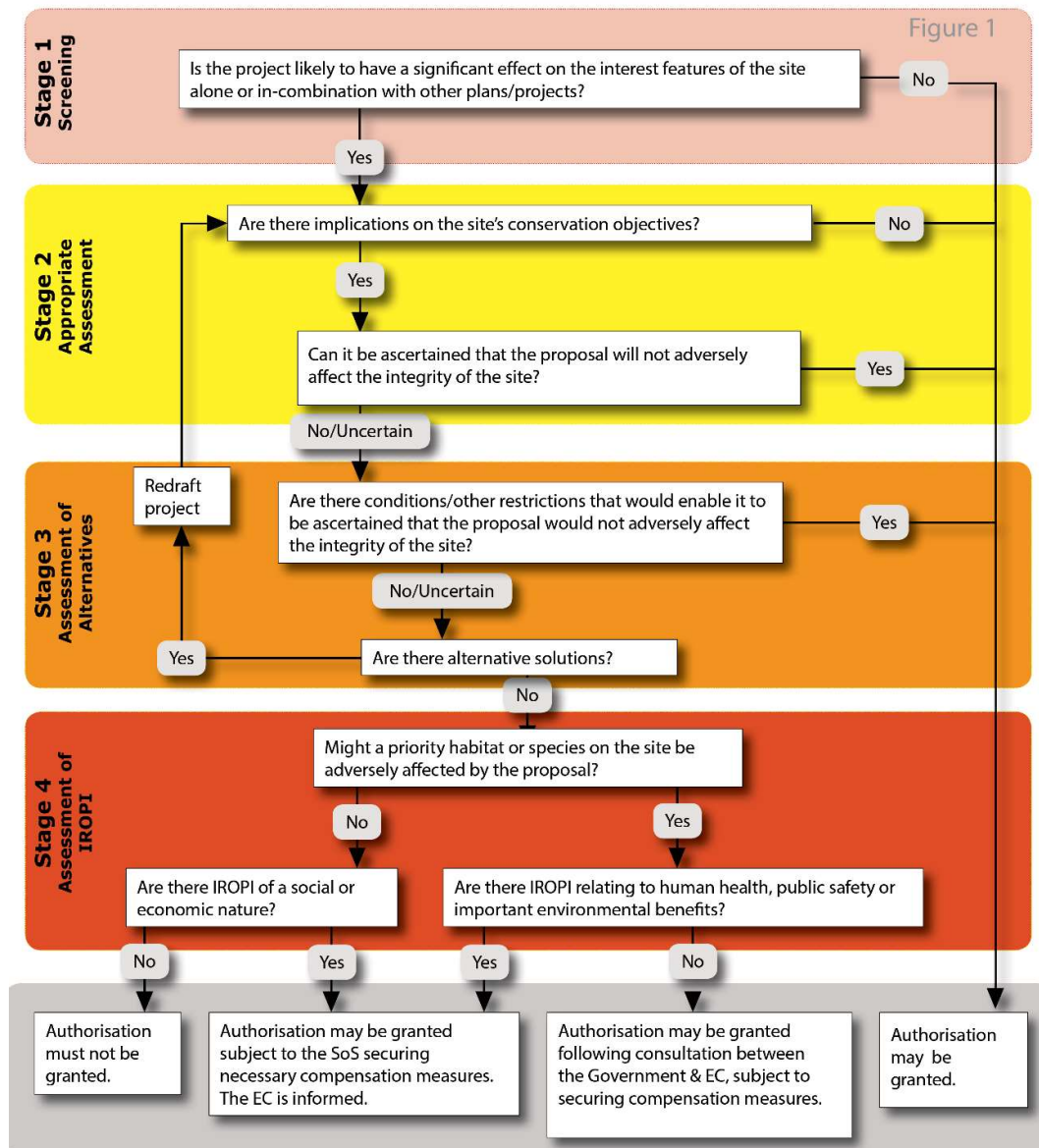


Figure 2.1 - 4 stage HRA process (The Planning Inspectorate, 2016)

- 2.2.1.3 The integrity of a site (referred to in [Figure 2.1](#) above in Stage 2) is defined by guidance as the coherence of the site's ecological structure and function, across the whole of its area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated (EC, 2001). An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status as it did at the time of designation.
- 2.2.1.4 All 4 stages of the process are referred to as the HRA to clearly distinguish the whole process from the one step within it referred to as the "AA". Under the Habitats Regulations

and the Offshore Habitats Regulations, before granting approval (i.e. planning permissions, licenses and consents) for a development likely to have a significant effect on an SAC or SPA/Ramsar site, an appropriate assessment must be made by a Competent Authority of its implications for the site in view of that site's conservation objectives.

- 2.2.1.5 This report comprises the first stage of the HRA process, the Screening Stage, where the identification of LSE is reported. LSE is, in this context, any effect that may be reasonably predicted as a consequence of a project that may affect the conservation objectives of the feature(s) for which the European Site was designated, but excluding trivial or inconsequential effects.

2.3 Roles and Responsibilities

- 2.3.1.1 The Examining Authority will not make the final decision on Hornsea Four; this decision will fall to the Secretary of State for the Department for Business, Energy and Industrial Strategy (BEIS) (hereafter referred to as "the Secretary of State"). The Secretary of State is therefore the Competent Authority in this instance.
- 2.3.1.2 This Screening Report and the Report to Inform the Appropriate Assessment (RIAA) produced for Hornsea Four will provide the information required by the Competent Authority to enable it to undertake an AA, if required, in accordance with Article 6(3) of the Habitats Directive.

2.4 Approach to Screening

- 2.4.1.1 Screening is a relatively coarse filter to identify those sites and features for which, in the context of the proposed project, a LSE cannot be discounted. For the purposes of this report an initial pre-LSE screening stage has been introduced into the process ([section 4](#)). This stage is essentially a site and/or feature-identification / selection process, which, while it forms part of the overall LSE determination stage of HRA, has been separated out to refine the list of sites including the relevant feature(s) associated with those sites taken forward for a more detailed consideration of LSE. Once a site/feature is identified, the screening exercise considers (in [section 5](#)), in the context of anticipated effects resulting from the construction, operation & maintenance and decommissioning of Hornsea Four, whether or not a significant effect can be foreseen. Consideration will be given to potential effects that may occur for the project alone; a summary of the approach to in-combination assessment is provided ([section 6](#)). A precautionary approach is followed; where it is not currently possible to exclude a LSE, then the site/feature is progressed to the AA Stage (Stage 2 of the HRA) and included within the RIAA.
- 2.4.1.2 In relation to each European site considered in the screening exercise, at Stage 1 of the HRA (Screening), it will be concluded that either:
- there are no LSEs on the features of the European site(s) and therefore no further assessment is required; or

- LSEs on the European site(s) cannot be discounted (in relation to one or more designated feature, but not necessarily all) and will require an AA by the Competent Authority.

2.4.1.3 With respect to in-combination effects, this screening report identifies the categories of plans and projects that will need to be considered, but recognises that further discussion with local authorities and SNCBs will be required to identify specific projects for inclusion in the in-combination assessment. The RIAA will include, for those sites screened into assessment, a detailed in-combination assessment drawing on the environmental impact assessments (including cumulative assessment) undertaken specifically for Hornsea Four to understand the magnitude of those effects and whether they may lead to an adverse effect on site integrity.

2.4.1.4 Of note are recent rulings by the European Court of Justice (ECJ), referred to as Sweetman rulings². The rulings relate to how screening for LSE is carried out, specifically in relation to the way in which mitigation is considered in the LSE screening process, but also wider issues around site integrity. Mitigation included within the project specifically in relation to a relevant site cannot be taken into account during screening for LSE but remains relevant for consideration of adverse effect during the AA. Where project mitigation forms part of the project (or would be legally required by the project regardless of the content of the assessment for LSE), such mitigation is considered here to be an integral part of the project itself and therefore remains in consideration during the determination of LSE. Guidance has yet to be issued regarding the ruling. Issues around consideration of adverse effect stemming from these recent ECJ rulings are not considered here during screening but will be incorporated into the RIAA as appropriate.

2.5 Consultation

2.5.1.1 Initial discussions regarding Hornsea Four, including the approach to screening undertaken within the HRA Screening Report, have been held through the Evidence Plan process, with meetings held from the 11th to 13th September 2018. Comments received in the meetings outlined above are included within [Table 2.1](#) below. Relevant consultees involved in the Evidence Plan meetings were as follows:

- Natural England;
- RSPB;
- MMO;
- Cefas;
- Yorkshire Wildlife Trust; and
- East Riding of Yorkshire Council;

²<http://curia.europa.eu/juris/document/document.jsf?docid=200970&doclang=EN>
<http://curia.europa.eu/juris/document/document.jsf?text=&docid=204392&pageIndex=0&doclang=en&m ode=req&dir=&occ=first&part=1&cid=388838>

2.5.1.2 A summary of the comments received, together with where/ how they have been addressed within this HRA Screening Report, is provided in [Table 2.1](#) below.

Table 2.1 - Summary of consultation undertaken on the HRA Screening Report

Consultee	Reference	Comment	Addressed
Natural England	Onshore Ecology Technical Panel Meeting 1 12 September 2018	Requested that the Natural England impact risk zones for European and Ramsar sites were used in the screening assessment	The impact risk zones have been used and referenced where relevant
Natural England	Offshore & Intertidal Ornithology Technical Panel Meeting 1 13 September 2018	Meeting minutes currently being drafted and not available at the time of writing	
RSPB	Offshore & Intertidal Ornithology Technical Panel Meeting 1 13 September 2018	Meeting minutes currently being drafted and not available at the time of writing	
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Requested that additional clarification be added to the impacts and effects register to make it clear that the "likely significance of effect" is not the same as the term "likely significant effects" used in HRA assessments, and that this proportionate approach (and associated tools) are for the EIA and not applicable to the HRA.	Noted. The term Likely Significant Effect, as applied throughout the Screening Report, is a screening tool to identify those effects that require further consideration and not a means to identify a significant effect in EIA terms.
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Confirmed that altering longshore sediment transport would have implications for HRA if there was extensive nearshore rock armouring required that could interfere with this process.	Noted. Confirmation that the potential for a change in longshore sediment transport will be minimal will be sought during the PEIR and EIA stages and if a change in screening is required, that will be applied.
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Confirmed that a 16km buffer would be appropriate for benthic and intertidal ecology and agreed that the terrestrial elements of Flamborough Head SAC could be screened out.	Noted

Consultee	Reference	Comment	Addressed
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Clarified Natural England's interpretation of the Sweetman ruling, ensuring all potential impacts are initially screened in for assessment, and only when mitigation is subsequently applied is no likely significant effected reached.	Noted
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Suggested lamprey should be considered alongside other activities like abstraction and fishing licences – the EA would hold these records.	Will be applied in the in-combination assessment (see section 6)
Natural England	Hornsea Four Marine Processes & Ecology Technical Panel Meeting 12 09 2018	Concluded that the approach to HRA Screening seems appropriate.	Noted

3 Environmental Baseline

3.1 Introduction

3.1.1.1 This section provides an overview of the environmental characteristics relevant to the receptors under consideration as part of the HRA screening process for Hornsea Four, specifically:

- subtidal and intertidal benthic ecology;
- marine mammals;
- offshore and intertidal ornithology;
- fish ecology; and
- onshore ecology.

3.1.1.2 Baseline information relevant to the determination of LSE relates to the Hornsea Four array area and both the offshore EEC and onshore cable corridor. Where relevant, information is drawn from a wider area (e.g. marine mammal data across the Management Unit). The information presented here draws on the EIA Scoping Report for Hornsea Four (Ørsted, 2018) and it is not intended to repeat that information fully. Instead, for each receptor group, the relevant section of the Scoping report is noted, together with a bullet point list of the main sources of information drawn on for LSE screening and that will be drawn on further in the subsequent RIAA. The Scoping Report presents baseline information on a wider selection of topic areas that are not represent within the above receptor groups; where relevant (such as physical processes), these are drawn on here to define the potential effects (see [Table 4.9](#)) Where relevant, note is made of designated sites, purely to provide baseline information and not to prejudice screening.

3.2 Subtidal and Intertidal Benthic Ecology

3.2.1.1 In addition to the wealth of data collected previously across the former Hornsea Zone, additional surveys which are specific to Hornsea Four are currently ongoing, including geophysical surveys with associated benthic grab sampling. The results from those surveys will, where relevant, feed into the subsequent stages of the HRA process.

3.2.1.2 The Scoping Report summarises the information on benthic subtidal ecology, drawing on the information presented within Hornsea Three. The references available include the following:

- broad scale mapping studies (e.g. regional marine aggregate projects, technical reports as part of the oil and gas Strategic Environmental Assessment (SEA) process, the North Sea Benthos Project and the academic literature);
- mapping undertaken for specific locations in the region (e.g. other offshore wind farms, designated sites); and
- survey data collected within the former Hornsea Zone.

3.2.1.3 Detailed benthic subtidal surveys across the former Hornsea Zone were undertaken in 2010, with subsequent project specific surveys undertaken across Hornsea Project One

array area in 2010 and 2011, and surveys of Hornsea Project Two array area undertaken in 2012. The survey of the former Hornsea Zone included full coverage of the Hornsea Four array area, with the Hornsea Project One and Two surveys providing additional regional context together with some samples located directly within Hornsea Four.

- 3.2.1.4 Benthic ecology data available for the offshore ECC has been sourced from the Creyke Beck ES³, the inshore area of which coincided with the inshore stretch of the Hornsea Four offshore ECC. Additional data sets contain benthic ecology mapping for the entire Hornsea Four array area and offshore ECC.
- 3.2.1.5 From the data collected specifically for the former Hornsea Zone, it is apparent that the area is predominately characterised by infralittoral muddy sand with areas of Circalittoral fine sand at the northern and south east periphery of the array area. Further analysis of the grab samples was undertaken and predicted the component biotopes associated with the habitats to comprise SS.SSa.IMuSa.FfabMag (*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand) and SS.SSa.CFiSa.EpusOborApri (*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand).
- 3.2.1.6 No project or site specific data are available yet to describe the intertidal habitats found at the offshore ECC landfall, with the Scoping Report concluding that baseline intertidal surveying will be required to further inform the EIA and that potential effects upon the intertidal area cannot be scoped out of the EIA at this time. This site specific surveying will also therefore further inform the RIAA.
- 3.2.1.7 It should be noted that in terms of the HRA process, the closest European site to the offshore ECC at landfall with a marine element is the Greater Wash SPA, through which the offshore ECC passes. The Greater Wash SPA extends inland to the mean high water mark (MHW). The closest designated site to landfall of the offshore ECC with a benthic ecology aspect is the Humber Estuary SAC (some 26 km distant). The screening process that follows will determine if any European sites, which contain designated intertidal habitat, will be screened in for LSE.

3.3 Marine Mammals

- 3.3.1.1 Project specific marine mammal and ornithology surveys were conducted between April 2016 and March 2018, with the results from those surveys to be drawn on for the EIA and RIAA. For the purposes of screening, existing data is available from surveys conducted across the former Hornsea Zone, accompanied by broader scale surveys (e.g. Small Cetacean Abundance in the North Sea (SCANS) III⁴) and surveys conducted for other offshore wind farm projects in the region, with these reported on in the Scoping Report.

³All documents available <https://infrastructure.planninginspectorate.gov.uk/projects/yorkshire-and-the-humber/dogger-bank-creyke-beck/?ipcsection=docs>

⁴ <https://synergy.st-andrews.ac.uk/scans3/>

3.3.1.2 The Scoping Report focuses on five marine mammal species: harbour porpoise (*Phocoena phocoena*), minke whale (*Balaenoptera acutorostrata*), white-beaked dolphin (*Lagenorhynchus albirostris*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*), being the only marine mammal species expected to be present in the Hornsea Four array area. For the purposes of screening, the focus is on species for which sites have been designated, namely harbour porpoise, bottlenose dolphin, harbour seal and grey seal – other cetacean species will be addressed through the EIA process and, where required, European Protected Species (EPS) licensing. The full list of such sites across the management units is extensive and therefore not repeated here, but is presented in [Table 4.4](#) Species density information, where required, will be drawn from project specific data but also as relevant to individual species from SCANS, Joint Cetacean Protocol Data (Paxton et al., 2016), Heinänen and Skov 2015, Russell et al., 2017, Special Committee on Seals (SCOS) data sets and telemetry datasets. Overall population size will be at management unit level, following the approach detailed in the Scoping Report.

3.4 Offshore and Intertidal Ornithology

3.4.1.1 This section briefly describes the offshore and intertidal baseline for ornithology receptors. Further detail is provided in [section 7.6](#) (Offshore and Intertidal Ornithology) of the Scoping Report to the Environmental Impact Assessment for Hornsea Four (Ørsted, 2018). In this section there is a separation between the offshore and intertidal ornithology baseline with the onshore ornithology baseline being described in the Onshore Ecology Section. For ornithology receptors the separation is that the intertidal baseline considers birds occurring on land that is exposed between the mean low water spring (MLWS) mark and mean high water spring (MHWS), whilst the offshore baseline considers birds using the water (both on and below) and the air above that water seaward of the MHWS. Since birds are highly mobile and seasonally migratory, this baseline considers the bird populations of a wide geographical area including the North Sea and the east coast of England.

3.4.1.2 Extensive ornithological surveys have shown that the North Sea is an important area for birds, during migratory passage periods and in winter months when British breeding birds are joined by birds that have migrated from continental Europe and Fennoscandia. There is mix of bird populations present at different times including those overwintering in the area, those foraging from nearby breeding coastal colonies and those on post-breeding dispersal, migration and pre-breeding return. As well as true pelagic seabirds (e.g. gannet, fulmars and auks), other species that spend part of their annual life cycle at sea (e.g. divers, gulls and seaducks) are also be present in particular months, with periodic numbers of non-seabird migrants passing through the area (e.g. wildfowl, waders and passerines). The main sources of information on offshore ornithology receptors drawn on for this screening stage, and that will be drawn on further in the subsequent RIAA, are:

- surveys of bird populations across the North Sea and the resultant atlases of bird distribution;
- offshore Wind Farm (OWF) development specific surveys across the former Hornsea Zone as well as the specific Hornsea Projects;
- peer reviewed scientific papers; and

- literature reviews including the baseline reports of other OWF developments.
- 3.4.1.3 The offshore bird species that have been identified in this process and that have been considered in most detail in the evaluation and assessment of bird populations in relation to the other Hornsea Projects are red-throated diver (*Gavia stellata*), fulmar (*Fulmarus glacialis*), gannet (*Morus bassanus*), great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), kittiwake (*Rissa tridactyla*), puffin (*Fratercula arctica*), razorbill (*Alca torda*) and guillemot (*Uria aalge*).
- 3.4.1.4 Ornithological surveys have shown that the intertidal land of the Holderness coast of East Yorkshire is a relatively poor habitat for intertidal birds in comparison to the Humber Estuary that lies to the south. This is because it provides relatively limited food resources as it is dominated by mobile, sandy beaches and lacks any significant areas of muddy shore. The result is that the populations of birds using the coast are very low. The main sources of information on intertidal ornithology receptors drawn on for this screening stage, and that will be drawn on further in the subsequent RIAA, are:
- periodic surveys of bird populations along the coast as part of national programmes organised by the British Trust for Ornithology (BTO) and the resultant web based databases and atlases of bird distribution;
 - peer reviewed scientific papers;
 - county bird reports and County avifaunas; and
 - literature reviews including the baseline reports of other OWF developments.
- 3.4.1.5 The intertidal bird species that have been identified in this process and that have the highest numbers present on the Holderness coast include oystercatcher (*Haematopus ostralegus*), ringed plover (*Charadrius hiaticula*), turnstone (*Arenaria interpres*) and sanderling (*Calidris alba*).
- 3.4.1.6 There are two European sites with ornithology interest features that overlap with Hornsea Four, the overlap being with the offshore ECC and not the Array Area. The sites are the Greater Wash SPA and the Flamborough and Filey Coast pSPA. Their interest features are listed in [Table 4.2](#). The location of both European sites is illustrated in [Figure 4.1](#).

3.5 Onshore Ecology

- 3.5.1.1 The habitat within the onshore scoping boundary⁵ is predominantly agricultural, dominated by large open arable fields with hedgerows. There are some areas of scattered woodland, grassland and scrub and a network of rivers, streams, drains and ponds. The common and widespread habitat within the onshore scoping boundary is representative of the region's vast agricultural landscape.

⁵ 'Onshore scoping boundary' is the scoping boundary landward from MHWS and the intertidal zone plus substation search area as shown on

[Figure 1.1.](#)

3.5.1.2 The extended aerial phase 1 habitat assessment (JNCC, 2010) combined with ground-truthing completed in August 2018 identified habitats that could potentially support the following species:

- breeding birds;
- wintering birds;
- bats;
- great crested newt (*Triturus cristatus*);
- eurasian otter (*Lutra lutra*);
- water vole (*Arvicola amphibious*);
- reptiles; and
- badger (*Meles meles*).

3.5.1.3 Further detailed surveys for the species listed above are proposed to further inform the EIA and HRA process.

3.5.1.4 There are no European sites within the Hornsea Four onshore scoping boundary. [Table 3.1](#) below identifies European and Ramsar sites located within a 15 km buffer of the onshore scoping boundary.

Table 3.1 - European and Ramsar sites located within a 15 km buffer of the onshore scoping boundary

Site	Distance from Onshore Project Components	Description
Greater Wash SPA	Approximately 25 m (adjacent to onshore cable route corridor)	The Greater Wash SPA is a marine site designated for its important offshore foraging areas for sea birds including red-throated diver, little gull, sandwich tern, common tern, little tern and common scoter.
Flamborough Head SAC ¹	4.9 km	Flamborough Head encompasses a large area of hard and soft chalk cliffs that extend seaward as bedrock, boulder and cobble reefs. The reefs at Flamborough are important due to their substrate type, biogeographic position and the influences of hydrodynamic processes. The caves are important for their specialised cave-algal communities.
Hornsea Mere SPA	6.2 km	Hornsea Mere is a large, shallow, eutrophic lake of 120 hectares, with associated fen, carr woodland and reed swamp habitat. It supports internationally important wintering population of Gadwall (<i>Anas Strepera</i>) ⁶ .
Humber Estuary SPA/SAC/Ramsar	7.5 km	The Humber Estuary is the largest macro-tidal estuary on the British North Sea coast. The inner estuary supports extensive areas of reedbed with areas of mature and developing saltmarsh backed in places by limited areas of grazing marsh in the middle and outer

⁶ This site is only designated for gadwall according to the official citation. Other documentation in reference to this site includes mute swan. However, for the purposes of this assessment, the official citation will be used.

Site	Distance from Onshore Project Components	Description
		estuary. The Estuary regularly supports internationally important numbers of waterfowl in winter and nationally important breeding populations in summer.
Flamborough and Filey Coast pSPA	7.6 km	Flamborough and Filey Coast pSPA encompasses cliffs composed of chalk and other sedimentary rocks and supports internationally significant populations of kittiwake, gannet, guillemot and razorbill.
Flamborough Head and Bempton Cliffs SPA	9.2 km	Flamborough Head and Bempton Cliffs comprises chalk, softer sedimentary rocks, cliffs, stacks and caves that provide nesting grounds for large colonies of seabirds of international importance. Including the only gannetry in England.

3.6 Migratory Fish

- 3.6.1.1 The Scoping Report identifies a number of data sources for fish ecology, which draw on the former Hornsea Zone and project specific surveys in the same manner as for benthic ecology above. Effectively, no migratory fish species have been noted during the surveys, with screening for migratory fish species undertaken in subsequent sections drawing on European designated sites for which migratory fish are a primary reason for selection of the site. The closest such site to Hornsea Four is the Humber Estuary SAC, the seawards extent of which is some 26 km from the offshore ECC landfall. The Humber Estuary SAC includes both river and sea lamprey in its citation, with the River Derwent SAC (a tributary of the Humber) including the sea lamprey.

4 Screening of European Sites and Features

4.1 Approach to Initial Screening

4.1.1.1 Given the large spatial scale and nature of Hornsea Four and the number of European sites that could potentially be affected, an initial pre-LSE screening stage has been introduced into the process. This stage is essentially a site-identification / selection process which effectively identifies all those designated sites and the relevant features which are potentially at risk of LSE, should those features be sensitive to the relevant effects.

4.1.1.2 The criteria used in this first stage of selection are described in [Table 4.1](#).

Table 4.1 - Screening criteria used for initial screening of relevant European sites

Criteria used for initial screening of relevant European sites

1A	European or Ramsar site with physical overlap with Hornsea Four boundary (array, offshore ECC, offshore HVAC Booster Station, onshore cable corridor, substation Area of Search)
1B	European or Ramsar site with adjoining 'functionally linked habitat' with physical overlap with Hornsea Four boundary.
2	European or Ramsar site with qualifying mobile species whose range (e.g. foraging, migratory, overwintering, breeding or natural habitat range) may interact with potential effects from Hornsea Four .
3	European or Ramsar site with a qualifying feature located within the potential range of effect (the ZOI) associated with Hornsea Four.
4	European or Ramsar qualifying habitat or species recorded during site specific surveys at Hornsea Four.

4.1.1.3 This initial screening identified sites and relevant features where, based purely on proximity, further consideration is needed of the potential for Hornsea Four to result in LSE. The conclusions on the initial screening are presented in [section 4.1.2](#) below. To more accurately determine the potential for LSE, it is necessary to consider the potential effects associated with the construction, operation & maintenance and decommissioning of Hornsea Four in the context of the designated sites and features identified by the initial screening process. The potential impacts associated with Hornsea Project 4 are identified below in [section 4.2](#). It is a combination of the screening criteria listed above and these potential impacts that are drawn on in [section 5](#) to determine the potential for LSE – the determination of potential LSE therefore adopts the standard effect-pathway-receptor approach to impact assessment.

4.1.2 Initial Screening of Sites and Features

4.1.2.1 The following section lists those sites (and the relevant features) identified through one or more of the screening criteria listed in [Table 4.1](#) above. The results from each criteria are presented as follows:

- Criteria 1: depicted in [Figure 4.1](#) and summarised in [Table 4.2](#);

- Criteria 2: depicted in [Figure 4.2](#) and summarised in [Table 4.4](#);
- Criteria 3: depicted in [Figure 4.3](#) and summarised in [Table 4.6](#); and
- Criteria 4: summarised in [Table 4.7](#).

4.1.2.2 The citations used during screening of the criteria to identify the features associated with individual sites are referenced in [Appendix A](#).

4.1.2.3 **Criteria 1**

4.1.2.4 Criteria 1 has been subdivided, with 1A effectively identifying those designated sites which have physical overlap with Hornsea Four. All those designated sites and features identified under Criteria 1A are summarised in [Table 4.2](#) below and depicted in [Figure 4.1](#).

4.1.2.5 . There are no European or Ramsar sites within the Hornsea Four onshore scoping boundary.

Table 4.2 - European and Ramsar Sites identified through Criteria 1A

Designated Site	Feature(s)	Overlap with			
		Array boundary	Offshore ECC	Onshore cable corridor	Substation
Southern North Sea cSAC/SCI ⁷	Harbour Porpoise	✓	✓	✗	✗
Flamborough Head SAC	Annex I Habitats: <ul style="list-style-type: none"> • Reefs • Vegetated sea cliffs of the Atlantic and Baltic Coasts • Submerged or partially submerged sea caves 	✗	✓	✗	✗
Greater Wash SPA	Breeding: <ul style="list-style-type: none"> • Sandwich tern (<i>Sterna sandvicensis</i>) • Little tern (<i>Sternula albifrons</i>) • Common tern (<i>Sterna hirundo</i>) Non-breeding: <ul style="list-style-type: none"> • Red-throated diver • Little gull (<i>Hydrocoloeus minutus</i>) Migratory:	✗	✓	✓	✗

⁷ Designated site referred to as 'Southern North Sea cSAC/SCI' from correspondence with JNCC in an email dated 19/07/2018.

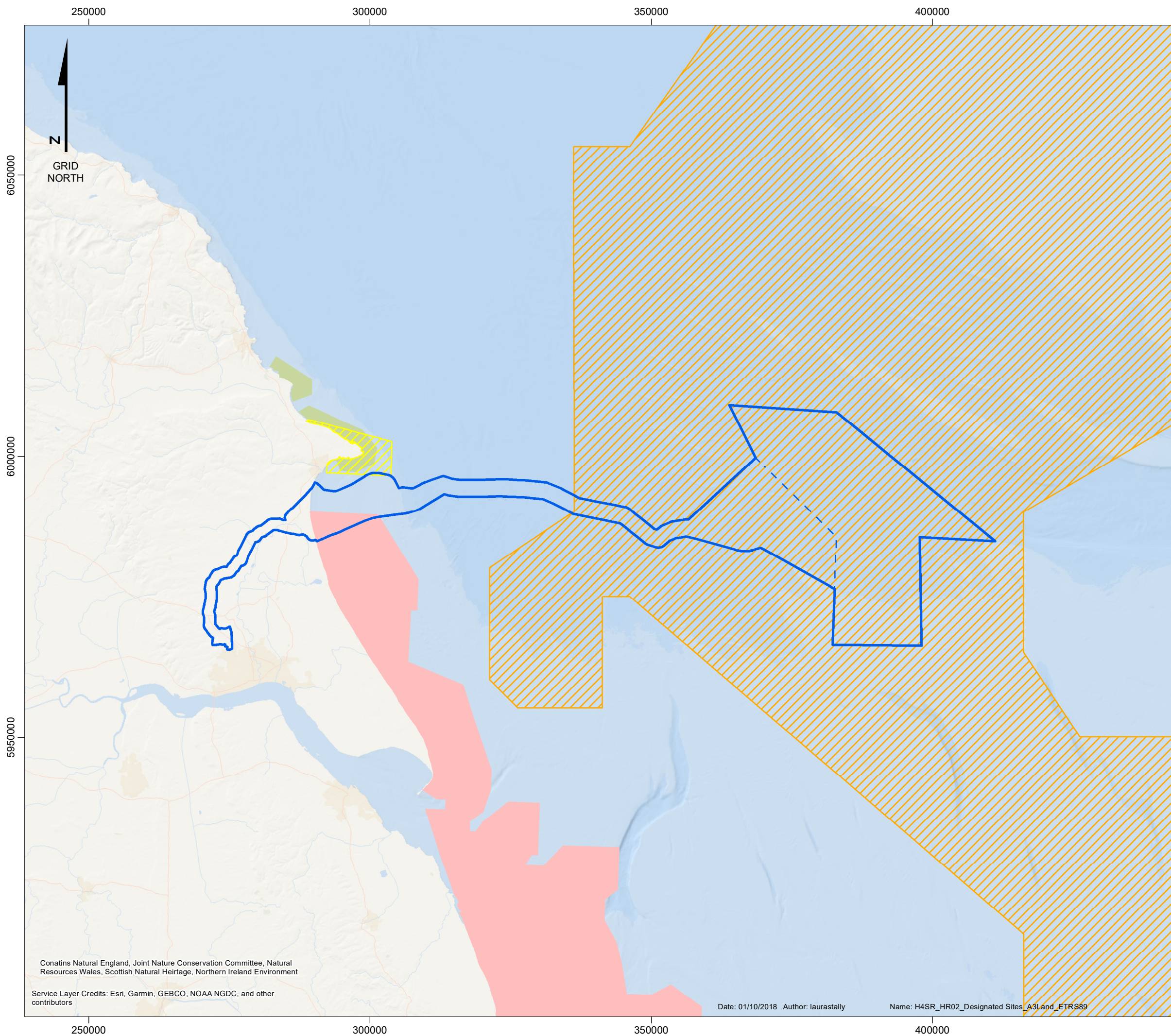
Designated Site	Feature(s)	Overlap with			
		Array boundary	Offshore ECC	Onshore cable corridor	Substation
	<ul style="list-style-type: none"> Common scoter (<i>Melanitta nigra</i>) 				
Flamborough & Filey Coast pSPA	Breeding: <ul style="list-style-type: none"> Kittiwake Gannet Guillemot Razorbill Seabird assemblage in addition to the above including: <ul style="list-style-type: none"> Puffin Herring gull Shag Cormorant Fulmar 	x	✓	x	x

4.1.2.6 The sub-category of criterion 1 (criteria 1B) relates to European or Ramsar sites with adjoining 'functionally linked habitat' over which there is then a physical overlap with the Hornsea Four boundary (array, offshore ECC, onshore ECC, substation AoS). The existence of any areas of 'functionally linked habitat' immediately adjoining or around a European or Ramsar site cannot be determined from standard published sources such as MAGIC⁸ and a case by case approach has to be taken. For Hornsea Four the identified cases relate to seabird breeding colonies and waterbirds using intertidal wetlands. Specific to onshore ecology, the scoping boundary is at least 7 km from the intertidal wetland area, so this will not affect hen harrier (*Circus cyaneus*) that may utilise the habitat adjacent to the Humber Estuary SPA that could be functionally linked.

4.1.2.7 With respect to breeding seabirds that are interest features of a European or Ramsar site and use marine waters adjacent to the breeding colony for functions such as preening, bathing and courtship (McSorley et al., 2003), the Flamborough & Filey Coast pSPA already provides for such habitat uses by the fact that the boundary extends 2 km in to marine waters. This site has already been screened in, as identified in [Table 4.2](#) and

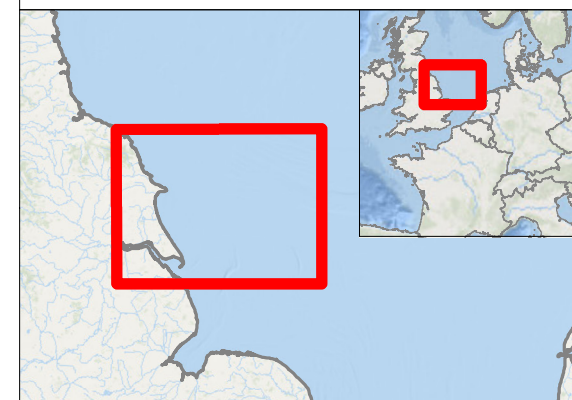
⁸ <https://magic.defra.gov.uk/>

- 4.1.2.8 **Figure 4.1.** No other European or Ramsar sites with a breeding seabird interest are sufficiently close to be screened in on the basis of overlap with 'functionally linked habitat'.
- 4.1.2.9 With respect to waterbirds using intertidal wetlands that are European or Ramsar sites, these birds can use habitat outside the boundary of the site for functions such as feeding and roosting. Examples include geese that roost within an estuary but fly out to feed on agricultural land; waders that feed within an estuary but fly out to roost on agricultural land; and waders that roost within an estuary but fly out to feed on agricultural land. The nearest European or Ramsar site with intertidal wetlands is the Humber Estuary SPA and Humber Estuary Ramsar site. Studies and reviews of the use of habitats outside of the site boundary have been undertaken for all waterbirds (Allen *et al.*, 2003), waterbird foraging and roost sites (Mander *et al.*, 2006), roost use by waterbirds (Cutts *et al.*, 2015) and habitat use by golden plover (*Pluvialis apricaria*), lapwing (*Vanellus vanellus*) and curlew (*Numenius arquata*) (Bériro & Goddall, 2007). Those studies identify that there will be no overlap between habitats used by the waterbird interest features of the Humber Estuary SPA / Ramsar site (whether specifically identified as 'functionally linked habitat' or not) and Hornsea Four. No other European or Ramsar sites with intertidal wetland habitat and waterbird interest features are sufficiently close to be screened in on the basis of overlap with 'functionally linked habitat'.



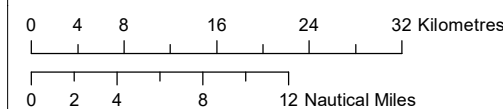
Hornsea Four Designated Sites within the Project Boundaries Figure 4.1

- Scoping Boundary
- Array Area
- Flamborough Head Special Area of Conservation
- Greater Wash potential Special Protection Area
- Flamborough & Filey Coast potential Special Protection Area
- Southern North Sea Site of Community Importance



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:653000



Designated Sites within
the Project Boundaries
Document no: H4SR_HR02
Created by: LS
Checked by: CC
Approved by: LK



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Date: 01/10/2018 Author: laurastally

Name: H4SR_HR02_Designated Sites_A3Land_ETRS89

4.1.2.11 **Criteria 2**

4.1.2.12 Criteria 2 is focused on identifying mobile species listed within European and Ramsar sites that occur within a defined range of Hornsea Four. The relevant receptors are identified in [Table 4.3](#) below including the relevant range identified.

4.1.2.13 The issue of connectivity between sites has been raised with respect to harbour seal and grey seal. It is considered that the existing screening ranges for these species are sufficient to identify relevant sites for further consideration, with the issue of connectivity taken into account in [section 5](#) when the potential for LSE is determined. Effectively, where data is available as regards at sea usage by seals, that is drawn on to assist in determining if Hornsea Four could result in LSE (eg is seals are known to move through or in proximity to Hornsea Four on route to the relevant designated site).

4.1.2.14 For offshore ornithology receptors this only screens sites with receptors that are interest features in the breeding season since it is only at that part of the year that a numeric range can be stated based on foraging distances from the designated site.

4.1.2.15 The screening of ornithology receptors that might pass through Hornsea Four on migration or use Hornsea Four over the winter is based on the application of Criteria 4.

Table 4.3 - Receptor ranges applied to identify sites for consideration

Receptor	Range	Reference
Cetaceans	Harbour porpoise = North Sea Management Unit. Bottlenose dolphin = Greater North Sea and Coastal East Scotland Management Unit	IAMMWG, 2015
Harbour seal	120 km	SMRU, 2011
Grey seal	145 km	Thompson et al., 1996
Migratory fish	100 km	This is a precautionary value used during the Hornsea Three HRA Screening report. To remain precautionary and continue consistency across projects within the Hornsea Zone, this range has been used for Hornsea Four.
Fulmar (breeding season)	400 km (mean max foraging)	Thaxter et al., 2012
Gannet (breeding season)	229 km (mean max foraging)	Thaxter et al., 2012
Shag (<i>Phalacrocorax aristotelis</i>) (breeding season)	14.5 km (mean max foraging)	Thaxter et al., 2012
Cormorant (<i>Phalacrocorax carbo</i>) (breeding season)	25.0 km (mean max foraging)	Thaxter et al., 2012
Black-headed gull (breeding season)	25.5 km (mean max foraging)	Thaxter et al., 2012
Common gull (<i>Larus canus</i>) (breeding season)	50.0 km (mean max foraging)	Thaxter et al., 2012
Herring gull (breeding season)	61.1 km (mean max foraging)	Thaxter et al., 2012
Lesser Black-backed gull (breeding season)	141 km (mean max foraging)	Thaxter et al., 2012
Kittiwake (breeding season)	60.0 km (mean max foraging)	Thaxter et al., 2012
Sandwich tern (breeding season)	49.0 km (mean max foraging)	Thaxter et al., 2012
Roseate tern (breeding season)	16.6 km (mean max foraging)	Thaxter et al., 2012
Common tern (breeding season)	15.2 km (mean max foraging)	Thaxter et al., 2012

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Receptor	Range	Reference
Arctic tern (breeding season)	24.2 km (mean max foraging)	Thaxter <i>et al</i> , 2012
Little tern (breeding season)	11.0 km (mean max foraging)	Thaxter <i>et al</i> , 2012
Guillemot (breeding season)	84.2 km (mean max foraging)	Thaxter <i>et al</i> , 2012
Razorbill (breeding season)	48.5 km (mean max foraging)	Thaxter <i>et al</i> , 2012
Puffin (breeding season)	105.4 km (mean max foraging)	Thaxter <i>et al</i> , 2012
Eurasian otter	The closest European site designated for otter is 24 km west of the onshore scoping boundary - Lower Derwent Valley SAC. This site's impact risk zone ⁹ does not overlap with Hornsea Four. Therefore, no sites designated for otter will be considered in this assessment under this criteria ¹⁰ .	
Bat	The closest European site designated for Annex II bat species is 161 km south of the onshore scoping boundary in East Anglia – Paston Great Barn SAC. This site's impact risk zone ¹¹ does not overlap with Hornsea Four. Therefore, no European sites designated for bats will be considered in this assessment under this criteria ¹² .	
Onshore ornithology	Although there are European sites with qualifying bird species with ranges that could overlap the onshore components of Hornsea Four, taking into account the habitat and context of the project, only those sites with a reasonably realistic chance of qualifying bird species using the habitat within Hornsea Four ZOI e.g. data from environmental record centres or local ornithology groups of qualifying species within the maximum ZOI of Hornsea Four) and potentially being affected by project activities will be screened in.	

⁹ The Impact Risk Zones (IRZs) are a GIS tool developed by Natural England to make a rapid initial assessment of the potential risks posed by development proposals to: Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites. They define zones around each site which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts.

¹⁰ This follows Hornsea Three approach where only sites within 5 km were screened in for assessment of likely significant effects

¹¹ The Impact Risk Zones (IRZs) are a GIS tool developed by Natural England to make a rapid initial assessment of the potential risks posed by development proposals to: Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites. They define zones around each site which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts.

¹² This follows Hornsea Three approach where only sites within 10 km were screened in for assessment of likely significant effects

Table 4.4 - European or Ramsar site with qualifying mobile species whose range (e.g. foraging, migratory, overwintering, breeding or natural habitat range) may interact with Hornsea Four

ID	Designated Site	Relevant feature(s) ¹³¹⁴	Within the relevant range from			
			Array boundary	Offshore ECC	Onshore ECC	Substation
1	Agger Tange, Nissum Bredning, Skibsted Fjord og Agerø (Denmark) SAC	• Harbour porpoise	511 km	534 km	N/A	N/A
2	Anse de Vauville (France) SAC	• Harbour porpoise • Bottlenose dolphin	512 km	494 km	N/A	N/A
3	Baie de Canche et couloir des trois estuaires (France) SAC	• Harbour porpoise	362 km	372 km	N/A	N/A
4	Baie de Seine occidentale (France) SAC	• Harbour porpoise	497 km	491 km	N/A	N/A
5	Baie de Seine orientale (France) SAC	• Harbour porpoise • Bottlenose dolphin	494 km	503 km	N/A	N/A
6	Banc et récifs de Surtainville (France) SAC	• Harbour porpoise • Bottlenose dolphin	528 km	513 km	N/A	N/A
7	Bancs des Flandres (France) SAC	• Harbour porpoise	284 km	296 km	N/A	N/A
8	Borkum-Riffgrund (Germany) SAC	• Harbour porpoise	292 km	320 km	N/A	N/A
9	Doggerbank (Germany) SAC	• Harbour porpoise	222 km	239 km	N/A	N/A
10	Doggersbank (Dutch) SAC	• Harbour porpoise • Grey seal • Harbour seal	84 km	109 km	N/A	N/A
11	Dråby Vig (Denmark) SAC	• Harbour porpoise	554 km	577 km	N/A	N/A
12	Estuaire de la Seine (France) SAC	• Harbour porpoise	485 km	495 km	N/A	N/A
13	Estuaires et littoral picards (baies de Somme et d'Authie) (France) SAC	• Bottlenose dolphin • Harbour porpoise	383 km	394 km	N/A	N/A
14	Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardighen et Dunes de Wissant (France) SAC	• Harbour porpoise	326 km	337 km	N/A	N/A

¹³ Sites with mention of harbour porpoise initially identified through <http://natura2000.eea.europa.eu/#>, followed by cross checking site details and other HRA documents to confirm as a designated feature.

¹⁴ Note that other features may be included within the citation at these sites, however only features screened in under Criteria 2 are listed here to enable the table to remain workable. Full details on the features associated with the designated sites are available in the site citations, referenced in Appendix A

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ID	Designated Site	Relevant feature(s) ¹³¹⁴	Within the relevant range from			
			Array boundary	Offshore ECC	Onshore ECC	Substation
		<ul style="list-style-type: none"> Bottlenose dolphin 				
15	Gule Rev (Denmark) SAC	<ul style="list-style-type: none"> Harbour porpoise 	535 km	555 km	N/A	N/A
16	Hamburgisches Wattenmeer (UK) SAC	<ul style="list-style-type: none"> Harbour porpoise 	431 km / 436 km	459 km / 464 km	N/A	N/A
17	Helgoland mit Helgoländer Felssockel (Germany) SAC	<ul style="list-style-type: none"> Harbour porpoise 	403 km	431 km	N/A	N/A
18	Humber Estuary (UK) SAC	<ul style="list-style-type: none"> Sea lamprey (<i>Petromyzon marinus</i>) River lamprey (<i>Lampetra fluviatilis</i>) Grey seal 	74 km	26 km	N/A	N/A
19	Jyske Rev, Lillefiskerbanke (Denmark) SAC	<ul style="list-style-type: none"> Harbour porpoise 	442 km	461 km	N/A	N/A
20	Klaverbank (Netherlands) SAC	<ul style="list-style-type: none"> Harbour porpoise Grey seal Harbour seal 	78 km	106 km	N/A	N/A
21	Kosterfjorden-Väderöfjorden (Sweden) SAC	<ul style="list-style-type: none"> Harbour porpoise 	768 km	788 km	N/A	N/A
22	Løgstør Bredning, Vejlerne og Bulbjerg (Denmark) SAC	<ul style="list-style-type: none"> Harbour porpoise 	560 km	582 km	N/A	N/A
23	Lønstrup Rødgrund (Denmark) SAC	<ul style="list-style-type: none"> Harbour porpoise 	625 km	646 km	N/A	N/A
24	Moray Firth (UK) SAC	<ul style="list-style-type: none"> Bottlenose dolphin 	471 km	451 km	N/A	N/A
25	Nationalpark Niedersächsisches Wattenmeer (Germany) SAC	<ul style="list-style-type: none"> Harbour porpoise 	326 km	354 km	N/A	N/A
26	Noordzeekustzone (Netherlands) SAC	<ul style="list-style-type: none"> Harbour porpoise 	221 km	244 km	N/A	N/A
27	NTP S-H Wattenmeer und angrenzende Küstengebiete (Germany) SAC	<ul style="list-style-type: none"> Harbour porpoise 	416 km	444 km	N/A	N/A
28	Oosterschelde (Netherlands) SAC	<ul style="list-style-type: none"> Harbour porpoise 	285 km	302 km	N/A	N/A
29	Récifs et landes de la Hague (France) SAC	<ul style="list-style-type: none"> Harbour porpoise 	501 km	483 km	N/A	N/A
30	Récifs et marais arrière-littoraux du Cap Lévi à la Pointe de Saire (France) SAC	<ul style="list-style-type: none"> Harbour porpoise Bottlenose dolphin 	484 km	475 km	N/A	N/A
31	Récifs Gris-Nez Blanc-Nez (France) SAC	<ul style="list-style-type: none"> Harbour porpoise 	316 km	326 km	N/A	N/A
32	Ridens et dunes hydrauliques du détroit du Pas-de-Calais (France) SAC	<ul style="list-style-type: none"> Harbour porpoise 	320 km	330 km	N/A	N/A
33	River Derwent (UK) SAC	<ul style="list-style-type: none"> Sea lamprey 	107 km	36 km	N/A	N/A

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ID	Designated Site	Relevant feature(s) ¹³¹⁴	Within the relevant range from			
			Array boundary	Offshore ECC	Onshore ECC	Substation
34	Sandbanker ud for Thorsminde (Denmark) SAC	• Harbour porpoise	480 km	503 km	N/A	N/A
35	SBZ 1 / ZPS 1 (Belguim)	• Harbour porpoise	301 km	315 km	N/A	N/A
36	SBZ 2 / ZPS 2 (Belguim)	• Harbour porpoise	291 km	306 km	N/A	N/A
37	SBZ 3 / ZPS 3 (Belguim)	• Harbour porpoise	295 km	311 km	N/A	N/A
38	Skagens Gren og Skagerak (Denmark) SAC	• Harbour porpoise	657 km	678 km	N/A	N/A
39	SPA Östliche Deutsche Bucht (Germany) SCI	• Harbour porpoise	378 km	406 km	N/A	N/A
40	Steingrund (Germany) SAC	• Harbour porpoise	414 km	442 km	N/A	N/A
41	Store Rev (Denmark) SAC	• Harbour porpoise	622 km	643 km	N/A	N/A
42	Sydlig Nordsø (Denmark) SAC	• Harbour porpoise	373 km	399 km	N/A	N/A
43	Sylter Aubenriff (Germany) SCI	• Harbour porpoise	321 km	347 km	N/A	N/A
44	The Wash and North Norfolk Coast (UK) SAC	• Harbour seal	88 km	98 km	N/A	N/A
45	Thyborøn Stenvolde (Denmark) SAC	• Harbour porpoise	479 km	501 km	N/A	N/A
46	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde (Denmark) SAC	• Harbour porpoise	443 km	469 km	N/A	N/A
47	Venø, Venø Sund (Denmark) SAC	• Harbour porpoise	523 km	546 km	N/A	N/A
48	Vlakte van de Raan (Belguim/Netherlands) SAC	• Harbour porpoise	291 km / 280 km	306 km / 296 km	N/A	N/A
49	Vlaamse Banken (Belguim) SAC	• Harbour porpoise	266 km	279 km	N/A	N/A
50	Voordelta (Netherlands) SAC	• Harbour porpoise	265 km	282 km	N/A	N/A
51	Waddenzee (Netherlands) SAC	• Harbour porpoise	229 km	253 km	N/A	N/A
52	Westerschelde and Saeflunghe (Netherlands) SAC	• Harbour porpoise	290 km	306 km	N/A	N/A
53	Southern North Sea (UK) cSAC/SCI	• Harbour porpoise	0 km	0 km	N/A	N/A
54	Flamborough Head & Bempton Cliffs (UK) SPA ¹⁵	• Kittiwake	• Kittiwake	• Kittiwake	N/A	N/A
55	Flamborough & Filey Coast (UK) pSPA ¹⁶	• Gannet • Kittiwake • Guillemot • Razorbill	• Gannet • Kittiwake • Guillemot • Razorbill	• Gannet • Kittiwake • Guillemot • Razorbill	N/A	N/A

¹⁵ Presented as species in range of project boundaries

¹⁶ Presented as species in range of project boundaries

Hornsea 4



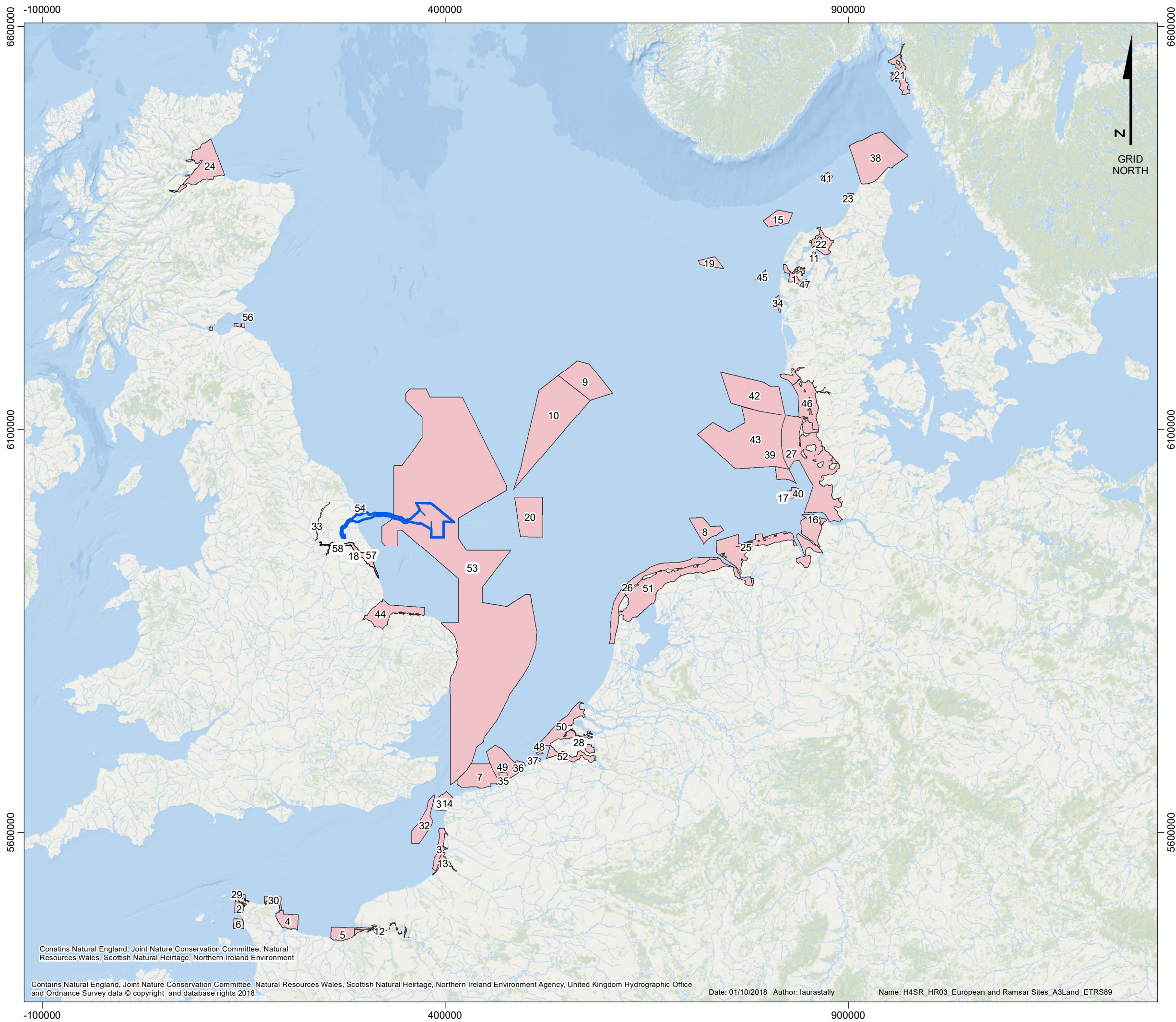
ID	Designated Site	Relevant feature(s) ¹³¹⁴	Within the relevant range from			
			Array boundary	Offshore ECC	Onshore ECC	Substation
		<ul style="list-style-type: none"> Fulmar Puffin Herring gull Shag Cormorant 	<ul style="list-style-type: none"> Fulmar Puffin Herring gull 	<ul style="list-style-type: none"> Fulmar Puffin Herring gull Shag Cormorant 		
56	Forth Islands (UK) SPA ¹⁷	<ul style="list-style-type: none"> Fulmar Gannet Kittiwake Guillemot Razorbill Puffin Herring gull Lesser black-backed Gull Shag Cormorant Arctic tern Common tern Roseate tern Sandwich tern 	<ul style="list-style-type: none"> Fulmar Gannet 	<ul style="list-style-type: none"> Fulmar Gannet 	N/A	N/A
57	Humber Estuary (UK) SPA	<ul style="list-style-type: none"> Avocet (<i>Recurvirostra avosetta</i>) Hen harrier Golden plover Black-tailed godwit (<i>Limosa limosa</i>) 	N/A	N/A	9.5 km	7.5 km

¹⁷ Presented as species in range of project boundaries

Hornsea 4



ID	Designated Site	Relevant feature(s) ¹³¹⁴	Within the relevant range from			
			Array boundary	Offshore ECC	Onshore ECC	Substation
		<ul style="list-style-type: none"> • Bar-tailed godwit (<i>Limosa lapponica</i>) • Ruff (<i>Philomachus pugnax</i>) • Marsh harrier (<i>Circus aeruginosus</i>) • Shelduck (<i>Tadorna tadorna</i>) • Dunlin (<i>Calidris alpina</i>) • Redshank (<i>Tringa totanus</i>) 				
58	Humber Estuary Ramsar (UK)	<ul style="list-style-type: none"> • Golden plover • Dunlin • Black-tailed godwit • Bar-tailed godwit • Redshank • Shelduck • Red knot (<i>Calidris canutus</i>) 	N/A	N/A	9.5 km	7.5 km



Hornsea Four

European and Ramsar sites supporting mobile species whose range overlaps with Hornsea Four

Figure 4.2

- Scoping Boundary
- Array Area
- European Designated Sites (numbered 1-58, see key in separate table in chapter)



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:4500000

0 25 50 100 150 200 Kilometres

0 20 40 80 120 Nautical Miles

European and Ramsar sites supporting mobile species whose range overlaps with Hornsea Project Four

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4.1.2.17 Criteria 3

4.1.2.18 Criteria 3 is focused on identifying those designated features that occur within range of the maximum expected extent of project related effects. The relevant range for each receptor group is identified in [Table 4.5](#) below.

Table 4.5 - Effect ranges applied to identify sites for consideration

Receptor	Range	Reference
Subtidal and intertidal benthic ecology	16 km	Based on the evidence from Hornsea Project One, Project Two and Project Three, its is suggested suspended sediment dispersal of up to 2 mg/l is predicted to extend out to 16 km from the Hornsea Four array and offshore ECC (SmartWind, 2015).
Cetaceans	26 km	For harbour porpoise, drawing on literature associated with the SNS cSAC/SCI (e.g. JNCC, 2016). Hornsea Project Two presented underwater noise modelling including disturbance ranges from pilling during construction for mid-frequency cetaceans (bottlenose dolphin). Hornsea Three modelled disturbance, with data presented as numbers of animals and not range. Hornsea Project Two behavioural impact range was given as up to 11 km (based on a 3,000kJ hammer energy). In order to remain precautionary in this screening approach, a receptor range of 26 km has been used for bottlenose dolphin, in line with the range applied for harbour porpoise. This range will be amended for the RIAA, if necessary, following project specific underwater noise modelling.
Harbour seal	120 km	SMRU, 2011
Grey seal	145 km	Thompson et al., 1996
Migratory fish	100 km	This is a precautionary value used during the Hornsea Three HRA Screening Report. To remain precautionary and continue consistency across projects within the Hornsea Zone, this range has been used for Hornsea Four.
Offshore and intertidal ornithology	Intertidal: 0.5 km displacement / disturbance due to project activities Offshore: 4 km displacement/disturbance due to project activities	SNCBs, 2017
Onshore terrestrial ecology	1 km	This distance has been allowed in the absence of standard mitigation to take account of disturbance from Hornsea Four activities e.g. noise, lighting and presence of work force during construction.
Onshore aquatic ecology	5 km	This distance has been determined in the absence of mitigation e.g. measures in a Code of Construction Practice (CoCP). Under

Receptor	Range	Reference
		normal working practices, maximum extent of effects are likely to be less.

4.1.2.19 All designated sites and features identified under Criteria 3 are summarised in [Table 4.6](#) below and depicted in [Figure 4.3](#).

4.1.2.20 There are no onshore (i.e. above MHW) European sites within 5km. Therefore, no sites have been screened in under this criteria for onshore ecology.

Table 4.6 - European or Ramsar site with a qualifying feature located within the potential range of effect (as identified in Table 4.5) associated with Hornsea Four

Designated Site	Feature(s)	Within the relevant range of effect			
		Array boundary	Offshore ECC	Onshore ECC	Substation
Humber Estuary SAC	<p>Annex I Habitats (noting that these habitats fall outside the benthic ecology screening range of 16 km):</p> <ul style="list-style-type: none"> • Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>) • Coastal lagoons • Dunes with <i>Hippophaë rhamnoides</i> • Embryonic shifting dunes • Estuaries • Mudflats and sandflats not covered by seawater at low tide • Fixed coastal dunes with herbaceous vegetation ('grey dunes') • <i>Salicornia</i> and other annuals colonising mud and sand • Sandbanks which are slightly covered by sea water all the time • Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ('white dunes') <p>Annex II Species (noting that seals and migratory fish fall within the relevant offshore screening ranges):</p> <ul style="list-style-type: none"> • Grey seal • River lamprey • Sea lamprey 	74 km	26 km	N/A	N/A

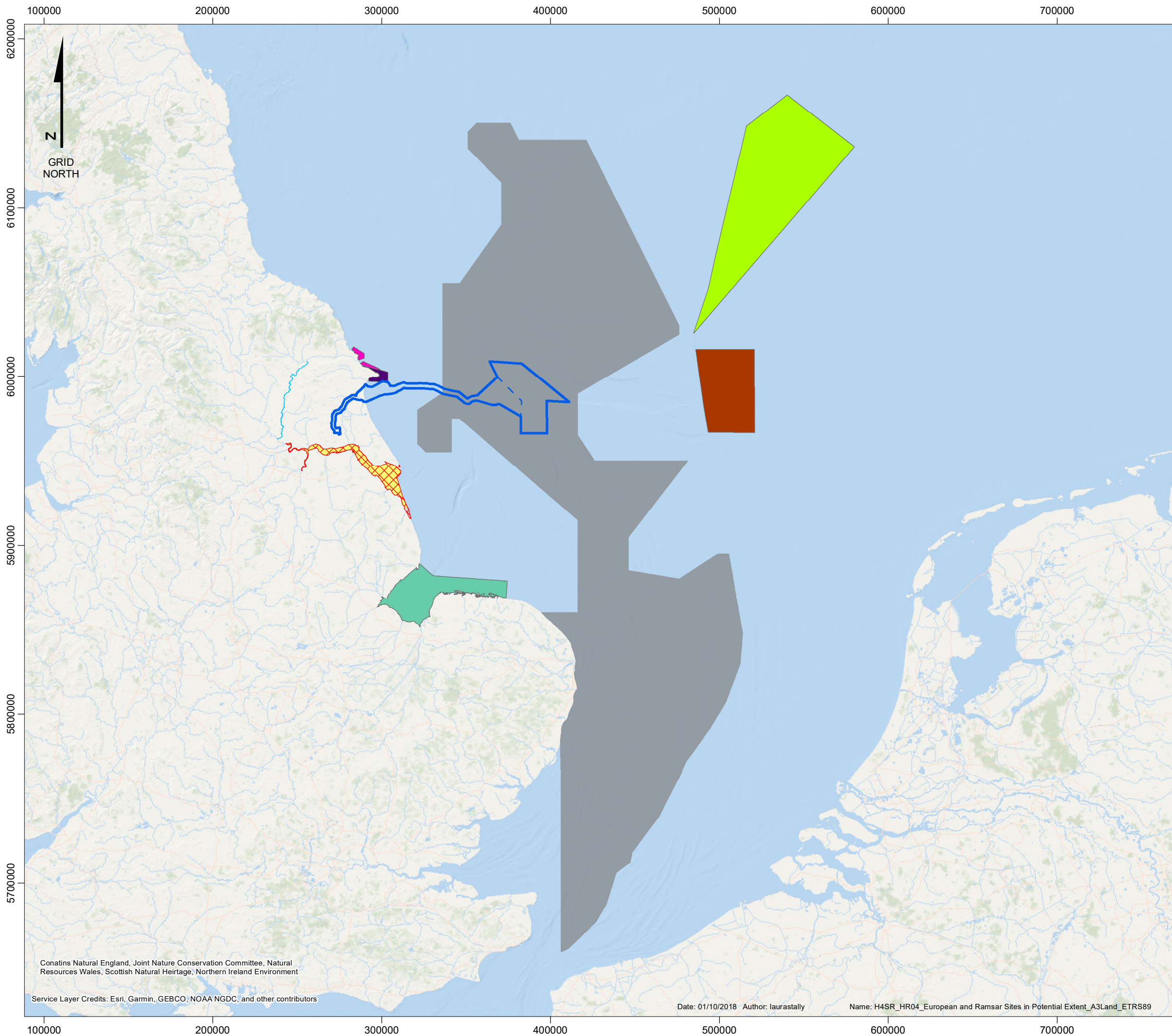
Designated Site	Feature(s)	Within the relevant range of effect			
		Array boundary	Offshore ECC	Onshore ECC	Substation
Humber Estuary Ramsar	<ul style="list-style-type: none"> Ramsar criterion 1 (estuary – outwith the benthic ecology screening range of 16 km) Ramsar criterion 3 (grey seal – within grey seal screening range) Ramsar criteria 5 (assemblage of international importance) (included under Criteria 2 in Table 4.4) Ramsar criterion 6 (species/populations occurring at levels of international importance) (included under Criteria 2 in Table 4.4) Ramsar criterion 8 (migratory fish river lamprey and sea lamprey) – within screening range for migratory fish 	74 km	26 km	N/A	N/A
Southern North Sea cSAC/SCI	Annex II Species: <ul style="list-style-type: none"> Harbour porpoise 	0 km	0 km	N/A	N/A
Doggersbank (Dutch) SAC	Annex I Habitats (outwith screening range): <ul style="list-style-type: none"> Sandbanks which are slightly covered by sea water all the time Annex II Species: <ul style="list-style-type: none"> Harbour porpoise Grey seal Harbour seal 	84 km	109 km	N/A	N/A
Klaverbank SCI	Annex II Species: <ul style="list-style-type: none"> Harbour porpoise Grey seal Harbour seal 	78 km	106 km	N/A	N/A

Designated Site	Feature(s)	Within the relevant range of effect			
		Array boundary	Offshore ECC	Onshore ECC	Substation
The Wash and North Norfolk Coast SAC	<p>Annex I Habitats (outwith screening range):</p> <ul style="list-style-type: none"> Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>) Coastal lagoons Large shallow inlets and bays Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>) Mudflats and sandflats not covered by seawater at low tide Reefs Salicornia and other annuals colonising mud and sand Sandbanks which are slightly covered by sea water all the time <p>Annex II Species (only harbour seal in range):</p> <ul style="list-style-type: none"> Harbour seal Eurasian otter 	88 km	98 km	N/A	N/A
River Derwent SAC	<p>Annex I Habitats (outwith screening range):</p> <ul style="list-style-type: none"> Water courses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation. <p>Annex II Species (migratory fish species only within screening range):</p> <ul style="list-style-type: none"> Bullhead (<i>Cottus gobio</i>) River lamprey Eurasian otter Sea lamprey 	140 km	36 km	N/A	N/A
Flamborough Head SAC	<p>Annex I Habitats (within screening range of the cable corridor only):</p> <ul style="list-style-type: none"> Reefs Vegetated sea cliffs of the Atlantic and Baltic Coasts Submerged or partially submerged sea caves. 	60 km	0 km	N/A	N/A
Flamborough Head & Bempton Cliffs SPA	<ul style="list-style-type: none"> Kittiwake 	-	<ul style="list-style-type: none"> Kittiwake 	-	-

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Designated Site	Feature(s)	Within the relevant range of effect			
		Array boundary	Offshore ECC	Onshore ECC	Substation
Flamborough & Filey Coast pSPA	<ul style="list-style-type: none"> • Gannet • Kittiwake • Guillemot • Razorbill • Fulmar • Puffin • Herring gull • Shag • Cormorant 	-	<ul style="list-style-type: none"> • Gannet • Kittiwake • Guillemot • Razorbill • Fulmar • Puffin • Herring gull • Shag • Cormorant 	-	-

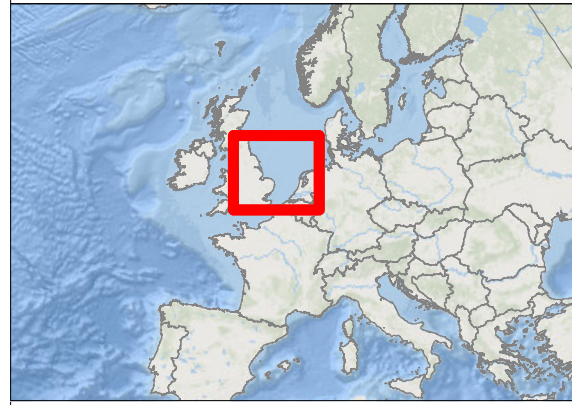


Hornsea Four

Designated habitat within a European or Ramsar Site located within the potential extent of effects

Figure 4.3

- Scoping Boundary
- Array Area
- Ramsar Site
 - Humber Estuary Ramsar
- Onshore Special Area of Conservation (SAC)
 - Flamborough Head SAC
 - Humber Estuary SAC
 - River Derwent SAC
- Flamborough & Filey Proposed Special Protection Area (SPA)
 - Flamborough and Filey Coast pSPA
- European Designated Site
 - Doggersbank (Dutch) SAC
 - Flamborough Head and Bempton Cliffs SPA
 - Klaverbank SAC
 - The Wash and North Norfolk Coast SAC
- Southern North Sea Site of Community Importance (CSI)
 - Souther North Sea cSAC/SCI



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:2179475

0 10 20 40 60 80 100 Kilometres

0 10 20 40 60 Nautical Miles

Designated habitat within a European or Ramsar Site located within the potential extent of effects

Document no: H4SR_HR04

Created by: LS

Checked by: CC

Approved by: LK

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Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Date: 01/10/2018 Author: laurastally

Name: H4SR_HR04_European and Ramsar Sites in Potential Extent_A3Land_ETRS89

4.1.2.22 Criteria 4

4.1.2.23 Criteria 4 is focused on identifying European and Ramsar species and/ or habitats which have been found during project (or former Hornsea Zone) specific surveys. All potential features identified under Criteria 4 are summarised in [Table 4.7](#) below, including where a relevant designated site has been identified through previous screening criteria.

4.1.2.24 Note that for the offshore and intertidal ornithology receptors this list excludes species that were recorded on less than ten occasions within the scoping boundary area during the project specific aerial surveys conducted between April 2016 and March 2018 (HiDef, 2018). Those species that were recorded on less than ten occasions were (with the number of records in parenthesis) red-throated diver (2), lapwing (1), curlew (1), Arctic skua *Stercorarius parasiticus* (3), great skua *Stercorarius skua* (5) and black-headed gull *Chroicocephalus ridibundus* (2).

4.1.2.25 All bird species identified as occurring within the scoping boundary area during the project specific aerial surveys conducted between April 2016 and March 2018 were (with the number of records in parenthesis for species occurring on less than 10 occasions):

- Red-throated diver (2)
- Fulmar
- Manx Shearwater (*Puffinus puffinus*)
- Gannet
- Lapwing (1)
- Curlew (1)
- Arctic skua (3)
- Great skua (5)
- Kittiwake
- Little gull
- Black-headed gull (2)
- Common gull
- Herring gull
- Lesser black-backed gull
- Great black-backed gull
- Razorbill
- Guillemot
- Puffin
- Starling (*Sturnus vulgaris*)¹⁸

Table 4.7 - European or Ramsar qualifying habitat or species recorded during site specific surveys at Hornsea Four boundary

Habitat or species	Recorded within ¹⁹				Relevant sites identified
	Array boundary	NOTE	Onshore cable corridor	Substation	
Fulmar	✓		-	-	Flamborough & Filey Coast pSPA (Cr2 & Cr3 Table)
Manx shearwater	✓		-	-	None in the North Sea
Gannet	✓		-	-	Flamborough & Filey Coast pSPA (Cr1, Cr2 & Cr3 Tables)

¹⁸ (not an interest feature of any SPA along the western seaboard of the North Sea (information drawn from the JNCC third review of the SPA network <http://jncc.defra.gov.uk/page-7309>))

¹⁹ Only the array boundary was included in the offshore bird surveys, accordingly this table does not present information on the offshore ECC.

Kittiwake	✓		-	-	Flamborough Head & Bempton Cliffs SPA (Cr2 & Cr3 Tables) Flamborough & Filey Coast pSPA (Cr1, Cr2 & Cr3 Tables)
Little gull	✓		-	-	Greater Wash SPA (Cr1 Table)
Common gull	✓		-	-	-
Herring gull	✓		-	-	Flamborough & Filey Coast pSPA (Cr2 & Cr3 Tables)
Lesser black-backed gull	✓		-	-	-
Great black-backed gull	✓		-	-	-
Razorbill	✓		-	-	Flamborough & Filey Coast pSPA (Cr1, Cr2 & Cr3 Tables)
Guillemot	✓		-	-	Flamborough & Filey Coast pSPA (Cr1, Cr2 & Cr3 Tables)
Puffin	✓		-	-	Flamborough & Filey Coast pSPA (Cr2 & Cr3 Tables)
Otter ²⁰	-		✓	✓	None within 24 km
Bats	-		✓	✓	None within 161 km
Red Kite	-		✓	✓	None within 260 km
Peregrine	-		✓	✓	None within 85 km
Little egret	-		✓	✓	None within 328 km
Kingfisher	-		✓	✓	None within 150 km

4.1.2.26 Those bird species that have been recorded during the project specific aerial surveys conducted between April 2016 and March 2018 (HiDef, 2018) might be breeding interest features at SPA sites to the north of Hornsea Four and either pass through the area on migration or reside in the area during the winter. For those species that were recorded on more than ten occasions, [Table 4.8](#) below lists SPA sites that are to the north of Hornsea Four, on the western seaboard of the North Sea or in the Northern Isles. The screening was also carried out for Ramsar sites with breeding interest features that included the bird species that were recorded more than ten times during site specific aerial surveys at Hornsea Four. That screening process did not identify any Ramsar sites that justified being screened in.

Table 4.8 - European or Ramsar qualifying bird species that were recorded more than ten times during site specific aerial surveys at Hornsea Four and the SPAs where they are breeding interest features situated to the north of Hornsea Four

²⁰ Onshore species are included from records from the North & East Yorkshire Ecological Data Centre.

Bird species	SPA sites to the north of Hornsea Four with these species as breeding interest features and from which they might pass through on migration or visit in winter
Fulmar	Hermaness, Saxa Vord and Valla Field; Fetlar; Foula; Noss; Sumburgh Head; Fair Isle; West Westray; Calf of Eday; Rousay; Hoy; Copinsay; North Caithness Cliffs; East Caithness Cliffs; Buchan Ness to Collieston Coast; Troup, Pennan and Lion's Heads; Fowlsheugh; and Forth Islands
Manx shearwater	[None in the North Sea]
Gannet	Forth Islands; Fair Isle; Hermaness, Saxa Vord and Valla Field; Noss; and Outer Firth of Forth and St Andrews Complex
Kittiwake	Hermaness, Saxa Vord and Valla Field; Foula; Noss; Sumburgh Head; Fair Isle; West Westray; Calf of Eday; Marwick Head; Rousay; Copinsay; Hoy; North Caithness Cliffs; East Caithness Cliffs; Troup, Pennan and Lion's Heads; Buchan Ness to Collieston Coast; Fowlsheugh; Forth Islands; Outer Firth of Forth and St Andrews Complex; St Abbs Head to Fast Castle; and Farne Islands
Little gull	[No breeding sites in UK]
Common gull	Tips of Corsemaul and Tom Mor
Herring gull	Buchan Ness to Collieston Coast; East Caithness Cliffs; Forth Islands; Fowlsheugh; St Abb's Head to Fast Castle; Troup, Pennan and Lion's Heads; Outer Firth of Forth and St Andrews Complex
Lesser black-backed gull	Forth Islands
Great black-backed gull	Calf of Eday; Copinsay; Hoy; and East Caithness Cliffs
Razorbill	Foula; Fair Isle; West Westray; North Caithness Cliffs; East Caithness Cliffs; Troup, Pennan and Lion's Heads; Fowlsheugh; Forth Islands; and St Abb's Head to Fast Castle
Guillemot	Hermaness, Saxa Vord and Valla Field; Foula; Noss; Sumburgh Head; Fair Isle; West Westray; Calf of Eday; Rousay; Marwick Head; Hoy; Copinsay; North Caithness Cliffs; East Caithness Cliffs; Troup, Pennan and Lion's Heads; Buchan Ness to Collieston Coast; Fowlsheugh; Forth Islands; Outer Firth of Forth and St Andrews Complex; St Abb's Head to Fast Castle; Farne Islands; and Northumberland Marine
Puffin	Hermaness, Saxa Vord and Valla Field; Foula; Noss; Fair Isle; Hoy; North Caithness Cliffs; East Caithness Cliffs; Forth Islands; Outer Firth of Forth and St Andrews Complex; Farne Islands; Coquet Island; and Northumberland Marine

4.1.2.27 Summary of all designated sites and relevant species identified

4.1.2.28 A summary of all designated sites screened in under the screening criteria is provided in [Table 4.9](#) below. Clarification is also provided on associated interest features have been screened in for consideration of LSE in [section 5](#) below and which have not. The latter point is relevant when a designated site has more than one feature listed, but the designated features are subject to different screening ranges. For example, Criteria 2 screens in designated sites based on ranges associated with specific mobile species – however these ranges exceed screening ranges for benthic habitat. [Table 4.9](#) below **ONLY**

identifies the features associated with designated sites that have been screened in, based on the relevant screening ranges.

Table 4.9 - Designated Features associated with European and Ramsar sites for which LSE cannot be discounted at this stage

Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
Southern North Sea cSAC/SCI	<ul style="list-style-type: none"> Harbour porpoise 	None	✓	✓	N/A	N/A
Flamborough Head SAC	Annex I Habitats: <ul style="list-style-type: none"> Reefs Vegetated sea cliffs of the Atlantic and Baltic Coasts Submerged or partially submerged sea caves. 	None	N/A ²¹	✓	N/A	N/A
Moray Firth SAC	<ul style="list-style-type: none"> Bottlenose dolphin 	<ul style="list-style-type: none"> Sandbanks which are slightly covered by sea water all the time 	✓	✓	N/A	N/A
The Wash and North Norfolk Coast SAC	<ul style="list-style-type: none"> Harbour seal 	<ul style="list-style-type: none"> Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>) Coastal lagoons Large shallow inlets and bays Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>) Mudflats and sandflats not covered by seawater at low tide Eurasian otter Reefs Salicornia and other annuals colonising mud and sand 	✓	✓	N/A	N/A

²¹ Outside relevant screening range

Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
		<ul style="list-style-type: none"> Sandbanks which are slightly covered by sea water all the time 				
River Derwent SAC	Annex II Species: <ul style="list-style-type: none"> Sea lamprey River lamprey 	Annex I Habitats: <ul style="list-style-type: none"> Water courses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation Annex II Species: <ul style="list-style-type: none"> Bullhead Eurasian otter 	N/A ²²	✓	N/A	N/A
Humber Estuary SAC	<ul style="list-style-type: none"> Sea lamprey River lamprey Grey seal 	<ul style="list-style-type: none"> Atlantic salt meadows (<i>Glaucopuccinellietalia maritima</i>) Coastal lagoons Dunes with <i>Hippophaë rhamnoides</i>. Embryonic shifting dunes Estuaries Mudflats and sandflats not covered by seawater at low tide Fixed coastal dunes with herbaceous vegetation ('grey dunes') <i>Salicornia</i> and other annuals colonising mud and sand Sandbanks which are slightly covered by sea water all the time Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ('white dunes') 	✓	✓	N/A	N/A

²² Outside relevant screening range

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Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
Humber Estuary SPA	<ul style="list-style-type: none"> • Avocet • Hen harrier • Golden plover • Black-tailed godwit • Bar-tailed godwit • Ruff • Marsh harrier • Shelduck • Dunlin • Redshank • Red knot 	<ul style="list-style-type: none"> • Bittern (<i>Botaurus stellaris</i>) • Little tern 	N/A	N/A	✓	✓
Humber Estuary Ramsar	<p>Ramsar criterion 3 (grey seal)</p> <p>Ramsar criteria 5 (assemblage of international importance – onshore ecology)</p> <p>Ramsar criterion 6 (species/populations occurring at levels of international importance – onshore ecology)</p> <p>Bird species total including:</p> <ul style="list-style-type: none"> • Golden plover • Dunlin • Black-tailed godwit • Bar-tailed godwit • Redshank • Shelduck • Red knot 	<ul style="list-style-type: none"> • Ramsar criterion 1 (estuary) 	✓	✓	✓	✓

Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
	Ramsar criterion 8 (migratory fish river lamprey and sea lamprey)					
Transboundary harbour porpoise sites (49 sites)	<ul style="list-style-type: none"> Harbour porpoise 	All other designated features (unless included for seals or bottlenose dolphin below)	✓	✓	N/A	N/A
Transboundary harbour seal sites (2 sites)	<ul style="list-style-type: none"> Harbour seal 	All other designated features (unless included for harbour porpoise above or grey seal or bottlenose dolphin below)	✓	✓	N/A	N/A
Transboundary grey seal sites (2 sites)	<ul style="list-style-type: none"> Grey seal 	All other designated features (unless included for harbour porpoise or harbour seal above or bottlenose dolphin below)	✓	✓	N/A	N/A
Transboundary bottlenose dolphin sites (6 sites)	<ul style="list-style-type: none"> Bottlenose dolphin 	All other designated features (unless included for harbour porpoise or seal above)	✓	✓	N/A	N/A
Greater Wash SPA	Breeding: <ul style="list-style-type: none"> Sandwich tern Little tern Common tern Non-breeding: <ul style="list-style-type: none"> Red-throated diver Little gull Migratory: <ul style="list-style-type: none"> Common scoter 		✓	✓	N/A	N/A

Hornsea 4



Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
Flamborough Head & Bempton Cliffs SPA	<ul style="list-style-type: none"> Kittiwake 		✓	✓	N/A	N/A
Flamborough & Filey Coast pSPA	<ul style="list-style-type: none"> Gannet Kittiwake Guillemot Razorbill Fulmar Puffin Herring gull Shag Cormorant 		✓	✓	N/A	N/A
Northumberland and Marine SPA	<ul style="list-style-type: none"> Guillemot Puffin 	<ul style="list-style-type: none"> Arctic tern Common tern Little tern Roseate tern Sandwich tern 	✓	✓	N/A	N/A
Coquet Island SPA	<ul style="list-style-type: none"> Puffin 	<ul style="list-style-type: none"> Arctic tern Common tern Roseate tern Sandwich tern 	✓	✓	N/A	N/A
Farne Islands SPA	<ul style="list-style-type: none"> Kittiwake Guillemot Puffin 	<ul style="list-style-type: none"> Arctic tern Common tern Roseate tern Sandwich tern 	✓	✓	N/A	N/A

Hornsea 4



Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
St Abb's Head to Fast Castle SPA	<ul style="list-style-type: none"> Kittiwake Herring gull Razorbill Guillemot 	<ul style="list-style-type: none"> Shag 	✓	✓	N/A	N/A
Forth Islands SPA	<ul style="list-style-type: none"> Fulmar Gannet Kittiwake Guillemot Razorbill Puffin Herring gull Lesser Black-backed Gull 	<ul style="list-style-type: none"> Shag Cormorant Arctic tern Common tern Roseate tern Sandwich tern 	✓	✓	N/A	N/A
Outer Firth of Forth and St Andrews Complex pSPA	<ul style="list-style-type: none"> Gannet Kittiwake Herring gull Common gull Guillemot Puffin 	<ul style="list-style-type: none"> Manx shearwater Shag Common scoter Eider Goldeneye Long-tailed duck Red-breasted merganser Arctic tern Common tern Black-headed gull Little gull 	✓	✓	N/A	N/A
Fowlsheugh SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Herring gull Razorbill Guillemot 		✓	✓	N/A	N/A

Hornsea 4



Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
Buchan Ness to Collieston Coast SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Herring gull Guillemot 	<ul style="list-style-type: none"> Shag 	✓	✓	N/A	N/A
Troup, Pennan and Lion's Heads SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Herring gull Razorbill Guillemot 		✓	✓	N/A	N/A
Tips of Corsemaul and Tom Mor SPA	<ul style="list-style-type: none"> Common gull 		✓	✓	N/A	N/A
East Caithness Cliffs SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Herring gull Great black-backed gull Razorbill Guillemot Puffin 	<ul style="list-style-type: none"> Shag Cormorant Peregrine 	✓	✓	N/A	N/A
North Caithness Cliffs SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Razorbill Guillemot Puffin 	<ul style="list-style-type: none"> Peregrine 	✓	✓	N/A	N/A
Copinsay SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Great black-backed gull 		✓	✓	N/A	N/A

Hornsea 4



Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
	<ul style="list-style-type: none"> Guillemot 					
Hoy SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Great black-backed gull Guillemot Puffin 	<ul style="list-style-type: none"> Red-throated diver Arctic skua Great skua peregrine 	✓	✓	N/A	N/A
Marwick Head SPA	<ul style="list-style-type: none"> Kittiwake Guillemot 	<ul style="list-style-type: none"> 	✓	✓	N/A	N/A
Rousay SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Guillemot 	<ul style="list-style-type: none"> Arctic skua Arctic tern 	✓	✓	N/A	N/A
Calf of Eday SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Great black-backed gull Guillemot 	<ul style="list-style-type: none"> Cormorant 	✓	✓	N/A	N/A
West Westray SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Razorbill Guillemot 	<ul style="list-style-type: none"> Arctic skua Arctic tern 	✓	✓	N/A	N/A
Fair Isle SPA	<ul style="list-style-type: none"> Fulmar Gannet Kittiwake Razorbill Guillemot Puffin 	<ul style="list-style-type: none"> Shag Arctic skua Arctic tern Great skua Fair Isle wren 	✓	✓	N/A	N/A
Sumburgh Head SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Guillemot 	<ul style="list-style-type: none"> Arctic tern 	✓	✓	N/A	N/A

Designated Site	Features screened in	Features screened out	Relevant Project Component			
			Array boundary	Offshore ECC	Onshore ECC	Substation
Noss SPA	<ul style="list-style-type: none"> Fulmar Gannet Kittiwake Razorbill Guillemot Puffin 	<ul style="list-style-type: none"> Great skua 	✓	✓	N/A	N/A
Foula SPA	<ul style="list-style-type: none"> Fulmar Kittiwake Razorbill Guillemot Puffin 	<ul style="list-style-type: none"> Leach's petrel Shag Red-throated diver Arctic skua Arctic tern Great skua 	✓	✓	N/A	N/A
Fetlar SPA	<ul style="list-style-type: none"> Fulmar 	<ul style="list-style-type: none"> Dunlin Whimbrel Red-necked Phalarope Arctic skua Arctic tern Great skua 	✓	✓	N/A	N/A
Hermaness, Saxa Vord and Valla Field SPA	<ul style="list-style-type: none"> Fulmar Gannet Kittiwake Guillemot Puffin 	<ul style="list-style-type: none"> Shag Red-throated diver Great skua 	✓	✓	N/A	N/A

4.2 Approach to the Identification of Potential Effects

- 4.2.1.1 Considerable experience and knowledge exists from previous offshore wind farm projects, including from within the former Hornsea Zone, with regard to the potential effects that may result from the construction, operation and maintenance and decommissioning of an offshore wind farm. This therefore provides a wealth of knowledge which can be drawn upon by Hornsea Four. . In addition, for a number of the designated sites identified through the screening criteria, Natural England has prepared site advice packages and supporting documents, which are intended to help with site assessments and the impact of marine activity in sensitive areas. Specifically, the 'advice on operations' documents are relevant here, as these identify the type of effect that specific features are sensitive to. All these sources of information have been drawn together to produce a concise list of effects that may result from Hornsea Four and that need to be taken into account when determining the potential for LSE for the designated sites and features identified in [Table 4.8](#) above. The information is summarised below in [Table 4.11](#). For the purposes of HRA Screening, and given the limited information available, the potential for effect during decommissioning is assumed, as a worst case scenario, to be the same as for construction (but is realistically likely to be less).
- 4.2.1.2 It should be noted that the effects identified in [Table 4.11](#) do not correlate to LSE; these are effects that may arise as a result of the construction, operation & maintenance and decommissioning of Hornsea Four. The potential for LSE is explored subsequently, in relation to relevant sites and feature(s) in [section 5](#).
- 4.2.1.3 It is noted that the terminology applied to the potential effects identified in [Table 4.11](#) for subtidal and intertidal benthic ecology may differ to the activities identified in the relevant advice on operations.
- 4.2.1.4 For clarity, the equivalent terms, as sourced from the Natural England Advice Packages for the northern North Sea²³, specifically for Flamborough Head²⁴, as available for the relevant benthic ecology sites screened in following the four screening criteria, and as relevant for cables and offshore wind, are defined in [Table 4.10](#) below (noting that these may be considered temporary or ongoing according to the stage of development).

Table 4.10 - Comparison of Relevant Terms used to Define Potential Effect for Subtidal and Intertidal Benthic Ecology

Temporary habitat loss/ disturbance	Abrasion/ disturbance of the substrate on the surface of the seabed Habitat structure changes - removal of substratum (extraction) Penetration and/ or disturbance of the substratum below the surface of the seabed, including abrasion
Temporary increases in suspended sediments/ smothering	Changes in suspended solids (water clarity) Smothering and siltation rate changes (Light-heavy)

²³<https://www.gov.uk/government/publications/northern-north-sea-marine-area-index-map-and-site-packages>

²⁴<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0013036&SiteName=flambor&SiteNameDisplay=Flamborough+Head+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

Accidental pollution	Deoxygenation, temperature decrease (Cables – in operation), temperature increase (Cables – in operation), introduction of light, nutrient enrichment
Changes to physical processes	Water flow (tidal current) changes, including sediment transport considerations Wave exposure changes
Long-term physical loss of habitat	Habitat structure changes - removal of substratum (extraction) Penetration and/ or disturbance of the substratum below the surface of the seabed, including abrasion Physical loss (to land or freshwater habitat)
Introduction of hard substrate	Introduction or spread of invasive non-native species (INIS) Physical change (to another seabed type) Barrier to species movement
EMF	Electromagnetic changes

Table 4.11 - Potential effects from Hornsea Four on relevant receptors

Receptor Type	Potential Effect	Potential Range of Effect	Justification
Construction			
Subtidal and intertidal benthic ecology	Temporary habitat loss/ disturbance	Within the project boundary	Construction phase works may present potential temporary, direct habitat loss and disturbance from cable laying operations, jack-up leg impacts and seabed preparation works for foundations and associated scour or cable protection installation. .
	Temporary increases in suspended sediments/ smothering	16 km *	A temporary increase in suspended sediment concentrations and associated sediment deposition may arise from construction activities (e.g. cable and foundation installation) and may affect benthic or intertidal communities.
	Accidental pollution	Within the project boundary	Construction activities may result in accidental pollution which can affect the sediment and water quality, with potential implications for benthic or intertidal ecology.
	Invasive non-native species	Within the project boundary	The potential spread of non-native, invasive species via associated construction activities.
Marine Mammals	Increase in underwater noise	26 km (JNCC, 2016)	Construction activities, in particular pile-driving activities, will result in increased levels of underwater noise. Additionally, activities such as vessel traffic during construction will also lead to underwater noise. Potential for effect can range from lethal, permanent or temporary physiological injury through to disturbance.
	Vessel disturbance	Within the project boundary	Potential for the presence of vessels to result in disturbance
	Collision risk	Along the transit route from port and within the project boundary	The increased vessel traffic during construction may result in an increased collision risk to marine mammals.
	Changes in prey availability and behaviour	16 km *	Changes to prey availability can have an indirect effect on marine mammals.
	Accidental pollution	Within the project boundary	There is a risk of pollution being accidentally released from vessels and machinery used by the project, including construction and installation vessels and from the construction process itself.

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Receptor Type	Potential Effect	Potential Range of Effect	Justification
	Temporary increases in suspended sediments/ smothering	16 km *	A temporary increase in suspended sediment concentrations and associated sediment deposition may arise from construction activities (e.g. cable and foundation installation). This may impair the ability to forage.
Offshore and intertidal ornithology	Direct disturbance and displacement	Intertidal: 0.5 km Offshore 4 km	Advice from SNCBs (SNCBs, 2017)
	Changes in prey availability and behaviour	Up to 100 km	Response of fish prey (see below)
Migratory fish	Temporary increases in suspended sediments/ smothering	16 km *	A temporary increase in suspended sediment concentrations and associated sediment deposition may arise from construction activities (e.g. cable and foundation installation). Potential for direct effects (e.g. navigation) or indirect (via food sources).
	Increase in underwater noise	100 km ±	Construction activities, in particular pile-driving activities, will result in increased levels of underwater noise. Potential impacts, which are dependent on the level of noise, may include permanent or temporary effects and behavioural disturbance in sensitive species.
	Temporary habitat loss/ disturbance	Within the project boundary	Construction phase works may present potential for temporary, direct habitat loss and disturbance.
	Accidental pollution	Within the project boundary	Construction activities may result in accidental pollution which can affect the sediment and water quality, with potential implications for migratory fish.
Onshore ecology	Temporary habitat loss	Within the project boundary	Construction activities will lead to temporary habitat loss, damage, disturbance, fragmentation and / or severance that qualifying mobile species, such as Annex I birds may utilise outside of Europeans sites.
	Temporary disturbance / damage to habitats	Within the project boundary	
	Habitat fragmentation or severance	Within the project boundary	
	Visual disturbance to species	300 m	

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Receptor Type	Potential Effect	Potential Range of Effect	Justification
	Noise disturbance to species	300 m where maximum noise levels exceed 55dBA	Qualifying mobile species, such as Annex I birds e.g. wintering wader species feeding on inland fields at high tide, could potentially enter or cross the Hornsea Four project ZOI and be disturbed by construction works.
	Invasive non-native species	Within project boundary	Construction vehicle and staff movement could introduce invasive non-native species that could impact qualifying mobile species, such as Annex I birds species if they utilise areas within Hornsea Four outside of Europeans sites.
	Accidental release of contaminants	Within project boundary	Qualifying mobile species, such as Annex I bird could potentially be affected by an accidental release of contaminants if they utilise areas within Hornsea Four Project ZOI outside of Europeans sites.
Operation & Maintenance			
Subtidal and intertidal benthic ecology	Temporary habitat disturbance	Within the project boundary	Impacts are likely to be similar to those resulting from construction, but the magnitude will be less. For example, the presence of jack-up vessels during maintenance may disturb the substrate.
	Release of sediment into suspension/ smothering	16 km *	A temporary increase in suspended sediment concentrations and associated sediment deposition may arise during maintenance activities (e.g. cable works) or scour and may affect benthic or intertidal communities.
	Accidental pollution	Within the project boundary	There is a risk of pollution being accidentally released from vessels and machinery used by the project, as well as from project infrastructure. There is also potential risk of temperature change in close proximity to the operational cables. Pollution can affect sediment and water quality with potential subsequent implications for benthic or intertidal ecology.
	Changes to physical processes	Within the project boundary for waves and hydrodynamics. Up to 16 km for sediment pathways *	Manmade structures such as scour protection and foundations may result in localised changes in hydrodynamics and wave regimes, with a potential effect on sediment transport pathways and associated effects on benthic and intertidal ecology. This may affect some benthic organisms as water flows may be reduced and therefore reducing the amount of suspended food particles which may inhibit feeding and growth. Alternatively, increased flows and scour may make the habitat less suitable for some species.

Receptor Type	Potential Effect	Potential Range of Effect	Justification
	Long-term physical loss of habitat	Within the project boundary	There is the potential for long-term habitat loss at and around manmade structures, and at any subsea cables where secondary cable protection is installed.
	Introduction of hard substrate	Within the project boundary	Man-made structures placed on the seabed such as foundations and scour/cable protection are expected to be colonised by a range of marine organisms leading to localised changes in biodiversity. Structures may also act as a refuge for fish and may facilitate the spread of non-native species.
	EMF	Within the project boundary	Whilst there is uncertainty surrounding the potential effect of EMF on benthic ecology, advice on activities is to screen in for subsequent consideration based on the best available evidence.
Marine Mammals	Underwater noise	Localised to individual WTs and vessels	Increased underwater noise resulting from operational WTs and increased vessel activity required for operation and maintenance operations may result in disturbance of marine mammal receptors. EMF emitted by export and array cables has the potential to lead to a behavioural response in marine mammals. It should be noted that the noise and associated impacts within the operational phase will be substantially lower than construction in terms of magnitude.
	Vessel disturbance	Within the project boundary	Potential for the presence of vessels to result in disturbance
	Long-term physical loss of habitat	Within the project boundary	The footprint/ presence of structures (i.e. WTs, substations, possible scour protection and cable protection) will reduce the area of the habitat for benthic species.
	Collision risk	Along the transit route from port and within the project boundary	On-going vessel traffic during operation and maintenance may result in an increased collision risk to marine mammals.
	Accidental pollution	Within the project boundary	There is a risk of pollution being accidentally released from vessels and machinery used by the project, as well as from project infrastructure. Pollution can affect sediment and water quality with potential subsequent implications for marine mammals and their prey.
	Changes in prey availability	Within the project boundary	Potential for a loss of prey resources for marine mammals as a result of changes in fish communities from operation and maintenance activities.

Receptor Type	Potential Effect	Potential Range of Effect	Justification
Offshore and intertidal ornithology	Direct disturbance and displacement	Intertidal: 0.5 km Offshore: 4 km	Advice from SNCBs (SNCBs, 2017)
	Indirect impacts through effects on habitats and prey species	Up to 10 km	Response of fish prey (see below)
	Risk of collision	Requires bird to fly across the rotor swept area	Only occurs in rotor swept area
	Barrier effect	Requires the bird to seek to fly across site of OWF	Only occurs on array area
Migratory fish	Temporary habitat disturbance	Within the project boundary	Maintenance activities may present potential temporary disturbance to benthos and therefore have an indirect impact on migratory fish through their prey species.
	Release of sediment into suspension/ smothering	16 km *	A temporary increase in suspended sediment concentrations and associated sediment deposition may arise during maintenance activities (e.g. cable works) or scour. Potential for direct effects (e.g. navigation) or indirect (via food sources). However, the potential for sediment disturbance will be much reduced when compared to the construction phase.
	Underwater noise	Localised to individual WTCs and vessels	Increased underwater noise resulting from operational WTCs and increased vessel activity required for operation and maintenance operations may result in disturbance of fish receptors. EMF emitted by export and array cables has the potential to lead to a behavioural response in fish. It should be noted that the noise and associated impacts within the operational phase will be substantially lower than construction in terms of magnitude.
	Accidental pollution	Within the project boundary	There is a risk of pollution being accidentally released from vessels and machinery used by the project, as well as from project infrastructure. Pollution can affect sediment and water quality with potential subsequent implications for migratory fish.

Receptor Type	Potential Effect	Potential Range of Effect	Justification
	Long-term physical loss of habitat	Within the project boundary	The footprint and/ or presence of structures will reduce the area of habitat for fish species and potential prey species.
	Introduction of hard substrate	Within the project boundary	Man-made structures placed on the seabed such as foundations and scour/cable protection will be colonised by a range of marine species, potentially including migratory fish or their prey. Structures may form the role of artificial fish but also facilitate the spread of non-native species.
	Changes to physical processes	Within the project boundary for waves and hydrodynamics. Up to 16 km for sediment pathways *	Man-made structures placed on the seabed such as foundations and scour/cable protection have the potential to bring about localised changes in hydrodynamics and wave regimes, with a potential effect on sediment transport pathways. This may have subsequent impacts on migratory fish receptors via their prey species.
Onshore ecology	Long-term habitat loss	Within the onshore substation footprint	The onshore substation will reduce the area of habitat available for qualifying mobile species, such as Annex I birds, that may utilise the habitat outside of Europeans sites.
	Intermittent temporary habitat loss	Within the project boundary	Operation and maintenance activities could lead to temporary habitat loss, damage, disturbance, fragmentation and / or severance that qualifying mobile species, such as Annex I birds or Annex II species could utilise outside of Europeans sites.
	Intermittent temporary disturbance to habitats and or species	Within the project boundary	Qualifying mobile species, such as Annex I birds e.g. wintering wader species feeding on inland fields at high tide, could potentially enter or cross the project boundary and be disturbed by the operation and maintenance activities.
	Accidental release of contaminants	Within project boundary	Qualifying mobile species, such as Annex I birds could potentially be affected by an accidental release of contaminants if they utilise areas within Hornsea Four outside of Europeans sites.
Decommissioning			
Subtidal and intertidal benthic ecology	The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.		
Marine Mammals	The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.		

Receptor Type	Potential Effect	Potential Range of Effect	Justification
Offshore and intertidal ornithology	The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.		
Migratory fish	The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.		
Onshore ecology	The impacts during the decommissioning phase are considered to be similar and likely less than those outlined in the construction phase.		

* Based on the evidence from Hornsea Project One, Project Two and Project Three which suggested suspended sediment dispersal of up to 2 mg/l is predicted to extend out to 16 km from the Hornsea Four array and offshore ECC (SmartWind, 2015).

‡ This is a precautionary value used during the Hornsea Three HRA Screening report. To remain precautionary and continue consistency across projects within the Hornsea Zone, this range has been used for Hornsea Four.

5 Determination of Likely Significant Effect (LSE)

5.1 Introduction

- 5.1.1.1 The initial screening documented in [section 4](#) generated a list of designated sites and relevant features for which, based purely on proximity, there is a need to consider the potential for LSE in relation to Hornsea Four. In addition, in [section 4.2](#), the likely effects that may result during construction, operation and maintenance and decommissioning of Hornsea Four (and are relevant to the receptors being considered here) are identified to enable these to be considered. This section combines that information for the project alone and presents the assessment of LSE, thus providing the necessary information for Stage 1 of the Habitats Regulations Assessment process. The assessment is provided separately in respect of the offshore and onshore components of Hornsea Four.
- 5.1.1.2 The assessment of LSE is based on Hornsea Four's current understanding of the baseline environment and the scope and nature of the proposed project activities, together with the relevant information available for the designated sites. Further environmental survey and assessment work, consultee and advisor responses to this document, and refinements to the project design may change this assessment. These changes will be reflected in the RIAA to be submitted with the DCO application for Hornsea Four.

5.2 Assessment of Likely Significant Effect (LSE)

5.2.1 Offshore and Intertidal

- 5.2.1.1 The assessment and conclusions with regards to LSEs on all offshore and intertidal designated sites and the relevant features identified has been carried out taking account of the ZOI of potential impacts, location of the European site under consideration and (where known) the distribution of qualifying features within the sites. The information is presented below in [Table 5.1](#), on a site by site basis.

Table 5.1 - Determination of LSE for offshore and intertidal

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Construction				
Southern North Sea cSAC/SCI	<ul style="list-style-type: none"> Harbour porpoise 	Increase in underwater noise	Hornsea Four is located within 0 km of the SAC. There is potential for a significant effect.	Potential for LSE
		Vessel disturbance	The presence of additional vessels within the SAC may result in disturbance of harbour porpoise. However, the relevant site selection assessment document found a negative relationship only where levels of traffic increased beyond a threshold of approximately 80 ships per day. It is not expected that Hornsea Four will exceed this level, and therefore the potential for effect is considered to be negligible. The conclusion will be revisited during PEIR for confirmation.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals). Further, the Advice on Activities for the site found that 'few collisions between harbour porpoise and vessels occur and is not a significant pressure for this species'. Therefore the potential for effect is considered to be negligible.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species and the short-term duration and temporary nature of any impact, and the conclusions of the Scoping report regarding fish and benthic ecology the potential effect is therefore considered to be negligible.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Harbour porpoise frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of harbour porpoise.	
Flamborough Head SAC	Annex I Habitats: <ul style="list-style-type: none"> • Reefs • Vegetated sea cliffs of the Atlantic and Baltic Coasts • Submerged or partially submerged sea caves 	Temporary habitat loss/ disturbance	Potential physical overlap with Annex I Habitat features: reefs. The remaining features are located around the immediate shoreline and therefore will not be subject to temporary habitat loss or disturbance by Hornsea Four.	Potential for LSE for: reefs No LSE for other designated Annex I Habitats
		Temporary increases in suspended sediments / smothering	Potential physical overlap with Annex I Habitat features: reefs. Although it is considered unlikely, until the cable corridor is finalised there is potential for some suspended sediment released during works along the cable corridor only to reach a submerged or partially submerged sea cave. The distance between the array boundary and the SAC is such that effects resulting from the array are screened out. The vegetated sea cliffs lie above the level at which any suspended sediment associated with Hornsea Four could reach and therefore will not be subject to a temporary increase in suspended sediment/smothering resulting from Hornsea Four.	Potential for LSE for: reefs Potential for LSE during cable corridor works only: submerged or partially submerged sea caves No LSE for other designated Annex I Habitats
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE for the following feature: reefs, submerged or partially submerged sea caves. No LSE for other designated Annex I Habitats

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Invasive non-native species	A number of measures and best practice approaches will be implemented during the construction phase to reduce the potential for release and spread of non-native, invasive species and to provide a process to deal with any should they occur. These will include measures to follow published guidelines and best working practice for the prevention of the release and spread of non-native, invasive species. Such measures are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE for the following feature: reefs, submerged or partially submerged sea caves. No LSE for other designated Annex I Habitats
Moray Firth SAC	<ul style="list-style-type: none"> Bottlenose dolphin 	Increase in underwater noise	The range applied to UK harbour porpoise for Screening of effect is 26 km. As noted in Table 4.5 , the same distance has been used for bottlenose dolphin. This site is located at a significant distance beyond 26 km from Hornsea Four array (471 km) and cable corridor (451 km) (Table 4.4) and therefore presenting no potential for effect on harbour porpoise at this site from underwater noise associated with Hornsea Four.	No LSE
		Vessel disturbance	The site is located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within the site.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals), and the minimum distance between Hornsea Four and the Moray Firth SAC is substantial (417 km to the cable corridor, 451 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the Moray Firth SAC.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology the potential effect is considered to be limited. Furthermore, the minimum distance of 451 km from site to the Hornsea Four boundary reinforces the very low risk of potential effect.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
The Wash and North Norfolk Coast SAC		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. Although it is acknowledged that these plans have yet to be drafted, given the distance involved (minimum of 451 km) LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Bottlenose dolphin frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of bottlenose dolphin. The range between the project and the SAC (at least 451 km) reinforces the conclusion.	No LSE
	• Harbour seal	Increase in underwater noise	Site within a distance of 120 km (Table 4.4) from the project. Therefore, there is the potential for some level of interaction between harbour seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Hornsea Four is located at least 88km from the SAC, and following the harbour seal at sea density maps within the Hornsea Three ES is not in an area of high usage by seals. This enables a conclusion that disturbance of seals attributed to the SAC is unlikely and not sufficient to result in LSE. The conclusion will be revisited during PEIR for confirmation.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). The Advice on Activities for the SAC identifies collision risk for harbour seal, however the text draws on the risk of corkscrew injuries which is considered to be outdated. The advice concludes that incidents of mortality or injury of harbour seals caused by vessels remain a very rare occurrence in UK waters. Overall therefore it is concluded that the potential for effect is negligible.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology the	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			potential effect is considered to be limited. Furthermore, the minimum distance of 88 km from site to the Hornsea Four boundary reinforces the low risk of potential effect.	
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Harbour seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of harbour seal.	No LSE
River Derwent SAC	Annex II Species: <ul style="list-style-type: none"> Sea lamprey River lamprey 	Temporary increases in suspended sediments/ smothering	The mouth of the Humber Estuary, which leads to the River Derwent, is located at least 26 km from the Hornsea Four offshore ECC. Due to the lower maximum range of effect for this impact (up to 16 km), it is considered that there is no potential for a significant effect to migratory fish moving into or out of the Humber Estuary and therefore migratory fish found within the River Derwent.	No LSE
		Increase in underwater noise	The distance between the mouth of the Humber Estuary, which leads to the River Derwent, and the array area is approximately 74 km. It is therefore unlikely there will be a significant impact from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary and therefore the migratory fish found within the River Derwent.	No LSE
		Temporary habitat loss/ disturbance	The SAC is located upstream from the Humber Estuary and therefore is remote from direct temporary habitat loss or disturbance.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is	Potential for LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	
Humber Estuary SAC	<ul style="list-style-type: none"> Grey seal 	Increase in underwater noise	Site within a distance of 145 km (Table 4.9) from the project. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Hornsea Four is located at least 26km from the SAC, and following the grey seal at sea density maps within the Hornsea Three ES is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out, however the issue will be revisited during PEIR.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). Further, the Advice on Activities for the Humber Estuary SAC found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. Overall therefore it is concluded that the potential for effect is negligible..	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of grey seal.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary increases in suspended sediments/ smothering	The site is located at least 26 km from Hornsea Four boundary which is outside the potential range of effect (16 km) for this particular impact. It is therefore considered that the potential for a significant effect to migratory fish is negligible.	No LSE
		Increase in underwater noise	The distance between the mouth of the Humber Estuary and the array is some 74 km. It is therefore unlikely there will be a significant effect from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary.	No LSE
		Temporary habitat loss/ disturbance	The SAC is a minimum 26 km from the cable corridor for Hornsea Four and therefore is remote from direct temporary habitat loss or disturbance.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
Humber Estuary Ramsar ²⁵	<ul style="list-style-type: none"> Grey seal 	Increase in underwater noise	This site is within a distance of 145 km (Table 4.9) from the project. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Hornsea Four is located at least 26km from the SAC, and following the grey seal at sea density maps within the Hornsea Three ES is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out, however the issue will be revisited during PEIR.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). Following the grey seal relevant Advice on Activities for the Humber Estuary SAC, it	No LSE

²⁵Note that Ramsar criteria 5 (assemblage of international importance) and Ramsar criterion 6 (species/populations occurring at levels of international importance) are addressed in Table 5.2

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			is clear that the risk from collision is low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. Overall therefore it is concluded that the potential for effect is negligible.	
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of grey seal.	No LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary increases in suspended sediments/ smothering	The site is located at least 26 km from Hornsea Four boundary which is outside the potential range of effect (16 km) for this particular impact. It is therefore considered that the potential for a significant effect to migratory fish is negligible.	No LSE
		Increase in underwater noise	The distance from the mouth of the Humber Estuary to the array is some 74km. It is therefore unlikely there will be a significant effect from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary.	No LSE
		Temporary habitat loss/ disturbance	The SAC is a minimum 26 km from the cable corridor for Hornsea Four and therefore is remote from direct temporary habitat loss or disturbance.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is	Potential for LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	
Transboundary harbour porpoise sites (49 sites)	<ul style="list-style-type: none"> Harbour porpoise 	Increase in underwater noise	The range applied to UK harbour porpoise sites for Screening of effect is 26 km. No transboundary site falls within that range for this species and therefore there is no potential for LSE.	No LSE
		Vessel disturbance	The sites are all located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible. Furthermore, the minimum distance of 78 km from site to the Hornsea Four boundary reinforces the low risk of potential effect.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Harbour porpoise frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of harbour porpoise.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Transboundary bottlenose dolphin sites (6 sites)	<ul style="list-style-type: none"> Bottlenose dolphin 	Increase in underwater noise	The range applied to UK harbour porpoise for Screening of effect is 26 km. Whilst this is likely to be over precautionary (see Table 4.5 , the same distance has been used for bottlenose dolphin. No transboundary site falls within that range for this species and therefore there is no potential for an interaction between harbour porpoise and underwater noise associated with Hornsea Four.	No LSE
		Vessel disturbance	The sites are located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (326 km to the cable corridor, 337 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible. Furthermore, the minimum distance of 326 km from site to the Hornsea Four boundary reinforces the low risk of potential effect.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Bottlenose dolphin frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of bottlenose dolphin.	No LSE

Hornsea 4



Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Transboundary harbour seal sites (2 sites)	<ul style="list-style-type: none"> Harbour seal 	Increase in underwater noise	All the designated sites fall within the foraging range (120 km) of harbour seal, with potential for a significant effect.	Potential for LSE
		Vessel disturbance	The harbour seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Hornsea Three considered that seals found in this area may originate from North Norfolk. At this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out, although this will be revisited for PEIR.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible. Furthermore, the minimum distance of 78 km from site to the Hornsea Four boundary reinforces the low risk of potential effect.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Harbour seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of harbour seal.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Transboundary grey seal sites (2 sites)	<ul style="list-style-type: none"> Grey seal 	Increase in underwater noise	All the designated sites fall within the foraging range (145 km) of grey seal, with potential for a significant effect.	Potential for LSE
		Vessel disturbance	The grey seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Hornsea Three considered that seals found in this area may originate from North Norfolk. At this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out, although this will be revisited for PEIR.	Potential for LSE
		Collision risk	Based on the relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, combined with an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals) and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array), it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology the potential effect is considered to be negligible. Furthermore, the minimum distance of 78 km from site to the Hornsea Four boundary reinforces the low risk of potential effect.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that there is little potential of a significant effect on the foraging ability of grey seal.	No LSE
Greater Wash SPA	<ul style="list-style-type: none"> Red-throated diver 	Direct disturbance and displacement	A sensitive species, construction close to / in SPA	Potential for LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Common scoter	Direct disturbance and displacement	A sensitive species, construction close to / in SPA	Potential for LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Little gull	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Sandwich tern	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Little tern	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Common tern	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
Flamborough Head & Bempton Cliffs SPA	• Kittiwake	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
Flamborough & Filey Coast pSPA	• Fulmar	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Gannet	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Shag	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Cormorant	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Herring gull	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Kittiwake	Direct disturbance and displacement	Not sensitive to construction activities.	No LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Guillemot	Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
	• Razorbill	Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> Puffin 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
Northumberland Marine SPA	<ul style="list-style-type: none"> Guillemot 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
	<ul style="list-style-type: none"> Puffin 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
Coquet Island SPA	<ul style="list-style-type: none"> Puffin 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
Farne Islands SPA	<ul style="list-style-type: none"> Kittiwake 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Not sensitive to construction activities	No LSE
	<ul style="list-style-type: none"> Guillemot 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE
	<ul style="list-style-type: none"> Puffin 	Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to construction activities.	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes in prey availability and behaviour	Experience of other OWFs is no LSE	No LSE

For the remaining 21 SPAs that have been screened in because they support seabirds as breeding interest features that might pass across Hornsea Four on migration or reside within or adjacent to Hornsea Four in the winter, a proportionate approach is to recognise that any process of attributing birds detected by survey within and around Hornsea Four to these 21 SPAs can only conclude that the proportion of birds from those sites will be insignificant and that LSE can be ruled out with confidence.

Operation and Maintenance

Southern North Sea cSAC/SCI	Harbour porpoise	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No significant negative effect has therefore been identified.	No LSE
		Vessel disturbance	The presence of additional vessels within the SAC may result in disturbance of harbour porpoise. However, the relevant site selection assessment document found a negative relationship only where levels of traffic increased beyond a threshold of approximately 80 ships per day. It is not expected that Hornsea Four will exceed this level, and therefore the potential for effect is considered to be negligible. The conclusion will be revisited during PEIR for confirmation.	No LSE
		Long-term physical loss of habitat	The cSAC/SCI extends 36,951 km ² . The long-term but not permanent habitat loss as a result of the projects infrastructure will be a fraction of this total area during the lifetime of Hornsea Four. Furthermore, the long term but not permanent loss of habitat is that of harbour porpoise prey, not the designated feature of the site itself.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals). Further, the Advice on Activities for the site found that 'few collisions between harbour porpoise and vessels occur and is not a significant pressure for this species'. Therefore the potential for effect is considered to be negligible.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of	Potential for LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Flamborough Head SAC	Annex I Habitats: <ul style="list-style-type: none"> • Reefs • Vegetated sea cliffs of the Atlantic and Baltic Coasts, • Submerged or partially submerged sea caves 		HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
		Temporary habitat disturbance	Potential physical overlap with Annex I Habitat features: reefs. The remaining features are located around the immediate shoreline and therefore will not be subject to temporary habitat disturbance by Hornsea Four.	Potential for LSE for: reefs No LSE for other designated Annex I Habitats
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction. Potential physical overlap with Annex I Habitat features: reefs. Although it is considered unlikely, until the cable corridor is finalised there is potential for some suspended sediment released during works along the cable corridor only to reach a submerged or partially submerged sea cave. The distance between the array boundary and the SAC is such that effects resulting from the array are screened out. The vegetated sea cliffs lie above the level at which any suspended sediment associated with Hornsea Four could reach and therefore will not be subject to a temporary increase in suspended sediment/smothering resulting from Hornsea Four.	Potential for LSE for: reefs Potential for LSE during cable corridor works only: submerged or partially submerged sea caves No LSE for other designated Annex I Habitats
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE for the following feature: reefs, submerged or partially

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
				submerged sea caves. No LSE for other designated Annex I Habitats
		Changes to physical processes	Potential for overlap between Annex I Habitats and Hornsea Four. It is likely that any changes to physical processes will be small scale and localised in nature, with any risk likely to be limited to Annex I reefs only. Further information on this impact will be available in the physical processes chapter of the PEIR.	Potential for LSE for the following Annex I Habitat features: reefs No LSE for remaining Annex I Habitats.
		Long-term physical loss of habitat	Due to the slight overlap of the offshore ECC with the SAC boundary, there is some potential for habitat loss during the projects lifetime, should cable protection be required within the SAC boundary. Such risk is expected to be managed through Annex I plans, however such plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE for the following Annex I Habitat feature: reefs. No LSE for remaining Annex I Habitats.
		Introduction of hard substrate	Potential for overlap between Annex I Habitats and project structures. There is potential for some positive effect and a subsequent increase in biodiversity. There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four.	No LSE
		EMF	Potential for overlap with some subtidal features.	Potential for LSE for the following Annex I Habitat features: reefs.

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
				No LSE for remaining Annex I Habitats.
Moray Firth SAC	<ul style="list-style-type: none"> Bottlenose dolphin 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	The site is located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within the site.	No LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the Moray Firth SAC (471 km to the cable corridor, 451 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the Moray Firth SAC.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the SAC and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
	<ul style="list-style-type: none"> Harbour seal 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
The Wash and North Norfolk Coast SAC			noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	
		Vessel disturbance	Hornsea Four is located at least 88km from the SAC, and following the harbour seal at sea density maps within the Hornsea Three ES is not in an area of high usage by seals. This enables a conclusion that disturbance of seals attributed to the SAC is unlikely and not sufficient to result in LSE. The conclusion will be revisited during PEIR for confirmation.	No LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). The Advice on Activities for the SAC identifies collision risk for harbour seal, however the text draws on the risk of corkscrew injuries which is considered to be outdated. The advice concludes that incidents of mortality or injury of harbour seals caused by vessels remain a very rare occurrence in UK waters. Overall therefore it is concluded that the potential for effect is negligible.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
River Derwent SAC	Annex II Species: • Sea lamprey • River lamprey	Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Introduction of hard substrate	Potential for overlap between Annex I Habitats and project structures. There is potential for some positive effect and a subsequent increase in biodiversity. There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four.	No LSE
		Changes to physical processes	Any change in physical processes are likely to be localised and certainly insufficient to reach the River Derwent.	No LSE
Humber Estuary SAC	<ul style="list-style-type: none"> Grey seal 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	Hornsea Four is located at least 26km from the SAC, and following the grey seal at sea density maps within the Hornsea Three ES is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out, however the issue will be revisited during PEIR.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). Further, the Advice on Activities for the Humber	No LSE

Hornsea 4



Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			Estuary SAC found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. Overall therefore it is concluded that the potential for effect is negligible..	
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Introduction of hard substrate	Potential for overlap between Annex I Habitats and project structures. There is potential for some positive effect and a subsequent increase in biodiversity. There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four.	No LSE

Hornsea 4



Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes to physical processes	Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.	No LSE
Humber Estuary Ramsar ²⁶	<ul style="list-style-type: none"> Grey seal 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	Hornsea Four is located at least 26km from the SAC, and following the grey seal at sea density maps within the Hornsea Three ES is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out, however the issue will be revisited during PEIR.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for effect on marine mammals). Following the grey seal relevant Advice on Activities for the Humber Estuary SAC, it is clear that the risk from collision is low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. Overall therefore it is concluded that the potential for effect is negligible.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE

²⁶ Note that Ramsar criteria 5 (assemblage of international importance) and Ramsar criterion 6 (species/populations occurring at levels of international importance) are addressed in [Table 5.2](#).

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
		Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that these plans have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Introduction of hard substrate	Potential for overlap between Annex I Habitats and project structures. There is potential for some positive effect and a subsequent increase in biodiversity. There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four.	No LSE
		Changes to physical processes	Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.	No LSE
Transboundary harbour porpoise sites (49 sites)	<ul style="list-style-type: none"> Harbour porpoise 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	The sites are all located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
Transboundary bottlenose dolphin sites (6 sites)	• Bottlenose dolphin	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	The sites are located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE
		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (326 km to the cable corridor, 337 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
Transboundary harbour seal sites (2 sites)	<ul style="list-style-type: none"> Harbour seal 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	The harbour seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Hornsea Three considered that seals found in this area may originate from North Norfolk. At this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out, although this will be revisited for PEIR.	Potential for LSE
		Long-term physical loss of habitat	The transboundary sites does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Overall, it is considered	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
Transboundary grey seal sites (2 sites)	<ul style="list-style-type: none"> Grey seal 	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified.	No LSE
		Vessel disturbance	The grey seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Hornsea Three considered that seals found in this area may originate from North Norfolk. At this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out, although this will be revisited for PEIR.	Potential for LSE
		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, it is anticipated that the application will be accompanied by an integral Vessel Management Plan (required regardless of the potential for impact on marine mammals), and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Overall, it is considered that there is little potential for increased vessel activity to result in a significant effect in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE
Greater Wash SPA	• Red-throated diver	Direct disturbance and displacement	A sensitive species, maintenance vessels may pass close to or through the SPA	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Common scoter	Direct disturbance and displacement	A sensitive species, maintenance vessels may pass close to or through the SPA	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in low numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Little gull	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Risk of collision	Present in low numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Sandwich tern	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in low or zero numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Little tern	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in low or zero numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Common tern	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in low or zero numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
Flamborough Head & Bempton Cliffs SPA	• Kittiwake	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Flamborough & Filey Coast pSPA		Risk of collision	Present in numbers and proportion fly at potential collision height (PCH)	Potential for LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Fulmar	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Gannet	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in numbers and proportion fly at PCH	Potential for LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Shag	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in low or zero numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Cormorant	Direct disturbance and displacement	Not sensitive to operation and maintenance activities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Risk of collision	Present in low or zero numbers	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Herring gull	Direct disturbance and displacement	Not sensitive to operation and maintenanceactivities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in numbers and proportion fly at PCH	Potential for LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Kittiwake	Direct disturbance and displacement	Not sensitive to operation and maintenanceactivities.	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in numbers and proportion fly at PCH	Potential for LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Guillemot	Direct disturbance and displacement	Moderate sensitivity to operation and maintenanceactivities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Razorbill	Direct disturbance and displacement	Moderate sensitivity to operation and maintenanceactivities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> Puffin 	Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Moderate sensitivity to operation and maintenance activities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
Northumberland Marine SPA	<ul style="list-style-type: none"> Guillemot 	Direct disturbance and displacement	Moderate sensitivity to operation and maintenance activities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	<ul style="list-style-type: none"> Puffin 	Direct disturbance and displacement	Moderate sensitivity to operation and maintenance activities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
Coquet Island SPA	<ul style="list-style-type: none"> Puffin 	Direct disturbance and displacement	Moderate sensitivity to operation and maintenance activities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Farne Islands SPA	• Kittiwake	Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
		Direct disturbance and displacement	Not sensitive to operation and maintenanceactivities	No LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	Present in numbers and proportion fly at PCH	Potential for LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Guillemot	Direct disturbance and displacement	Moderate sensitivity to operation and maintenanceactivities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE
	• Puffin	Direct disturbance and displacement	Moderate sensitivity to operation and maintenanceactivities.	Potential for LSE
		Indirect impacts through effects on habitats and prey species	Experience of other OWFs is no LSE	No LSE
		Risk of collision	A species that flies low to the water	No LSE
		Barrier effect	Experience of other OWFs is no LSE	No LSE

For the remaining 21 SPAs that have been screened in because they support seabirds as breeding interest features that might pass across Hornsea Four on migration or reside within or adjacent to Hornsea Four in the winter, a proportionate approach is to recognise that any process of attributing birds detected by survey within and around Hornsea Four to these 21 SPAs can only conclude that the proportion of birds from those sites will be insignificant and that LSE can be ruled out with confidence.

Decommissioning

The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Hornsea 4

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5.2.3 Onshore

5.2.3.1 The assessment and conclusions with regards to LSEs on all onshore designated sites and the relevant features identified has been carried out taking account of the ZOI of potential impacts, location of the European site under consideration and (where known) the distribution of qualifying features within the sites. It should be noted that the onshore scoping boundary does not overlap with any European or Ramsar site or their impact risk zone²⁷ for this type of infrastructure development. The information is presented below in [Table 5.2](#), on a site by site basis.

Table 5.2 - Determination of LSE onshore

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Construction				
Humber Estuary SPA	<ul style="list-style-type: none"> • Avocet • Hen harrier • Golden plover • Black-tailed godwit 	Temporary habitat loss	The site does not physically overlap with Hornsea Four and therefore does not result in loss of habitat, disturbance, damage or fragmentation.	No LSE
	<ul style="list-style-type: none"> • Bar-tailed godwit 	Temporary disturbance / damage to habitats		No LSE
	<ul style="list-style-type: none"> • Ruff • Marsh harrier • Shelduck • Dunlin • Redshank • Red knot 	Habitat fragmentation or severance		No LSE
		Visual and / or noise disturbance to species	Although it is possible that the species screened in may use habitat within the Hornsea Four ZOI, given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the SPA site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.	No LSE

²⁷ The Impact Risk Zones (IRZs) are a GIS tool developed by Natural England to make a rapid initial assessment of the potential risks posed by development proposals to: Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites. They define zones around each site which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts.

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Invasive non-native species	<p>The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Estuary SPA site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the SPA site.</p> <p>It is anticipated that a number of relevant plans will be agreed with relevant the authorities and submitted with the application or during examination to address the risk of accidental pollution and the introduction of invasive non-native species (e.g. a CoCP and EMMP). Such plans are considered an integral part of the project, and would be required regardless of HRA matters.</p> <p>It is acknowledged that these plans have yet to be drafted. However, taking into account the nature of the onshore components of Hornsea Four and distance to the SPA, it is still reasonable to conclude there will be no likely significant effects.</p>	No LSE
		Accidental release of contaminants		No LSE
Humber Estuary Ramsar ²⁸	<ul style="list-style-type: none"> Golden plover Dunlin Black-tailed godwit Bar-tailed godwit Redshank 	Temporary habitat loss	The site does not physically overlap with Hornsea Four and therefore does not result in loss of habitat, disturbance, damage or fragmentation.	No LSE
		Temporary disturbance / damage to habitats		No LSE
		Habitat fragmentation or severance		No LSE

²⁸ Note that Ramsar Criterion 3 (grey seal) and Ramsar Criterion 8 (migratory fish) are addressed in [Table 5.1](#) above.

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Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> Shelduck Red knot 	Visual and / or noise disturbance to species	Although it is possible that the species screened in may use habitat within the Hornsea Four ZOI, given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the Ramsar site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.	No LSE
		Invasive non-native species	The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Ramsar site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the Ramsar site.	No LSE
		Accidental release of contaminants	<p>However, Hornsea Four will include preventative and contingency mitigation. It is anticipated that a number of relevant plans will be agreed with the authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP and EMMP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. These plans will also address the risk of introduction of invasive non-native species.</p> <p>It is acknowledged that these plans have yet to be drafted. However, taking into account the nature of the onshore components of Hornsea Four and distance to the SPA, it is reasonable to conclude there will be no likely significant effects.</p>	No LSE

Operation and Maintenance

The likely significant impacts during the operation and maintenance phase are considered similar but less than those outlined in the construction phase due to their smaller extent and shorter duration e.g. repairing a short section of cable.

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Decommissioning				
The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.				

6 Approach to the In-combination Assessment

- 6.1.1.1 Planning Inspectorate (PINS) Advice Note Ten: Habitats Regulations Assessment (Version 8, November 2017) indicates that an appraisal of the effects of any other plans or projects which, in-combination with the proposed development, might be likely to have a significant effect on the European site(s). The scope of this appraisal should be clearly agreed with the local authorities and SNCBs.
- 6.1.1.2 PINS Advice Note Seventeen: Cumulative Effects Assessment Relevant to Nationally Significant Infrastructure Projects (NSIPs) (Version 1, December 2015) provides guidance on the categories of projects that are relevant for consideration in cumulative assessments and suggests the use of tiers to distinguish different degrees of certainty in the information publicly available to inform assessments, with Tier 1 being the most certain. Such an approach is also consistent with the Renewable UK CIA Guidelines, specifically Guiding Principle 4 and Guiding Principle 7 (Renewable UK, 2013). A tiered approach assists the decision maker in placing relative weight upon the potential for each project/plan assessed cumulatively to ultimately be realised, based upon the project/plan's current stage of maturity.
- 6.1.1.3 In the context of the Project the tiered approach for the majority of receptors would use the following categories:
- Tier 1: Hornsea Four considered alongside other projects/plans currently under construction and/or (where relevant) those consented and that hold a Contract for Difference (CfD) and (where relevant) have undergone financial investment decision (FID) but are not yet implemented, and/or those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an ongoing impact;
 - Tier 2: Hornsea Four considered alongside other projects/plans which have been consented but do not currently hold CfD;
 - Tier 3: Hornsea Four considered alongside projects/plans currently progressing through examination on the PINS Programme of Projects but have not yet achieved consent; and
 - Tier 4: Hornsea Four considered alongside projects/plans which appear on the PINS Programme of Projects but where the application has not yet been submitted for examination.
- 6.1.1.4 In the Hornsea Three Report to Inform Appropriate Assessment (DONG Energy Power (UK) Ltd., 2016) a three main tier with sub-division approach was used. That tiered approach was structured as follows, noting that it has a total of seven divisions:

Tier 1	>	Operational projects (both those that were not operational when baseline data was collected and those that have an on-going impact).
	>	Projects currently under construction.
	>	Projects not yet implemented that have a legally secure consent (i.e. not subject to an ongoing judicial review process) and that have been awarded a CFD.
Tier 2	>	Projects not yet implemented that have a legally secure consent (i.e. not subject to an ongoing judicial review process) but have no CFD.
	>	Projects with a non-legally secure consent (i.e. projects that are subject to an ongoing judicial review process);
	>	Projects that have submitted an application for consent but not have yet been determined.
Tier 3	>	Projects where the developer has advised PINS in writing that they intend to submit an application in the future, those projects where a Scoping Report is available and those projects which have published a PEIR.

6.1.1.5 This three tier approach, with a total of seven sub-divisions, which was used in the Hornsea Three Report to Inform Appropriate Assessment, will be used for the in-combination assessment of offshore ornithology receptors for Hornsea Four.

6.1.1.6 The search for plans and projects will be informed through the cumulative process to be followed by the ES. The type of plans and projects to be considered will include the following:

- aggregate dredging and marine disposal areas;
- offshore energy;
- commercial fisheries;
- oil and gas;
- cables and pipelines;
- shipping;
- military, aviation and radar;
- relevant works in the Humber Estuary (in relation to migratory fish); and
- coastal.

6.1.1.7 Offshore, and from previous experience, it is anticipated that the most likely relevant plans and projects will include other offshore wind farm developments and, for marine mammals, other activities resulting in underwater noise.

6.1.1.8 Onshore, it is likely that the plans and projects identified will be more geographically focused in the vicinity of Hornsea Four, with relevant projects typically including other construction works.

7 Summary of Likely Significant Effect (LSE)

- 7.1.1.1 A summary of the European sites, features and potential impacts for which a potential for a LSE has been identified as a result of Hornsea Four alone and/or in combination with other plans or projects (recognising that there will be further discussion with local authorities and SNCBs to identify other potential in-combination effects), is given in [Table 7.1](#) (offshore and intertidal). No potential for LSE has been identified for onshore sites (and relevant features). The table is adapted from [Table 5.1](#) and excludes all features screened out and excludes all those effects for which no LSE has been identified.

Table 7.1 - European sites and features for which Potential LSEs have been identified (offshore and intertidal)

Site	Feature	Project Phase	Effect
Southern North Sea cSAC/SCI	Harbour porpoise	Construction	Increase in underwater noise
Southern North Sea cSAC/SCI	Harbour porpoise	Construction	Accidental pollution
Southern North Sea cSAC/SCI	Harbour porpoise	Operation and Maintenance	Accidental pollution
Flamborough Head SAC	Reefs	Construction	Temporary habitat loss/ disturbance
Flamborough Head SAC	Reefs (array and cable corridor) Submerged and partially submerged caves (cable corridor only)	Construction	Temporary increases in suspended sediments / smothering
Flamborough Head SAC	Reefs Submerged and partially submerged caves	Construction	Accidental pollution
Flamborough Head SAC	Reefs Submerged and partially submerged caves	Construction	Invasive non-native species
Flamborough Head SAC	Reefs	Operation and Maintenance	Temporary habitat loss
Flamborough Head SAC	Reefs (array and cable corridor) Submerged and partially submerged caves (cable corridor only)	Operation and Maintenance	Temporary increases in suspended sediments / smothering
Flamborough Head SAC	Reefs Submerged and partially submerged caves	Operation and Maintenance	Accidental pollution
Flamborough Head SAC	Reefs	Operation and Maintenance	Changes to physical processes
Flamborough Head SAC	Reefs	Operation and Maintenance	Long-term physical loss of habitat
Flamborough Head SAC	Reefs	Operation and Maintenance	EMF
The Wash and North Norfolk Coast SAC	Harbour seal	Construction	Increase in underwater noise

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Site	Feature	Project Phase	Effect
The Wash and North Norfolk Coast SAC	Harbour seal	Construction	Accidental pollution
The Wash and North Norfolk Coast SAC	Harbour seal	Operation and Maintenance	Accidental pollution
River Derwent SAC	Sea lamprey River lamprey	Construction	Accidental pollution
River Derwent SAC	Sea lamprey River lamprey	Operation and Maintenance	Accidental pollution
Humber Estuary SAC	Grey seal	Construction	Increase in underwater noise
Humber Estuary SAC	Grey seal	Construction	Vessel disturbance
Humber Estuary SAC	Grey seal	Construction	Accidental pollution
Humber Estuary SAC	Grey seal	Operation and Maintenance	Vessel disturbance
Humber Estuary SAC	Grey seal	Operation and Maintenance	Accidental pollution
Humber Estuary SAC	River lamprey Sea lamprey	Construction	Accidental pollution
Humber Estuary SAC	River lamprey Sea lamprey	Operation and Maintenance	Accidental pollution
Humber Estuary Ramsar	Grey seal	Construction	Increase in underwater noise
Humber Estuary Ramsar	Grey seal	Construction	Vessel disturbance
Humber Estuary Ramsar	Grey seal	Construction	Accidental pollution
Humber Estuary Ramsar	Grey seal	Operation and Maintenance	Vessel disturbance
Humber Estuary Ramsar	Grey seal	Operation and Maintenance	Accidental pollution
Humber Estuary Ramsar	River lamprey Sea lamprey	Construction	Accidental pollution
Humber Estuary Ramsar	River lamprey Sea lamprey	Operation and Maintenance	Accidental pollution
Transboundary harbour seal sites (2 sites)	Harbour seal	Construction	Increase in underwater noise
Transboundary harbour seal sites (2 sites)	Harbour seal	Construction	Vessel disturbance
Transboundary harbour seal sites (2 sites)	Harbour seal	Operation and Maintenance	Vessel disturbance
Transboundary grey seal sites (2 sites)	Grey seal	Construction	Increase in underwater noise

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Site	Feature	Project Phase	Effect
Transboundary grey seal sites (2 sites)	Grey seal	Construction	Vessel disturbance
Transboundary grey seal sites (2 sites)	Grey seal	Operation and Maintenance	Vessel disturbance
Greater Wash SPA	Red-throated diver	Construction	Disturbance and displacement
Greater Wash SPA	Red-throated diver	Operation and maintenance	Disturbance and displacement
Greater Wash SPA	Common scoter	Construction	Disturbance and displacement
Greater Wash SPA	Common scoter	Operation and maintenance	Disturbance and displacement
Flamborough Head and Bempton Cliffs SPA	Kittiwake	Operation and maintenance	Risk of collision
Flamborough and Filey Coast pSPA	Gannet	Operation and maintenance	Risk of collision
Flamborough and Filey Coast pSPA	Herring gull	Operation and maintenance	Risk of collision
Flamborough and Filey Coast pSPA	Kittiwake	Operation and maintenance	Risk of collision
Flamborough and Filey Coast pSPA	Guillemot	Construction	Disturbance and displacement
Flamborough and Filey Coast pSPA	Guillemot	Operation and maintenance	Disturbance and displacement
Flamborough and Filey Coast pSPA	Razorbill	Construction	Disturbance and displacement
Flamborough and Filey Coast pSPA	Razorbill	Operation and maintenance	Disturbance and displacement
Flamborough and Filey Coast pSPA	Puffin	Construction	Disturbance and displacement
Flamborough and Filey Coast pSPA	Puffin	Operation and maintenance	Disturbance and displacement
Northumberland Marine SPA	Guillemot	Construction	Disturbance and displacement
Northumberland Marine SPA	Guillemot	Operation and maintenance	Disturbance and displacement
Northumberland Marine SPA	Puffin	Construction	Disturbance and displacement
Northumberland Marine SPA	Puffin	Operation and maintenance	Disturbance and displacement
Coquet Island SPA	Puffin	Construction	Disturbance and displacement
Coquet Island SPA	Puffin	Operation and maintenance	Disturbance and displacement
Farne Islands SPA	Guillemot	Construction	Disturbance and displacement
Farne Islands SPA	Guillemot	Operation and maintenance	Disturbance and displacement
Farne Islands SPA	Puffin	Construction	Disturbance and displacement
Farne Islands SPA	Puffin	Operation and maintenance	Disturbance and displacement

8 HRA Screening Questions for Consultees

- Do you agree that the data sources identified are sufficient to inform the screening process for offshore and intertidal ornithological sites and interest features for the Hornsea Four HRA Screening Report?
- Do you agree with the seabird data collection method i.e. 24 months of aerial survey of the Hornsea Four array area plus a 4 km buffer?
- Do you agree that all potential impacts resulting from Hornsea Four been identified for offshore and intertidal ornithological sites and interest features?
- Do you agree with the proposed screening assessment criteria, listed in [Table 4.1](#)?
- Do you agree that those seabird species primarily identified as occurring in greatest numbers in the recent aerial surveys of the Hornsea Four array area and linked with nearby breeding colonies (SPA & pSPA) and that may be potentially impacted by the construction and operation of the WTC array should form the focus of the offshore ornithological screening process: Fulmar, gannet, great black-backed gull, herring gull, kittiwake, puffin, razorbill and guillemot?
- Do you agree with the list of sites, features and effects screened in and screened out that are listed in [Table 5.1](#)?
- Do you agree with the approach to in-combination assessment described in [section 6](#)?

9 References

- Allen, J., Boyes, S., Burdon, D., Cutts, N., Hawthorne, E., Hemingway, K., Jarvis, S., Jennings, K., Mander, L., Murby, P., Procter, N., Thomson, S. and Waters, R. (2003). *The Humber Estuary: A comprehensive review of its nature conservation interest*. English Nature Research Report 547. English Nature, Peterborough.
- Béiro, D. and Goodall, A. (2007). *A desk study on the use of North Lincolnshire's terrestrial habitat by three species of wader: European Golden Plover, Northern Lapwing and Eurasian Curlew*. Report for Natural England. Graham Cartwright Associates. Grimsby.
- CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.
- Cutts, N., Hemingway, K. and Thomson, S. (2015). *Humber Estuary High Tide Roost Review 2013-2014*. Report to RSPB and Natural England. Institute of Estuarine and Coastal Studies, University of Hull.
- DONG Energy Power (UK) Ltd. (2016). *Hornsea Three Offshore Wind Farm Habitat Regulations Assessment: Screening Report*. DONG Energy Power (UK) Ltd., London.
- DONG Energy Power (UK) Ltd. (2018). *Hornsea Three Offshore Wind Farm Habitat Regulations Assessment: Report to inform Appropriate Assessment*. DONG Energy Power (UK) Ltd., London.
- Heinänen, S. & Skov, H (2015). The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, JNCC Report No.544 JNCC, Peterborough.
- HiDef Aerial Surveying Ltd (2018). *Digital video aerial surveys of seabirds and marine mammals at Hornsea Project Four (HOW04): final report for April 2016 to March 2018*. HiDef Aerial Surveying Ltd, Cleator Moor, Cumbria.
- IAMMWG. 2015. Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough.
- Joint Nature Conservation Committee (2010) Handbook for Phase 1 Habitat Survey - A Technique for Environmental Audit, Joint Nature Conservation Committee (JNCC), Peterborough
- JNCC (2016), Harbour Porpoise (*Phocoena phocoena*) possible Special Area of Conservation: Southern North Sea [online], Available: <http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf>
- Mander, L., Cutts, N. and Thomson, S. (2006). *Review of High Tide Waterfowl Roosting and Foraging Sites on the Humber Estuary*. IECS Report to Natural England.
- McSorley, C.A., Dean, B.J., Webb, A. and Reid, J.B. (2003). *Seabird use of waters adjacent to colonies: implications for seaward extensions to existing breeding seabird colony Special Protection Areas*. JNCC Report, No. 329. JNCC, Aberdeen.
- Ørsted (2018). Evidence Plan Terms of Reference.

Paxton, C.G.M., Scott-Hayward, L. Mackenzie, M. Rexstad. E. & Thomas L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resource JNCC Report No.517

Renewables UK (2013). Cumulative Impact Assessment Guidelines. Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms.

Russell, D. J. F., Jones, E. L. and Morris, C. D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25. pp. 25. DOI: 10.7489/2027-1.

Sea Mammal Research Unit (SMRU) (2011). Summary of seal count and telemetry data from the Humber area. Report to SMart Wind.

SmartWind (2015). Hornsea Three Offshore Wind Farm Environmental Statement: Volume 2, Chapter 1 – Marine Process. PINS Document Reference: A6.2.1.

SNCBs (2017). Joint SNCB Interim Displacement Advice Note. Available online at: http://jncc.defra.gov.uk/pdf/Joint_SNCB_Interim_Displacement_AdviceNote_2017.pdf

Thaxter, C. B., Lascelles, B., Sugar, K., Cook A., Roos, S., Bolton, M., Langston, R. and Burton, N. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61.

Thompson, P.M., McConnell, B.J., Tollit, D.J., MacKay, A., Hunters, C. Racey, P.A., (1996). Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, N.E. Scotland. Journal of Applied Ecology, 33, pp. 1572-1584.

10 Appendix A

Agger Tange, Nissum Bredning, Skibsted Fjord og Agerø SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00EY133
Anse de Vauville SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502019
Baie de Canche et couloir des trois estuaires SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR3102005
Baie de Seine occidentale SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502020
Baie de Seine orientale SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502021
Banc et récifs de Surtainville SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2502018
Bancs des Flandres SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR3102002
Borkum-Riffgrund SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE2104301
Doggerbank (Germany) SCI	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE1003301
Doggersbank (Dutch) SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL2008001
Dråby Vig SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00EX026
Estuaire de la Seine SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2300121
Estuaires et littoral picards (baies de Somme et d'Authie) SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2200346
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR3100478
Flamborough Head SAC	https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0013036&SiteName=flamborough&countyCode=&responsiblePerson=&SeaArea=&IFCAAarea=
Gule Rev SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA259
Hamburgisches Wattenmeer SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE2016301
Helgoland mit Helgoländer Felssockel SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE1813391
Humber Estuary SAC	http://publications.naturalengland.org.uk/publication/5009545743040512
Humber Estuary SPA	http://publications.naturalengland.org.uk/file/4968674834251776
Humber Estuary Ramsar	http://jncc.defra.gov.uk/pdf/RIS/UK11031.pdf
Jyske Rev, Lillefiskerbanke SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA257
Klaverbank SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL2008002

Kosterfjorden-Väderöfjorden SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0520170
Løgstør Bredning, Vejlerne og Bulbjerg SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00EY124
Lønstrup Rødgrund SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA301
Moray Firth SAC	http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8327
Nationalpark Niedersächsisches Wattenmeer SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE2306301
Noordzeekustzone SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL9802001
NTP S-H Wattenmeer und angrenzende Küstengebiete SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE0916391
Oosterschelde SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL3009016
Récifs et landes de la Hague SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2500084
Récifs et marais arrière-littoraux du Cap Lévi à la Pointe de Saire SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR2500085
Récifs Gris-Nez Blanc-Nez SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR3102003
Ridens et dunes hydrauliques du détroit du Pas-de-Calais SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=FR3102004
River Derwent SAC	http://publications.naturalengland.org.uk/publication/4824082210095104
Sandbanker ud for Thorsminde SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA341
SBZ 1 / ZPS 1 SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BE MNZ0002
SBZ 2 / ZPS 2 SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BE MNZ0003
SBZ 3 / ZPS 3 SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BE MNZ0004
Skagens Gren og Skagerak SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00FX112
SPA Östliche Deutsche Bucht SPA	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE1011401
Steingrund SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE1714391
Store Rev SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA258
Sydlig Nordsø SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA347
Sylter Außenriff SCI	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DE1209301

The Wash and North Norfolk Coast SAC	https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0017075&SiteName=the%20wash&countyCode=&responsiblePerson=&SeaArea=&IFCAAarea=
Thyborøn Stenvolde pSCI	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00VA348
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00AY176
Venø, Venø Sund SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=DK00CY040
Vlakte van de Raan SCI	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BE MNZ0005
Vlaamse Banken SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BE MNZ0001
Voordelta SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL4000017
Waddenzee SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL1000001
Westerschelde and Saeflunghe SAC	http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL9803061
Southern North Sea cSAC/SCI	http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0030395

Appendix B – Revised Screening Based on Natural England’s Advice

Hornsea 4

Ørsted



Habitats Regulations Assessment Screening Revisited May 2019

Prepared	Sally Kazer, GoBe Consultants. 23 May 2019
Checked	Lauren Kirkland, GoBe Consultants. 24 May 2019
Accepted	David King, Ørsted. 28 May 2019
Approved	David King, Ørsted. 28 May 2019

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Acronyms

Acronym	Definition
CoCP	Code of Construction Practice
cSAC	candidate Special Area of Conservation
DCO	Development Consent Order
ECC	Export Cable Corridor
EMF	Electromagnetic Field
EMMP	Environmental Management and Monitoring Plan
HRA	Habitats Regulations Assessment
IRZ	Impact Risk Zone
LSE	Likely Significant Effect
PEIR	Preliminary Environmental Information Report
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SCI	Site of Community Importance
SPA	Special Protection Area
WTG	Wind Turbine Generator
ZOI	Zone of Influence

1 Introduction

1.1 Project background

- 1.1.1.1 Ørsted Hornsea Project Four (UK) Ltd., (hereafter Hornsea Four) is proposing to develop the Hornsea Project Four offshore wind farm(hereafter Hornsea Four). Hornsea Four is located approximately 65 km offshore from coastline of the East Riding of Yorkshire in the Southern North Sea with the array area covering an area of approximately 600 km² and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network.

1.2 Purpose of this document

- 1.2.1.1 Habitats Regulations Assessment (HRA) Screening was conducted in 2018 for Hornsea Four. The Screening Report was issued in October 2018 to consultees, with responses received. Those responses will be used to inform the subsequent Report to Inform Appropriate Assessment (RIAA), which will include an update to Screening – to ensure any relevant changes in the interim (e.g. following consultation, changes to designated sites, case law or resulting from project changes) are fully included within the RIAA.
- 1.2.1.2 The purpose of the current document is to provide an interim update to Screening for Natural England, in response to the comments received on the Screening Report (received 1st May 2019). Following receipt of those comments, a meeting was held via telephone on 16th May 2019 between Natural England, Hornsea Four, GoBe, RHDHV and APEM to discuss the screening process (draft meeting minutes provided alongside this document). The conclusion reached at that meeting was that the screening tables 5.1 (offshore) and 5.2 (onshore) contained within the Screening Report would be revisited and issued to Natural England for comment, with the aim of agreeing on the sites, features and effects screened in for assessment within the RIAA.
- 1.2.1.3 To date, screening has been revisited for benthic ecology, marine mammals, migratory fish and onshore ecology, with information on offshore and intertidal ornithology to follow on week commencing 10th June 2019, to tie in with availability of relevant Natural England staff.
- 1.2.1.4 The Screening Report is not, therefore, repeated in full here, however it is important to note that since the publishing of the Screening Report, the boundary of the Export Cable Corridor (ECC) has been refined. Hornsea Four can confirm that the boundary to be provided within the RIAA and Preliminary Environmental Information Report (PEIR) will not have any overlap with any Natura 2000 sites (with the exception of the Southern North Sea SAC).

2 Overview of Topic-Specific Screening

2.1 Benthic Ecology

- 2.1.1.1 Screening for benthic ecology sites/features applied an initial broad scale screening (as presented in Table 4.9 of the Screening Report), subsequently focused in Table 5.1 of the Screening Report to take account of effects during construction, operation & maintenance and decommissioning (including the presence/absence of a pathway).
- 2.1.1.2 The revision to screening relates to the adjustment of the offshore ECC, which now fully avoids all sites with benthic habitat as a feature and therefore removes any pathway for potential disturbance/loss of such habitat listed as a feature, or for electromagnetic field (EMF) impacts to occur within the site.

2.2 Marine Mammals

- 2.2.1.1 Screening for marine mammal sites/features applied an initial broad scale screening (as presented in Table 4.9 of the Screening Report) subsequently focused in Table 5.1 of the Screening Report to take account of effects during construction, operation & maintenance and decommissioning (including the presence/absence of a pathway).
- 2.2.1.2 Updates to the screening presented in Table 5.1 are based on the following:
- A request by Natural England to consider sites for bottlenose dolphin;
 - The draft Marine Mammal Technical Report that will be submitted as part of the PEIR; and
 - Clarification on potential effects.
- 2.2.1.3 The updates outlined above have resulted in changes to the marine mammal sites screening in, with the additional sites being screened in for grey seals (UK and transboundary), together with clarifications provided on the consideration of Likely Significant Effect (LSE).

2.3 Offshore and Intertidal Ornithology

- 2.3.1.1 Screening for offshore and intertidal ornithology sites/features applied an initial broad scale screening (as presented in Table 4.9 of the Screening Report) subsequently focused in Table 5.1 of the Screening Report to take account of effects during construction, operation & maintenance and decommissioning (including the presence/absence of a pathway).
- 2.3.1.2 Updates to the screening presented in Table 5.1 of the Screening Report will be based on the following (and supplied in the week commencing 10th June 2019):
- A request by Natural England to consider revised screening ranges;
 - A request by Natural England to revisit screening of Farne and Coquet Islands Special Protection Areas (SPAs); and
 - A request by Natural England to confirm screening for migratory birds (Humber and Hornsea Mere).

2.4 Onshore Ecology

2.4.1.1 Screening for onshore ecology sites/features applied an initial broad scale screening (as presented in Table 4.9 of the Screening Report) subsequently focused in Table 5.2 of the Screening Report to take account of effects during construction, operation & maintenance and decommissioning (including the presence/absence of a pathway). The result was no onshore ecology sites/features being screened in for LSE.

2.4.1.2 Updates to the screening presented in Table 5.2 are based on the following:

- A request by Natural England to confirm onshore screening by checking Impact Risk Zones (IRZs).

2.4.1.3 It can be confirmed that based on IRZs, no sites and/or features have been screened in and therefore all onshore ecology sites and features remain screened out from assessment. Table 5.2 of the Screening Report is repeated here as [Table 2](#) for ease of reference.

2.5 Migratory Fish

2.5.1.1 Screening for migratory fish sites/features applied an initial broad scale screening (as presented in Table 4.9 of the Screening Report) subsequently focused in Table 5.1 of the Screening Report to take account of effects during construction, operation & maintenance and decommissioning (including the presence/absence of a pathway).

2.5.1.2 No updates to screening for migratory fish have been identified (with the original screening included here for ease of reference). However, it is relevant to highlight that following the revised ECC that will be presented at PEIR, the landfall of the cable corridor is now further away from the Humber Estuary than considered within the Screening Report. Specifically, the offshore ECC will now be at least 32 km distant from the boundary of the Humber Estuary Special Area of Conservation (SAC), compared to the 26 km that applied at the time the Screening Report was drafted. The change effectively further reduces the potential for a pathway of effect to link activity at Hornsea Four to the migratory fish that utilise the Humber Estuary (including the Humber Estuary SAC and its tributary, the River Derwent SAC).

3 Offshore Screening

- 3.1.1.1 As noted above, the initial coarse screening generated a list of designated sites and relevant features for which, based purely on proximity, there is a need to consider the potential for LSE in relation to Hornsea Four. **Table 1** below (an update to Table 5.1 of the Screening Report) progresses that information, together with the potential identified effects, to determine where a pathway for effect exists and therefore where potential for LSE applies.
- 3.1.1.2 As within the Screening Report, the assessment of LSE is based on Hornsea Four's current understanding of the baseline environment and the scope and nature of the proposed project activities, together with the relevant information available for the designated sites. Further environmental survey and assessment work, consultee and advisor responses to this document, and refinements to the project design may change this assessment. These changes will be reflected in the RIAA to be submitted with the Development Consent Order (DCO) application for Hornsea Four.
- 3.1.1.3 It is proposed that the updated tables are included within the RIAA, with further additions/amendments as relevant, for completeness and clarity. Where new sites have been screened in, or the previous conclusion on LSE changed, these are highlighted in red. It should be noted that for consideration of in-combination effect, consideration will be given to all potential effects (and not just those screened in for the project alone).

Table 1 - Update to Table 5.1 from the Screening Report - Determination of LSE for offshore and intertidal¹

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Construction				
Southern North Sea Candidate SAC (cSAC)/ Site of Community Importance (SCI)	<ul style="list-style-type: none"> Harbour porpoise 	Increase in underwater noise	Hornsea Four is located within 0 km of the SAC. There is potential for a significant effect.	Potential for LSE
		Vessel disturbance	<p>The presence of additional vessels within the SAC may result in disturbance of harbour porpoise. However, the relevant site selection assessment document found a negative relationship only where levels of traffic increased beyond a threshold of approximately 80 ships per day. It is not expected that Hornsea Four will exceed this level; and therefore no LSE applies.</p> <p>Note – once the marine mammal and navigation assessments have been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Collision risk	<p>There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. The recently re-issued 'Advice on Activities' finds that the risk of death or injury collision to be 'not currently considered a significant risk and no additional management is likely to be required'². Therefore no LSE has been identified.</p> <p>Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Changes in prey availability and behaviour	<p>Given the large foraging range of this species and the short-term duration and temporary nature of any impact, and the conclusions of the Scoping report regarding fish and benthic ecology the potential effect is considered to be negligible, with no LSE identified.</p> <p>Note – once the marine mammal, fish ecology and benthic assessments have been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution	Potential for LSE

¹ Additional sites are highlighted in red text, with any change in the potential for LSE similarly marked in red text

² http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			(e.g. a Code of Construction Practice (CoCP)); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	
		Temporary increases in suspended sediments/ smothering	Harbour porpoise frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
Flamborough Head SAC ³	Annex I Habitats: <ul style="list-style-type: none"> • Reefs • Vegetated sea cliffs of the Atlantic and Baltic Coasts • Submerged or partially submerged sea caves 	Temporary habitat loss/ disturbance	The Screening Report included physical overlap between the cable corridor and the SAC boundary and therefore screened the feature 'reefs' in for this effect. The change in the offshore ECC, to avoid overlap with the SAC, means that the screening conclusion can be updated to be no LSE for all features as no works will occur within the SAC boundary and therefore no temporary habitat loss/disturbance will occur.	No LSE ⁴
		Temporary increases in suspended sediments / smothering	<p>Suspended sediment released during works within the ECC may reach the SAC, within which the reef feature is located. Potential for LSE exists for 'reefs'.</p> <p>Although it is considered unlikely, there is potential for some suspended sediment released during works along the cable corridor only to reach a submerged or partially submerged sea cave. The distance between the array boundary and the SAC is such that effects resulting from the array are screened out.</p> <p>The vegetated sea cliffs lie above the level at which any suspended sediment associated with Hornsea Four could reach and therefore will not be subject to a temporary increase in suspended sediment/smothering resulting from Hornsea Four.</p>	<p>Potential for LSE for: reefs</p> <p>Potential for LSE during cable corridor works only: submerged or partially submerged sea caves</p> <p>No LSE for other designated Annex I Habitats</p>

³ Please note that the meeting minutes from the 12 September 2018 'Marine Processes & Ecology Technical Panel Meeting One – pre-scoping' recorded that Natural England confirmed that a 16km buffer seemed appropriate for screening of benthic and intertidal ecology and agreed that the terrestrial elements of Flamborough Head SAC (the vegetated sea cliffs) could be screened out

⁴ Amended following the change in the ECC

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE for: reefs, submerged or partially submerged sea caves. No LSE for other designated Annex I Habitats
		Invasive non-native species	A number of measures and best practice approaches will be implemented during the construction phase to reduce the potential for release and spread of non-native, invasive species and to provide a process to deal with any should they occur. These will include measures to follow published guidelines and best working practice for the prevention of the release and spread of non-native, invasive species. Such measures are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE for the following feature: reefs, submerged or partially submerged sea caves. No LSE for other designated Annex I Habitats
Moray Firth SAC	• Bottlenose dolphin	Increase in underwater noise	This site is located at a significant distance from the Hornsea Four array (471 km) and cable corridor (451 km) and therefore there is no pathway for effect on bottlenose dolphin at this site from Hornsea Four. Although it is acknowledged that anecdotal sightings of bottlenose dolphin have been occurring further to the south of the Moray Firth SAC, no such sightings are apparent in the draft Marine Mammal Technical Report, with the species scoped out of assessment for PEIR. No likely significant effect identified. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Vessel disturbance		No LSE
		Collision risk		No LSE
		Changes in prey availability and behaviour		No LSE
		Accidental pollution		No LSE
		Temporary increases in suspended sediments/ smothering		No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
The Wash and North Norfolk Coast SAC	<ul style="list-style-type: none"> Harbour seal 	Increase in underwater noise	Site within a distance of 120 km from the project. Therefore, there is the potential for some level of interaction between harbour seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	<p>Hornsea Four is located at least 88 km from the SAC, and following the harbour seal at sea density maps within the draft Marine Mammal Technical Report is not in an area of high usage by seals. This enables a conclusion that disturbance of seals attributed to the SAC is unlikely, with no likely significant effect identified.</p> <p>Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Collision risk	<p>There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. The Advice on Activities for the SAC identifies collision risk for harbour seal, however the text draws on the risk of corkscrew injuries which is considered to be outdated. The advice concludes that incidents of mortality or injury of harbour seals caused by vessels remain a very rare occurrence in UK waters. Therefore it is concluded that no LSE applies.</p> <p>Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Changes in prey availability and behaviour	<p>Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology the potential effect is considered to be limited. Furthermore, the minimum distance of 88 km from site to the Hornsea Four boundary reinforces the low risk of potential effect, with no likely significant effect identified.</p> <p>Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.</p>	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Temporary increases in suspended sediments/ smothering	Harbour seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
River Derwent SAC	Annex II Species: • Sea lamprey • River lamprey	Temporary increases in suspended sediments/ smothering	The mouth of the Humber Estuary, which leads to the River Derwent, is located at least 32 km from the Hornsea Four offshore ECC. Due to the lower maximum range of effect for this impact (up to 16 km), it is considered that there is no potential for a LSE to migratory fish moving into or out of the Humber Estuary and therefore migratory fish found within the River Derwent.	No LSE
		Increase in underwater noise	The distance between the mouth of the Humber Estuary, which leads to the River Derwent, and the array area is approximately 74 km. It is therefore considered that there will be no LSE from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary and therefore the migratory fish found within the River Derwent.	No LSE
		Temporary habitat loss/ disturbance	The SAC is located upstream from the Humber Estuary and therefore is remote from direct temporary habitat loss or disturbance, with no likely significant effect identified.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE
Humber Estuary SAC	• Grey seal	Increase in underwater noise	Site within a distance of 145 km from the project. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Following the grey seal at sea density maps within the draft Marine Mammal Technical Report, Hornsea Four is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. Further, the Advice on Activities for the Humber Estuary SAC	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. No likely significant effect identified. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible and no LSE applies. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary increases in suspended sediments/ smothering	The site is located at least 32 km from Hornsea Four boundary which is outside the potential range of effect (16 km) for this particular impact. It is therefore considered that the potential for a significant effect to migratory fish is negligible, and no LSE applies.	No LSE
		Increase in underwater noise	The distance between the mouth of the Humber Estuary and the array is some 74 km. It is therefore unlikely there will be a significant effect from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary.	No LSE
		Temporary habitat loss/ disturbance	The SAC is a minimum 32 km from the cable corridor for Hornsea Four and therefore is remote from direct temporary habitat loss or disturbance.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			(e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	
Humber Estuary Ramsar ⁵	<ul style="list-style-type: none"> Grey seal 	Increase in underwater noise	This site is within a distance of 145 km (from the project). Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Following the grey seal at sea density maps within the draft Marine Mammal Technical Report, Hornsea Four is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. Further, the Advice on Activities for the Humber Estuary SAC found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. No likely significant effect identified Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible and no LSE applies. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However,	Potential for LSE

⁵Note that Ramsar criteria 5 (assemblage of international importance) and Ramsar criterion 6 (species/populations occurring at levels of international importance) are addressed in the following table

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, and therefore no LSE applies.	No LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary increases in suspended sediments/ smothering	The site is located at least 32 km from Hornsea Four boundary which is outside the potential range of effect (16 km) for this particular impact. It is therefore considered that the potential for a significant effect to migratory fish is negligible and no LSE applies.	No LSE
		Increase in underwater noise	The distance from the mouth of the Humber Estuary to the array is some 74 km. It is therefore unlikely there will be a significant effect from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary.	No LSE
		Temporary habitat loss/ disturbance	The SAC is a minimum 32 km from the cable corridor for Hornsea Four and therefore is remote from direct temporary habitat loss or disturbance.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE
Berwickshire and North Northumberland Coast SAC ⁶	<ul style="list-style-type: none"> Grey Seal 	Increase in underwater noise	This site is located beyond the screening distance applied in the Screening Report, but has been identified in the initial PEIR work as having potential connectivity. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.	Potential for LSE
		Vessel disturbance	Following the grey seal at sea density maps within the draft Marine Mammal Technical Report, Hornsea Four is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out.	Potential for LSE

⁶ Additional site screened in based on the draft Marine Mammal Technical Report

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. Further, the risk for grey seals from collision is low, and depends on factors such as vessel speed, nature of the activity and proximity to the feature. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible and no LSE applies. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, given that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
Transboundary harbour porpoise sites (49 sites)	• Harbour porpoise	Increase in underwater noise	The range applied to UK harbour porpoise sites for Screening of effect is 26 km. No transboundary site falls within that range for this species and therefore there is no potential for LSE.	No LSE
		Vessel disturbance	The sites are all located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			transboundary site (78 km to the cable corridor, 106 km to the array). Therefore, it is considered that there is no LSE from increased vessel activity in terms of collision risk for marine mammals associated with the transboundary sites.	
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible. Furthermore, the minimum distance of 78 km from site to the Hornsea Four boundary reinforces the low risk of potential effect. Therefore no LSE applies.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted and form mitigation, given the distance between the nearest transboundary site and Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Harbour porpoise frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
Transboundary bottlenose dolphin sites (6 sites)	• Bottlenose dolphin	Increase in underwater noise	These sites are all located at a significant distance from Hornsea Four (at least 326 km) and therefore there is no pathway for effect on bottlenose dolphin at these sites from Hornsea Four. Further, no sightings of the species are apparent in the draft Marine Mammal Technical Report, with the species scoped out of assessment for PEIR. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Vessel disturbance		No LSE
		Collision risk		No LSE
		Changes in prey availability and behaviour		No LSE
		Accidental pollution		No LSE
		Temporary increases in suspended sediments/ smothering		No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Transboundary harbour seal sites (2 offshore sites in Dutch waters, Dogger and Klaver Bank)	<ul style="list-style-type: none"> Harbour seal 	Increase in underwater noise	Both the designated sites fall within the foraging range (120 km) of harbour seal, with potential for a significant effect.	Potential for LSE
		Vessel disturbance	The harbour seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Evidence from PEIR will help inform potential connectivity, however at this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Therefore, it is considered that there is no potential for increased vessel activity to result in a LSE in terms of collision risk for marine mammals associated with the transboundary sites. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, large range to the sites (at least 78km) and the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, there is considered to be no LSE.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Temporary increases in suspended sediments/ smothering	Harbour seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Transboundary grey seal sites (2 sites initially screened in, further sites identified along the Dutch coast to be identified and confirmed ⁷)	<ul style="list-style-type: none"> Grey seal 	Increase in underwater noise	Both the designated sites initially screened in fall within the foraging range (145 km) of grey seal, with potential for a significant effect. PEIR suggests connectivity with transboundary sites further afield, with those sites to be identified and included within the RIAA.	Potential for LSE
		Vessel disturbance	The grey seal sites initially screened in are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. PEIR suggests connectivity with transboundary sites further afield, with those sites to be identified and included within the RIAA. At this point, the potential for disturbance of seals cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Collision risk	Based on the relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array), it is considered that there is no potential for increased vessel activity to result in a LSE in terms of collision risk for marine mammals. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Changes in prey availability and behaviour	Given the large foraging range of this species, the short-term duration and temporary nature of any impact and the conclusions of the Scoping report regarding fish and benthic ecology, the potential effect is considered to be negligible. Furthermore, the minimum distance of 78 km from site to the Hornsea Four boundary reinforces the low risk of potential effect. Therefore no LSE applies.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE

⁷ Additional site screened in based on the draft Marine Mammal Technical Report

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Temporary increases in suspended sediments/ smothering	Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, it is considered that no LSE applies.	No LSE
Operation and Maintenance				
Southern North Sea cSAC/SCI	Harbour porpoise	Underwater noise	Operational underwater noise associated with Wind Turbine Generators (WTGs) has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No likely significant negative effect has therefore been identified.	No LSE
		Vessel disturbance	The presence of additional vessels within the SAC may result in disturbance of harbour porpoise. However, the relevant site selection assessment document found a negative relationship only where levels of traffic increased beyond a threshold of approximately 80 ships per day. It is not expected that Hornsea Four will exceed this level, and therefore no LSE applies. Note – once the marine mammal and navigation assessments have been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Long-term physical loss of habitat	The cSAC/SCI extends 36,951 km ² . The long-term but not permanent habitat loss as a result of the projects infrastructure will be a fraction of this total area during the lifetime of Hornsea Four. Furthermore, the long term but not permanent loss of habitat is that of harbour porpoise prey, not the designated feature of the site itself. ,No likely significant effect identified	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background. Further, the Advice on Activities for the site found that 'few collisions between harbour porpoise and vessels occur and is not a significant pressure for this species'. Therefore no LSE has been identified.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			acknowledged that these plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance, with no LSE identified.	No LSE
Flamborough Head SAC ⁸	Annex I Habitats: <ul style="list-style-type: none"> Reefs Vegetated sea cliffs of the Atlantic and Baltic Coasts, Submerged or partially submerged sea caves 	Temporary habitat disturbance	The Screening Report included physical overlap between the cable corridor and the SAC boundary and therefore screened the feature 'reefs' in for this effect. The change in the ECC, to avoid overlap with the SAC, means that the screening conclusion can be updated to be no LSE for all features as no works will occur within the SAC boundary and therefore no temporary habitat loss/disturbance will occur.	No LSE ⁹
		Release of sediment into suspension/ smothering	<p>The potential for sediment release during operation and maintenance is considered less than during construction.</p> <p>Suspended sediment released during works within the ECC may reach the SAC, within which the reef feature is located. Potential for LSE exists for 'reefs'.</p> <p>Although it is considered unlikely, until the cable corridor is finalised there is potential for some suspended sediment released during works along the cable corridor only to reach a submerged or partially submerged sea cave. The distance between the array boundary and the SAC is such that effects resulting from the array are screened out.</p> <p>The vegetated sea cliffs lie above the level at which any suspended sediment associated with Hornsea Four could reach and therefore will not be subject to a temporary increase in suspended sediment/smothering resulting from Hornsea Four.</p>	<p>Potential for LSE for: reefs</p> <p>Potential for LSE during cable corridor works only: submerged or partially submerged sea caves</p> <p>No LSE for other designated Annex I Habitats</p>
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of	Potential for LSE for the following feature: reefs,

⁸ Please note that the meeting minutes from the 12 September 2018 'Marine Processes & Ecology Technical Panel Meeting One – pre-scoping' recorded that Natural England confirmed that a 16km buffer seemed appropriate for screening of benthic and intertidal ecology and agreed that the terrestrial elements of Flamborough Head SAC (the vegetated sea cliffs) could be screened out

⁹ Amended following the change in the ECC

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	submerged or partially submerged sea caves. No LSE for other designated Annex I Habitats
		Changes to physical processes	Following the change in the ECC, there is no potential for overlap between Annex I Habitats and Hornsea Four. It is likely that any changes to physical processes will be small scale and localised in nature, with any risk likely to be limited to Annex I reefs only. Further information on this potential impact will be drawn from the physical processes chapter of the PEIR.	Potential for LSE for the following Annex I Habitat features: reefs No LSE for remaining Annex I Habitats.
		Long-term physical loss of habitat	Following changes to the ECC, there is no longer any overlap of the offshore ECC with the SAC boundary, and therefore no potential for any loss of habitat within the SAC.	No LSE ¹⁰
		Introduction of hard substrate	Following changes to the ECC, there is no longer any overlap of the offshore ECC with the SAC boundary. There is already a potential for non-native species to occur due to the presence of other local offshore wind farms and major shipping lanes. No additional risk is posed by Hornsea Four, should a hard substrate be introduced in proximity to the SAC.	No LSE
		EMF	Following changes to the ECC, there is no longer any overlap of the offshore ECC with the SAC boundary, and therefore no potential for any EMF within the SAC.	No LSE ¹¹
Moray Firth SAC	• Bottlenose dolphin	Underwater noise	This site is located at a significant distance from the Hornsea Four array (471 km) and cable corridor (451 km) and therefore there is no pathway for effect on bottlenose dolphin at this site from Hornsea Four. Although it is acknowledged that anecdotal sightings of bottlenose dolphin have been occurring further to the south of the Moray Firth SAC, no such sightings are apparent in	No LSE
		Vessel disturbance		No LSE
		Long-term physical loss of habitat		No LSE

¹⁰ Change in the ECC removes the potential for LSE

¹¹ Change in the ECC removes the potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
The Wash and North Norfolk Coast SAC		Collision risk	the draft Marine Mammal Technical Report, with the species scoped out of assessment for PEIR.	No LSE
		Accidental pollution	No likely significant effect identified.	No LSE
		Changes in prey availability	Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
	• Harbour seal	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified, with no LSE identified.	No LSE
		Vessel disturbance	Hornsea Four is located at least 88km from the SAC, and following the harbour seal at sea density maps within the draft Marine Mammal Technical Report is not in an area of high usage by seals. This enables a conclusion that disturbance of seals attributed to the SAC is unlikely, with no likely significant effect identified. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background. The Advice on Activities for the SAC identifies collision risk for harbour seal, however the text draws on the risk of corkscrew injuries which is considered to be outdated. The advice concludes that incidents of mortality or injury of harbour seals caused by vessels remain a very rare occurrence in UK waters. Therefore it is concluded that the potential for effect is negligible, with no LSE identified.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted, LSE cannot be ruled out at this stage.	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of no LSE drawn for construction remains appropriate for operation and maintenance.	No LSE
River Derwent SAC	Annex II Species: <ul style="list-style-type: none"> Sea lamprey River lamprey 	Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted, therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
Humber Estuary SAC	<ul style="list-style-type: none"> Grey seal 	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and with no significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified, with no LSE applied.	No LSE
		Vessel disturbance	Following the grey seal at sea density maps within the draft Marine Mammal Technical Report, Hornsea Four is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background. Further, the Advice on Activities for the	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			Humber Estuary SAC found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. No likely significant effect identified. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of no LSE drawn for construction remains appropriate for operation and maintenance.	No LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in habitat disturbance.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Introduction of hard substrate	There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four, should a hard substrate be introduced in proximity to the SAC.	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Changes to physical processes	Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.	No LSE
Humber Estuary Ramsar ¹²	<ul style="list-style-type: none"> Grey seal 	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and with no significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified, with no LSE applied.	No LSE
		Vessel disturbance	Following the grey seal at sea density maps within the draft Marine Mammal Technical Report, Hornsea Four is located primarily on the fringes of an area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background. Further, the Advice on Activities for the Humber Estuary SAC found the risk from collision to be low, depending on factors such as vessel speed, nature of the activity and proximity to the feature. Therefore it is concluded that the potential for effect is negligible, with no LSE identified.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE

¹² Note that Ramsar criteria 5 (assemblage of international importance) and Ramsar criterion 6 (species/populations occurring at levels of international importance) are addressed in the following table.

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
	<ul style="list-style-type: none"> River lamprey Sea lamprey 	Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of no LSE drawn for construction remains appropriate for operation and maintenance.	No LSE
		Temporary habitat disturbance	The site does not physically overlap with Hornsea Four and therefore does not result in habitat disturbance.	No LSE
		Release of sediment into suspension/ smothering	The potential for sediment release during operation and maintenance is considered less than during construction.	No LSE
		Underwater noise	Underwater noise during operation and maintenance is considered less than during construction.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Introduction of hard substrate	There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four, should a hard substrate be introduced in proximity to the SAC.	No LSE
		Changes to physical processes	Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.	No LSE
Berwickshire and North Northumberland Coast SAC ¹³	Grey Seal	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and with no significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No negative effect has therefore been identified, with no LSE applied.	No LSE
		Vessel disturbance	Hornsea Four is located at least 32 km from the SAC, and following the grey seal at sea density maps within the draft Marine Mammal Technical Report, is located primarily on the fringes of an	Potential for LSE

¹³ Additional site screened in based on the draft Marine Mammal Technical Report

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			area of high usage by seals. At this point it is considered that LSE as a result of vessel disturbance cannot be ruled out, however the issue will be revisited during PEIR.	
		Long-term physical loss of habitat	The site does not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the construction of Hornsea Four compared to background. Further, the risk for grey seals from collision is low, and depends on factors such as vessel speed, nature of the activity and proximity to the feature. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Accidental pollution	It is anticipated a number of relevant plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, it is acknowledged that such plans form mitigation and have yet to be drafted and therefore LSE cannot be ruled out at this stage.	Potential for LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of no LSE drawn for construction remains appropriate for operation and maintenance.	No LSE
Transboundary harbour porpoise sites (49 sites)	• Harbour porpoise	Underwater noise	Operational underwater noise associated with WTCs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No LSE has therefore been identified.	No LSE
		Vessel disturbance	The sites are all located at a significant distance from Hornsea Four and therefore it is considered that vessel traffic at Hornsea Four will not result in disturbance within those sites.	No LSE
		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			array). Therefore, it is considered that there is no LSE from increased vessel activity in terms of collision risk for marine mammals associated with the transboundary sites.	
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance, with no LSE applying.	No LSE
Transboundary bottlenose dolphin sites (6 sites)	• Bottlenose dolphin	Underwater noise	These sites are all located at a significant distance from Hornsea Four (at least 326 km) and therefore there is no pathway for effect on bottlenose dolphin at these sites from Hornsea Four. Further, no sightings of the species are apparent in the draft Marine Mammal Technical Report, with the species scoped out of assessment for PEIR. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Vessel disturbance		No LSE
		Long-term physical loss of habitat		No LSE
		Collision risk		No LSE
		Accidental pollution		No LSE
		Changes in prey availability		No LSE
Transboundary harbour seal sites (2 offshore sites in Dutch waters, Dogger and Klaver Bank)	• Harbour seal	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No LSE has therefore been identified.	No LSE
		Vessel disturbance	The harbour seal sites are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. Evidence from PEIR will help inform potential connectivity, however at this point, the potential for disturbance of seals in transit between the site and the coast cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Therefore, it is considered that there is no potential for increased vessel activity to result in a LSE in terms of collision risk for marine mammals associated with the transboundary sites. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of no LSE will be revisited and, if relevant, amended to reflect those conclusions.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of no LSE drawn for construction remains appropriate for operation and maintenance.	No LSE
Transboundary grey seal sites (2 sites initially screened in, further sites identified along the Dutch coast)	• Grey seal	Underwater noise	Operational underwater noise associated with WTGs has been shown to be low and localised and is unlikely to produce a significant behavioural response in marine mammals. Underwater noise generated by operational and maintenance vessel traffic is negligible in comparison to the shipping area located near Hornsea Four. No LSE has therefore been identified.	No LSE
		Vessel disturbance	The grey seal sites initially screened in are located broadly to the east of Hornsea Four and not between Hornsea Four and the UK coastline. PEIR suggests connectivity with transboundary sites further afield, with those sites to be identified and included within the RIAA. At this point, the potential for disturbance of seals cannot be ruled out. Note – once the marine mammal assessment has been completed for PEIR, the existing conclusion of LSE will be revisited and, if relevant, amended to reflect those conclusions.	Potential for LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
to be identified and confirmed ¹⁴)		Long-term physical loss of habitat	The transboundary sites do not physically overlap with Hornsea Four and therefore does not result in long-term physical loss of habitat.	No LSE
		Collision risk	There is a relatively small increase in vessel traffic associated with the operation and maintenance of Hornsea Four compared to background, and the minimum distance between Hornsea Four and the closest transboundary site (78 km to the cable corridor, 106 km to the array). Therefore, it is considered that there is no potential for increased vessel activity to result in a LSE in terms of collision risk for marine mammals associated with the transboundary sites.	No LSE
		Accidental pollution	It is anticipated a number of plans will be agreed with relevant authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP); such plans are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. However, although it is acknowledged that these plans have yet to be drafted, given the distance between the nearest transboundary site and the Hornsea Four, LSE can be ruled out at this stage.	No LSE
		Changes in prey availability	The potential for an effect on prey availability during operation and maintenance is significantly reduced from that during construction and therefore the conclusion of negligible drawn for construction remains appropriate for operation and maintenance.	No LSE

¹⁴ Additional site screened in based on the draft Marine Mammal Technical Report

4 Onshore Screening

- 4.1.1.1 As noted above, the initial coarse screening generated a list of designated sites and relevant features for which, based purely on proximity, there is a need to consider the potential for LSE in relation to Hornsea Four. That information was progressed in Table 5.2 of the Screening Report by taking account of the potential identified effects, to determine where a pathway for effect exists and therefore where potential for LSE applies.
- 4.1.1.2 As within the Screening Report, the assessment of LSE is based on Hornsea Four's current understanding of the baseline environment and the scope and nature of the proposed project activities, together with the relevant information available for the designated sites. Further environmental survey and assessment work, consultee and advisor responses to this document, and refinements to the project design may change this assessment. These changes will be reflected in the RIAA to be submitted with the DCO application for Hornsea Four.
- 4.1.1.3 It is proposed that the updated tables are included within the RIAA, with further additions/amendments as relevant, for completeness and clarity. Where new sites have been screened in, or the previous conclusion on LSE changed, these would be highlighted in red. It should be noted that for consideration of in-combination effect, consideration will be given to all potential effects (and not just those screened in for the project alone).
- 4.1.1.4 As noted above, the reconsideration of screening for onshore ecology (in line with the request by Natural England) has not identified any new sites or features and [Table 2](#) below reproduces Table 5.2 from the Screening Report, for information only.

Table 2 - Reproduced Table 5.2 from the Screening Report for ease of reference – conclusion on Screening Onshore

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Construction				
Humber Estuary SPA	<ul style="list-style-type: none"> • Avocet • Hen harrier • Golden plover • Black-tailed godwit • Bar-tailed godwit • Ruff • Marsh harrier • Shelduck • Dunlin • Redshank • Red knot 	Temporary habitat loss	The site does not physically overlap with Hornsea Four and therefore does not result in loss of habitat, disturbance, damage or fragmentation.	No LSE
		Temporary disturbance / damage to habitats		No LSE
		Habitat fragmentation or severance		No LSE
		Visual and / or noise disturbance to species	Although it is possible that the species screened in may use habitat within the Hornsea Four Zone of Influence (ZOI), given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the SPA site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.	No LSE
		Invasive non-native species	The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Estuary SPA site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the SPA site.	No LSE
		Accidental release of contaminants	It is anticipated that a number of relevant plans will be agreed with relevant the authorities and submitted with the application or during examination to address the risk of accidental pollution and the introduction of invasive non-native species (e.g. a CoCP and Environmental Management and Monitoring Plan (EMMP)). Such plans are considered an integral part of the project, and would be required regardless of HRA matters. It is acknowledged that these plans have yet to be drafted. However, taking into account the nature of the onshore components of Hornsea Four and distance to the SPA, it is still reasonable to conclude there will be no likely significant effects.	No LSE

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
Humber Estuary Ramsar ¹⁵	<ul style="list-style-type: none"> Golden plover Dunlin Black-tailed godwit Bar-tailed godwit Redshank Shelduck Red knot 	Temporary habitat loss	The site does not physically overlap with Hornsea Four and therefore does not result in loss of habitat, disturbance, damage or fragmentation.	No LSE
		Temporary disturbance / damage to habitats		No LSE
		Habitat fragmentation or severance		No LSE
		Visual and / or noise disturbance to species	Although it is possible that the species screened in may use habitat within the Hornsea Four ZOI, given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the Ramsar site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.	No LSE
		Invasive non-native species	<p>The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Ramsar site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the Ramsar site.</p> <p>However, Hornsea Four will include preventative and contingency mitigation. It is anticipated that a number of relevant plans will be agreed with the authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP and EMMP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. These plans will also address the risk of introduction of invasive non-native species.</p>	No LSE
		Accidental release of contaminants		No LSE

¹⁵ Note that Ramsar Criterion 3 (grey seal) and Ramsar Criterion 8 (migratory fish) are addressed in [Table 1](#) above.

Designated Site	Features Screened in	Relevant Effect	Consideration of LSE	Conclusion of LSE
			It is acknowledged that these plans have yet to be drafted. However, taking into account the nature of the onshore components of Hornsea Four and distance to the SPA, it is reasonable to conclude there will be no likely significant effects.	

Operation and Maintenance

The likely significant impacts during the operation and maintenance phase are considered similar but less than those outlined in the construction phase due to their smaller extent and shorter duration e.g. repairing a short section of cable.

Decommissioning

The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Appendix C – Screening Matrices

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Screening Matrix - Potential Impacts

Potential impacts upon the European site(s)¹ which are considered within the submitted RIAA Screening Report (included as [Appendix A](#) to the RIAA) and/or updates to screening included within the RIAA following consultation (see [Section 8](#) of the RIAA) are provided in the table below. Impacts have been grouped where appropriate for ease of presentation. It should be noted that, in response to questions raised during consultation, consideration of sites (specifically SPAs) at considerable distance from Hornsea Four have been considered for screening. A number of these are subsequently ruled out as 'no LSE' on the basis of source-pathway-receptor.

The effects listed below include all effects considered for LSE through screening. Only those where potential for LSE is identified are taken forward to the Integrity Matrix (with a summary of conclusions on LSE presented in the RIAA).

Impacts considered within the screening matrices

Designation	Impacts in submission information
Southern North Sea SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Collision risk Accidental pollution
Flamborough Head SAC ²	<u>Alone:</u> Temporary habitat loss/ disturbance Temporary increases in suspended sediments / smothering Accidental pollution Invasive non-native species Changes to physical processes Long-term physical loss of habitat Electromagnetic Fields (EMF)
	<u>In-combination:</u> Temporary habitat loss/ disturbance

¹ As defined in Advice Note 10.

² Please note that the meeting minutes from the 12 September 2018 'Marine Processes & Ecology Technical Panel Meeting One – pre-scoping' recorded that Natural England confirmed that a 16km buffer seemed appropriate for screening of benthic and intertidal ecology and agreed that the terrestrial elements of Flamborough Head SAC (the vegetated sea cliffs) could be screened out

Designation	Impacts in submission information
	<p>Temporary increases in suspended sediments / smothering</p> <p>Accidental pollution</p> <p>Invasive non-native species</p> <p>Changes to physical processes</p> <p>Long-term physical loss of habitat</p> <p>EMF</p>
Moray Firth SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p> <p><u>In-combination:</u></p> <p>Screened out as no LSE alone in all cases</p>
The Wash and North Norfolk Coast SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p> <p><u>In-combination:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Accidental pollution</p>
River Derwent SAC	<p><u>Alone:</u></p> <p>Temporary increases in suspended sediments</p> <p>Increase in underwater noise</p> <p>Temporary habitat loss/ disturbance</p> <p>Accidental pollution</p> <p><u>In-combination:</u></p> <p>Temporary increases in suspended sediments</p> <p>Increase in underwater noise</p> <p>Temporary habitat loss/ disturbance</p> <p>Accidental pollution</p>
Humber Estuary SAC	<p><u>Alone (grey seal):</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p>

Designation	Impacts in submission information
	<p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p> <p><u>Alone (river lamprey and sea lamprey):</u></p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Increase in underwater noise</p> <p>Temporary habitat loss/ disturbance</p> <p>Accidental pollution</p> <p><u>Alone (Atlantic saltmeadows and Salicornia and other annuals colonising mud and sand)</u></p> <p>Increased nitrogen deposition</p> <p><u>In-combination (grey seal):</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Accidental pollution</p>
Humber Estuary Ramsar	<p><u>Alone (grey seal):</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p> <p><u>Alone (river lamprey and sea lamprey):</u></p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Increase in underwater noise</p> <p>Temporary habitat loss/ disturbance</p> <p>Accidental pollution</p> <p><u>Alone (saltmarshes)</u></p> <p>Increased nitrogen deposition</p> <p><u>Alone (onshore ecology)</u></p> <p>Temporary habitat loss</p> <p>Temporary disturbance/ damage to habitats</p> <p>Habitat fragmentation or severance</p> <p>Visual and/ or noisedisturbance to species</p> <p>Invasive non-native species</p> <p>Accidental release of contaminants</p> <p><u>In-combination (grey seal):</u></p>

Designation	Impacts in submission information
	<p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Accidental pollution</p> <p><u>In-combination (river lamprey and sea lamprey):</u></p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Increase in underwater noise</p> <p>Temporary habitat loss/ disturbance</p> <p>Accidental pollution</p> <p><u>In-combination (onshore ecology):</u></p> <p>Screened out as no LSE alone in all cases</p>
Humber Estuary SPA	<p><u>Alone (onshore ecology)</u></p> <p>Temporary habitat loss</p> <p>Temporary disturbance/ damage to habitats</p> <p>Habitat fragmentation or severance</p> <p>Visual and/ or noisedisturbance to species</p> <p>Invasive non-native species</p> <p>Accidental release of contaminants</p> <p><u>In-combination (onshore ecology):</u></p> <p>Screened out as no LSE alone in all cases</p>
Berwickshire and North Northumberland Coast SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p> <p><u>In-combination:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Accidental pollution</p>
Transboundary harbour porpoise sites (49 sites)	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p>

Designation	Impacts in submission information
	<u>In-combination:</u> Screened out as no LSE alone in all cases
Transboundary bottlenose dolphin sites (6 sites)	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Screened out as no LSE alone in all cases
Transboundary site: Doggersbank (Dutch) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: Klaverbank (Dutch) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: Bancs des Flandres (France) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering

Designation	Impacts in submission information
	Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: Vlaamse Banken (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: SBZ 1 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: SBZ 2 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: SBZ 3 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise

Designation	Impacts in submission information
	<p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p>
	<p><u>In-combination:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Accidental pollution</p>
Transboundary site: Vlakte van de Raan (Belguim/Netherlands) SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p>
	<p><u>In-combination:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Accidental pollution</p>
Transboundary site: Westerschelde & Saeftinghe (Netherlands) SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p>
	<p><u>In-combination:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Accidental pollution</p>
Transboundary site: Voordelta (Netherlands) SAC	<p><u>Alone:</u></p> <p>Increase in underwater noise</p> <p>Vessel disturbance</p> <p>Collision risk</p> <p>Changes in prey availability and behaviour</p> <p>Accidental pollution</p> <p>Temporary increases in suspended sediments/ smothering</p> <p>Physical habitat loss</p>

Designation	Impacts in submission information
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: Noordzeekustzone (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Transboundary site: Waddenzee (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance Collision risk Changes in prey availability and behaviour Accidental pollution Temporary increases in suspended sediments/ smothering Physical habitat loss
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance Accidental pollution
Greater Wash SPA	<u>Alone:</u> Direct disturbance and displacement
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Flamborough & Filey Coast SPA	<u>Alone:</u> Risk of collision Barrier effect Direct disturbance and displacement
	<u>In-combination:</u> Risk of collision Direct disturbance and displacement
Northumbria Coast SPA	<u>Alone:</u> Risk of collision
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)

Designation	Impacts in submission information
Humber Estuary SPA	<p><u>Alone (offshore ornithology)</u></p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Hornsea Mere SPA	<p><u>Alone:</u></p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Coquet Island SPA	<p><u>Alone:</u></p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p>Direct disturbance and displacement</p> <p>Changes in prey availability and behaviour</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Farne Islands SPA	<p><u>Alone:</u></p> <p>Risk of collision</p> <p>Direct disturbance and displacement</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Forth Islands (UK) SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Outer Firth of Forth and St Andrew's Complex pSPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Fowlsheugh SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Buchan Ness to Collieston Coast SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Risk of collision</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Troup, Pennan and Lion's Heads SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p>

Designation	Impacts in submission information
	Risk of collision
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
East Caithness Cliffs SPA	<u>Alone:</u> Direct disturbance and displacement Risk of collision
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
North Caithness Cliffs SPA	<u>Alone:</u> Direct disturbance and displacement Risk of collision
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Copinsay SPA	<u>Alone:</u> Direct disturbance and displacement Risk of collision
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Hoy SPA	<u>Alone:</u> Direct disturbance and displacement Indirect impacts through effects on habitats and prey species Risk of collision Barrier effect
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Marwick Head SPA	<u>Alone:</u> Direct disturbance and displacement Indirect impacts through effects on habitats and prey species Risk of collision Barrier effect
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Rousay SPA	<u>Alone:</u> Direct disturbance and displacement Indirect impacts through effects on habitats and prey species Risk of collision Barrier effect
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Calf of Eday SPA	<u>Alone:</u> Direct disturbance and displacement Indirect impacts through effects on habitats and prey species

Designation	Impacts in submission information
	<p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
West Westray SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Fair Isle SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Sumburgh Head SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Foula SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Fetlar SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p> <p>Barrier effect</p> <p><u>In-combination:</u></p> <p>None – all screened out of LSE (therefore not presented here)</p>
Hermaness, Saxa Vord and Valla Field SPA	<p><u>Alone:</u></p> <p>Direct disturbance and displacement</p> <p>Indirect impacts through effects on habitats and prey species</p> <p>Risk of collision</p>

Designation	Impacts in submission information
	Barrier effect
	<u>In-combination:</u> None – all screened out of LSE (therefore not presented here)

Screening Matrix

The European Sites included within the screening assessment are:

- Southern North Sea SAC
- Flamborough Head SAC
- Moray Firth SAC
- The Wash and North Norfolk Coast SAC
- River Derwent SAC
- Humber Estuary SAC
- Humber Estuary Ramsar
- Humber Estuary SPA
- Berwickshire and North Northumberland Coast SAC
- Transboundary harbour porpoise sites (49 sites)
- Transboundary bottlenose dolphin sites (6 sites)
- Transboundary site: Doggersbank (Dutch) SAC
- Transboundary site: Klaverbank (Dutch) SAC
- Transboundary site: Bancs des Flandres (France) SAC
- Transboundary site: Vlaamse Banken (Belgium) SAC
- Transboundary site: SBZ 1 (Belgium) SAC
- Transboundary site: SBZ 2 (Belgium) SAC
- Transboundary site: SBZ 3 (Belgium) SAC
- Transboundary site: Vlakte van de Raan (Belguim/Netherlands) SAC
- Transboundary site: Westerschelde & Saeftinghe (Netherlands) SAC
- Transboundary site: Voordelta (Netherlands) SAC
- Transboundary site: Noordzeekustzone (Netherlands) SAC
- Transboundary site: Waddenzee (Netherlands) SAC
- Hornsea Mere SPA
- Coquet Island SPA
- Farne Islands SPA
- Forth Islands (UK) SPA
- Outer Firth of Forth and St Andrew's Complex pSPA
- Fowlsheugh SPA

- Buchan Ness to Collieston Coast SPA
- Troup, Pennan and Lion's Heads SPA
- East Caithness Cliffs SPA
- North Caithness Cliffs SPA
- Copinsay SPA
- Hoy SPA
- Marwick Head SPA
- Rousay SPA
- Calf of Eday SPA
- West Westray SPA
- Fair Isle SPA
- Sumburgh Head SPA
- Foula SPA
- Fetlar SPA
- Hermaness, Saxa Vord and Valla Field SPA

Evidence for likely significant effects on their qualifying features is detailed within the footnotes to the screening matrices below.

Matrix Key

✓: Likely significant effect **cannot** be excluded

X: Likely significant effect **can** be excluded

Lower case letters in the table relate to the evidence supporting the conclusions below.

C = construction

O = operation

D = decommissioning

Matrix 1: Southern North Sea SAC

Name of European site: Southern North Sea SAC																					
Distance to Hornsea Four: 0 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour porpoise	✓a	✓a	✓b	✓c	✓c	✓b	Xd	Xd	Xb	Xe	Xe	Xb	Xf	Xf	Xf	Xg	Xg	Xb		Xh	

Evidence supporting conclusions:

- Hornsea Four is located within 0 km of the SAC. There is potential for a likely significant effect.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The presence of additional vessels within the SAC may result in disturbance of harbour porpoise.
- Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. The recently re-issued 'Advice on Activities' finds that the risk of death or injury collision to be 'not currently considered a significant risk and no additional management is likely to be required'. Therefore, no LSE has been identified for the project alone.

- e) Given the large foraging range of this species and the short-term duration and temporary nature of any impact, and the conclusions of the PEI regarding fish and benthic ecology the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 *et seq.* No LSE identified.
- f) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019³) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- g) Harbour porpoise frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- h) Potential for physical habitat loss for the duration of the project is calculated within the RIAA (under paragraph 8.5.3.3), being 0.0001% of the volume (water column) and 0.01% of the footprint (seabed), considered to be trivial and non-consequential for both harbour porpoise and harbour porpoise prey. Confirms conclusion of no LSE.

³<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 2: Southern North Sea SAC

Name of European site: Southern North Sea SAC																						
Distance to Hornsea Four: 0 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Harbour porpoise	✓a	✓a	✓b	✓a	✓a	✓b	✓c	✓c	✓b				Xd	Xd	Xb							

Evidence supporting conclusions:

- Hornsea Four is located within 0 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- Despite the conclusion of no LSE alone, given the location of the project (and the significance to an individual should collision occur) collision risk is screened in for LSE in-combination.

- d) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁴) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

⁴<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 3: Flamborough Head SAC

Name of European site: Flamborough Head SAC																					
Distance to Hornsea Four: 1.64 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Temporary habitat loss/ disturbance			Temporary increases in suspended sediments / smothering			Accidental pollution			Invasive non-native species			Changes to physical processes			Long-term physical loss of habitat			EMF		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reefs	Xa	Xa	Xj	✓b	✓e	✓j	Xc	Xc	Xj	✓d	✓d	✓j		✓f			Xh			Xi	
Vegetated sea cliffs of the Atlantic and Baltic Coasts																					
Submerged or partially submerged sea caves	Xa	Xa	Xj	✓b	✓e	✓j	Xc	Xc	Xj	✓d	✓d	✓j		Xg			Xh			Xi	

Evidence supporting conclusions:

- The Screening Report included physical overlap between the cable corridor and the SAC boundary and therefore screened the feature 'reefs' in for this effect. The change in the RLB, to avoid overlap with the SAC, means that the screening conclusion can be updated to be no LSE for all features as no works will occur within the SAC boundary and therefore no temporary habitat loss/disturbance will occur.

- b) Suspended sediment released during works within the RLB may reach the SAC, within which the features are located. Potential for LSE exists.
- c) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁵) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- d) A number of measures and best practice approaches will be implemented during the construction phase to reduce the potential for release and spread of non-native, invasive species and to provide a process to deal with any should they occur. These will include measures to follow published guidelines and best working practice for the prevention of the release and spread of non-native, invasive species. Such measures are considered an integral part of the project and would be required regardless of HRA matters. It is anticipated that such plans will remove the risk of LSE. In addition, there is little evidence to date from other offshore wind farm development within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS. However, given that such plans form mitigation, LSE cannot be ruled out at this stage.
- e) The potential for sediment release during operation and maintenance is considered less than during construction. Suspended sediment released during works within the RLB may reach the SAC, within which the features are located. Potential for LSE exists.
- f) The only element of the project which is close enough to the SAC to potentially affect coastal processes is installation of the export cable. Although significant effects are unlikely a LSE cannot be ruled out at this stage.
- g) Following the change in the RLB, there is no potential for overlap between Annex I Habitats and Hornsea Four. It is likely that any changes to physical processes will be small scale and localised in nature, insufficient to effect the sea cave feature.
- h) Following changes to the RLB, there is no longer any overlap of the offshore ECC with the SAC boundary, and therefore no potential for any loss of habitat within the SAC.
- i) Following changes to the RLB, there is no longer any overlap of the offshore ECC with the SAC boundary. Therefore no potential for EMF within the SAC boundary.
- j) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

⁵<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 4: Flamborough Head SAC

Name of European site: Flamborough Head SAC																					
Distance to Hornsea Four: 1.64 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Temporary habitat loss/ disturbance			Temporary increases in suspended sediments / smothering			Accidental pollution			Invasive non-native species			Changes to physical processes			Long-term physical loss of habitat			EMF		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reefs	Xa	Xa	Xa	√b	Xc	√b	Xd	Xd	Xd	√e	√e	√e		√f							
Vegetated sea cliffs of the Atlantic and Baltic Coasts																					
Submerged or partially submerged sea caves	Xa	Xa	Xa	√b	Xc	√b	Xd	Xd	Xd	√e	√e	√e		xf							

Evidence supporting conclusions:

- The Screening Report included physical overlap between the cable corridor and the SAC boundary and therefore screened the feature 'reefs' in for this effect. The change in the RLB, to avoid overlap with the SAC, means that the screening conclusion can be updated to be no LSE for all features as no works will occur within the SAC boundary and therefore no temporary habitat loss/disturbance will occur.

- b) Suspended sediment released during works within the RLB may reach the SAC, within which the reef and submerged sea cave features are located. Potential for LSE exists for reefs and sea cave features in-combination with the Bridlington Bay disposal site and also the Creyke Beck export cable installation.
- c) This HRA concluded that there will be no impact on the Flamborough Head SAC due to temporary increases in suspended sediment during operation and maintenance of Hornsea Four alone. No assessment of effects in-combination with other plans or projects is therefore necessary.
- d) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁶) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- e) This HRA concluded that there will be no impact on the Flamborough Head SAC due to increase in the risk of spread of marine invasive non-native species during construction and decommissioning of Hornsea Four alone. However, as no reliance can be placed on mitigation during LSE screening the potential is screened in in-combination.
- f) The only element of the project which is close enough to the SAC to potentially affect coastal processes is installation of the export cable. Although significant effects are unlikely, a LSE in-combination with Creyke Beck cannot be ruled out at this stage. Following the change in the RLB, there is no potential for overlap between Annex I Habitats and Hornsea Four. It is likely that any changes to physical processes will be small scale and localised in nature, with any risk likely to be limited to Annex I reefs only. Further information on this potential impact will be drawn from the physical processes chapter of the PEIR.

⁶<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 5: Moray Firth SAC

Name of European site: Moray Firth SAC																							
Distance to Hornsea Four: 453 km																							
European Site Feature	Likely Effects of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Bottlenose dolphin	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	X	Xa			Xa			

Evidence supporting conclusions:

- This site is located at a significant distance from the Hornsea Four array (471 km) and cable corridor (451 km). Bottlenose dolphin were scoped out of assessment in the Marine Mammal Chapter of the Scoping Report, with Volume 5, Annex 4.1: Marine Mammals Technical Report not identifying bottlenose dolphin as a key species, including not identifying a need to consider SACs for bottlenose dolphin within the assessment. Similarly, Volume 2, Chapter 4: Marine Mammals of the PEIR does not consider bottlenose dolphin beyond its use as a proxy for other mid frequency cetaceans for assessment purposes. All effects screened out as no LSE.

Matrix 6: Moray Firth SAC

Name of European site: Moray Firth SAC																						
Distance to Hornsea Four: 453 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Bottlenose dolphin																						

Evidence supporting conclusions:

No potential for LSE alone in all cases and therefore no potential for AEol in-combination

Matrix 7: The Wash and North Norfolk Coast SAC

Name of European site: The Wash and North Norfolk Coast SAC																						
Distance to Hornsea Four: 32 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Atlantic salt meadows																						
Coastal lagoons																						
Large shallow inlets and bays																						
Mediterranean and thermo-Atlantic halophilous scrubs																						
Mudflats and sandflats not covered by seawater at low tide																						
Reefs																						
Salicornia and other annuals colonising mud and sand																						
Sandbanks which are slightly covered by sea water all the time and																						
Harbour seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xb	Xf	Xf	Xc	Xg	Xg	Xc	Xh	Xh	Xc		Xi		
Otter																						

Evidence supporting conclusions:

- a) Site within a distance of 120 km from the project. Therefore, there is the potential for some level of interaction between harbour seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, low harbour seal numbers within the array boundary and the small scale and localised potential for effect during operation result in a conclusion of no LSE.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the array on the fringes of the at sea usage area of harbour seal with connectivity to the SAC may result in disturbance of harbour seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Low levels of harbour seal are found within the site boundary. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of this species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁷) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Harbour seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

⁷<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 8: The Wash and North Norfolk Coast SAC

Name of European site: The Wash and North Norfolk Coast SAC																							
Distance to Hornsea Four: 32 km																							
European Site Feature	Likely Effects of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C																							
Operation: O																							
Decommissioning: D																							
Atlantic salt meadows																							
Coastal lagoons																							
Large shallow inlets and bays																							
Mediterranean and thermo-Atlantic halophilous scrubs																							
Mudflats and sandflats not covered by seawater at low tide																							
Reefs																							
Salicornia and other annuals colonising mud and sand																							
Sandbanks which are slightly covered by sea water all the time and																							
Harbour seal	✓a			✓b	✓c	✓c	✓b									Xd	Xd	Xd					
Otter																							

Evidence supporting conclusions:

- a) Hornsea Four is located within 120 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The presence of the array boundary on the fringes of the at sea usage area of harbour seal with connectivity to the SAC may result in disturbance of harbour seal in-combination. Potential for LSE.
- d) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁸) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

⁸<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 9: River Derwent SAC

Name of European site: River Derwent SAC												
Distance to Hornsea Four: 37 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Temporary increases in suspended sediments			Increase in underwater noise			Temporary habitat loss/ disturbance			Accidental pollution		
	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C Operation: O Decommissioning: D												
Water courses of plain to montane levels with the Ranunculus fluitans and Callitriche-Batrachium vegetation												
Bullhead												
Otter												
Sea lamprey	Xa	Xa	Xb	c	Xc	Xb	Xd	Xd	Xb	Xe	Xe	Xe
River lamprey	Xa	Xa	Xb	Xc	Xc	Xb	Xd	Xd	Xb	Xe	Xe	Xe

Evidence supporting conclusions:

- The mouth of the Humber Estuary, which leads to the River Derwent, is located at least 32 km from the Hornsea Four offshore ECC. Due to the lower maximum range of effect for this impact (up to 16 km), it is considered that there is no potential for a LSE to migratory fish moving into or out of the Humber Estuary and therefore migratory fish found within the River Derwent.

- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The distance between the mouth of the Humber Estuary, which leads to the River Derwent, and the array area is approximately 74 km. It is therefore considered that there will be no LSE from underwater noise generated at Hornsea Four on migratory fish entering or leaving the mouth of the Humber Estuary and therefore the migratory fish found within the River Derwent.
- d) The SAC does not physically overlap with Hornsea Four, which is located upstream from the SAC and therefore is remote from direct temporary habitat loss or disturbance, with no likely significant effect identified.
- e) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019⁹) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

⁹<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 10: River Derwent SAC

Name of European site: River Derwent SAC												
Distance to Hornsea Four: 37 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Temporary increases in suspended sediments			Increase in underwater noise			Temporary habitat loss/ disturbance			Accidental pollution		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Water courses of plain to montane levels with the Ranunculus fluitantis and Callitriche-Batrachion vegetation												
Bullhead												
Otter												
Sea lamprey										Xa	Xa	Xa
River lamprey										Xa	Xa	Xa

Evidence supporting conclusions:

- a) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁰) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

¹⁰<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 11: Humber Estuary SAC

			Name of European site: Humber Estuary SAC																																
			Distance to Hornsea Four: 32 km																																
European Site Feature	Likely Effects of Hornsea Four (alone)																																		
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			Temporary habitat loss/ disturbance			Long-term physical loss of habitat			Introduction of hard substrate			Changes to physical processes			Increased nitrogen deposition	
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Atlantic salt meadows																														√n		√n			
Coastal lagoons																																			
Dunes with <i>Hippophae rhamnoides</i>																																			
Embryonic shifting dunes																																			
Estuaries																																			

[illegible]

Evidence supporting conclusions:

- a) Site within a distance of 145 km from the project. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

- d) The location of the project relative to the at sea usage area of grey seal together with connectivity to the SAC may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of this species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹¹) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.
- j) The site does not overlap with Hornsea Four and is located at least 32 km from its boundary, with the array even further distance. No potential for LSE with respect to underwater noise and fish accessing the Humber as a migration route, and no LSE applies.
- k) The site does not overlap with Hornsea Four and is located at least 32 km from its boundary, with the array even further distance, which is outside the potential range of effect (15km) for suspended sediment and no LSE applies.
- l) There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four, should a hard substrate be introduced in proximity to the SAC.
- m) Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.
- n) The air quality assessment has highlighted that there will be a potential increase in nitrogen deposition on an area of saltmarsh within the the Humber Estuary SAC

¹¹<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 12: Humber Estuary SAC

Name of European site: Humber Estuary SAC																																
Distance to Hornsea Four: 32 km																																
European Site Feature	Likely Effects of Hornsea Four (in-combination)																															
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			Temporary habitat loss/ disturbance			Long-term physical loss of habitat			Introduction of hard substrate			Changes to physical processes	
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Atlantic salt meadows																																
Coastal lagoons																																
Dunes with <i>Hippophae rhamnoides</i>																																
Embryonic shifting dunes																																
Estuaries																																

Evidence supporting conclusions:

- Doc. no. B2.2 Appendix C
Version A

- e) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹²) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

¹²<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 13: Humber Estuary Ramsar

Name of European site: Humber Estuary Ramsar																																	
Distance to Hornsea Four: 32 km																																	
European Site Feature	Likely Effects of Hornsea Four (alone)																																
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			Temporary habitat loss/ disturbance			Long-term physical loss of habitat			Introduction of hard substrate			Increased nitrogen deposition		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Dune systems and humid dune slacks																																	
Estuarine waters																																	
Intertidal mud and sand flats																																	
Saltmarshes																															✓r		✓
Coastal brackish/saline lagoons																																	
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi													

Name of European site: Humber Estuary Ramsar																															
Distance to Hornsea Four: 32 km																															
European Site Feature	Likely Effects of Hornsea Four (alone)																														
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		Temporary habitat loss/ disturbance		Long-term physical loss of habitat		Introduction of hard substrate		Increased nitrogen deposition				
Natterjack toad																															
Waterfowl																															
River lamprey	Xj	Xb	Xc								Xg	Xg	Xg	Xk	Xk	Xc				Xi	Xi	Xc	Xi				XL				
Sea lamprey	Xj	Xb	Xc								Xg	Xg	Xg	Xk	Xk	Xc				Xi	Xi	Xc	Xi				XL				
Golden plover																															
Dunlin							✓v																								
Black-tailed godwit							✓v																								
Bar-tailed godwit							✓v																								
Redshank							✓v																								
Shelduck							✓v																								
Red knot							✓v																								

Matrix 14: Humber Estuary Ramsar (continued)

Name of European site: Humber Estuary Ramsar (continued)																						
Distance to Hornsea Four: 32 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Changes to physical processes			Temporary habitat loss (onshore)			Temporary disturbance/ damage to habitats			Habitat fragmentation or severance			Visual and / or noise disturbance to species			Invasive non-native species			Accidental release of contaminants			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Dune systems and humid dune slacks																						
Estuarine waters																						
Intertidal mud and sand flats saltmarshes																						
Coastal brackish/saline lagoons																						
Grey seal																						
Natterjack toad																						
Waterfowl																						

Name of European site: Humber Estuary Ramsar (continued)																				
Distance to Hornsea Four: 32 km																				
European Site Feature	Likely Effects of Hornsea Four (alone)																			
	Changes to physical processes			Temporary habitat loss (onshore)			Temporary disturbance/ damage to habitats			Habitat fragmentation or severance		Visual and / or noise disturbance to species			Invasive non-native species			Accidental release of contaminants		
River lamprey		Xm																		
Sea lamprey		Xm																		
Golden plover				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Dunlin				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Black-tailed godwit				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Bar-tailed godwit				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Redshank				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Shelduck				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp
Red knot				Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xn	Xo	Xo	Xo	Xp	Xp	Xp	Xp	Xp	Xp

Evidence supporting conclusions:

- a) Site within a distance of 145 km from the project. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the Ramsar, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal together with connectivity to the Ramsar may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of this species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹³) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the Ramsar boundary has been identified within the PEI. No LSE applies.
- j) The site does not overlap with Hornsea Four and is located at least 32 km from its boundary, with the array even further distance. No potential for LSE with respect to underwater noise and fish accessing the Humber as a migration route, and no LSE applies.
- k) The site does not overlap with Hornsea Four and is located at least 32 km from its boundary, with the array even further distance, which is outside the potential range of effect (15km) for suspended sediment and no LSE applies.
- l) There is already a potential for non-native species to occur due to the presence of other local OWFs and major shipping lanes. No additional risk is posed by Hornsea Four, should a hard substrate be introduced in proximity to the Ramsar.
- m) Any change in physical processes are likely to be localised and certainly insufficient to reach the Humber Estuary.

¹³<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

- n) The site does not physically overlap with the onshore Hornsea Four boundaries and therefore does not result in loss of habitat, disturbance, damage or fragmentation.
- o) Although it is possible that these species may use habitat within the onshore Hornsea Four boundaries, given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the Ramsar site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.
- p) The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Ramsar site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the Ramsar site. However, Hornsea Four have included mitigation measures that are embedded within the project as a preventative and contingency mitigation. It is anticipated that a number of relevant plans will be agreed with the authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP and EMMP); such plans are considered an integral part of the project and would be required regardless of HRA matters. These plans will also address the risk of introduction of invasive non-native species.
- q) The air quality assessment has highlighted that there will be a potential increase in nitrogen deposition in an area of saltmarsh within the Humber Estuary Ramsar.
- r) The air quality assessment has highlighted that there will be a potential increase in nitrogen deposition on an area of saltmarsh within the the Humber Estuary SAC
- v) Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. However, quantification of any potential impacts and effects may be required.

Matrix 15: Humber Estuary Ramsar

Name of European site: Humber Estuary Ramsar																														
Distance to Hornsea Four: 32 km																														
European Site Feature	Likely Effects of Hornsea Four (in-combination)																													
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Dune systems and humid dune slacks																														
Estuarine waters																														
Intertidal mud and sand flats saltmarshes																														
Coastal brackish/saline lagoons																														
Grey seal	✓a			✓b	✓c	✓c	✓b	✓d	✓d	✓b				Xe	Xe	Xe														
Natterjack toad																														

Name of European site: Humber Estuary Ramsar																														
Distance to Hornsea Four: 32 km																														
European Site Feature	Likely Effects of Hornsea Four (in-combination)																													
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate		
Waterfowl																														
River lamprey													Xe	Xe	Xe															
Sea lamprey													Xe	Xe	Xe															
Golden plover																														
Dunlin																														
Black-tailed godwit																														
Bar-tailed godwit																														
Redshank																														
Shelduck																														
Red knot																														

Matrix 16: Humber Estuary Ramsar (continued)

Name of European site: Humber Estuary Ramsar (continued)																						
Distance to Hornsea Four: 32 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Changes to physical processes			Temporary habitat loss (onshore)			Temporary disturbance/ damage to habitats			Habitat fragmentation or severance			Visual and / or noise disturbance to species			Invasive non-native species			Accidental release of contaminants			
Construction: C Operation: O Decommissioning: D	C	O	D				C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Dune systems and humid dune slacks																						
Estuarine waters																						
Intertidal mud and sand flats saltmarshes																						
Coastal brackish/saline lagoons																						
Grey seal																						
Natterjack toad																						
Waterfowl																						

Name of European site: Humber Estuary Ramsar (continued)																					
Distance to Hornsea Four: 32 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Changes to physical processes			Temporary habitat loss (onshore)			Temporary disturbance/ damage to habitats			Habitat fragmentation or severance			Visual and / or noise disturbance to species			Invasive non-native species			Accidental release of contaminants		
River lamprey																					
Sea lamprey																					
Golden plover																					
Dunlin																					
Black-tailed godwit																					
Bar-tailed godwit																					
Redshank																					
Shelduck																					
Red knot																					

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the Ramsar. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage area of grey seal with connectivity to the Ramsar may result in disturbance of grey seal in-combination. Potential for LSE.
- d) Despite the conclusion of no LSE alone, given the location of the project (and the significance to an individual should collision occur) collision risk is screened in for LSE in-combination.
- e) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁴) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

¹⁴<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 17: Berwickshire and North Northumberland Coast SAC

Name of European site: Berwickshire and North Northumberland Coast SAC																					
Distance to Hornsea Four: 171 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Large shallow inlets and bays																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Submerged and partially submerged sea caves																					
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	

Evidence supporting conclusions:

- Site not within screening distance (145 km) of the project, but some site connectivity indicated from seal use at sea data. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.

- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal together with connectivity to the SAC may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of this species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁵) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

¹⁵<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 18: Berwickshire and North Northumberland Coast SAC

Name of European site: Berwickshire and North Northumberland Coast SAC																					
Distance to Hornsea Four: 171 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Large shallow inlets and bays																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Submerged and partially submerged sea caves																					
Grey seal	✓a		✓b	✓c	✓c	✓b							Xd	Xd	Xd						

Evidence supporting conclusions:

- Hornsea Four is not located within screening range of the SAC, but PEI indicates site connectivity. There is potential for a likely significant effect in-combination.

- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage area of grey seal with connectivity to the SAC may result in disturbance of grey seal in-combination. Potential for LSE.
- d) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁶) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

¹⁶<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 19: Transboundary harbour porpoise sites (49 sites*)

Name of European site: Transboundary harbour porpoise sites (49 sites)																					
Distance to Hornsea Four: Sites range from 78 to 768 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour porpoise																					

Evidence supporting conclusions:

All screened out based on 26km EDR (all sites located beyond that range)

*Transboundary sites include:

Agger Tange, Nissum Bredning, Skibsted Fjord og Agerø (Denmark) SAC
 Anse de Vauville (France) SAC
 Baie de Canche et couloir des trois estuaires (France) SAC
 Baie de Seine occidentale (France) SAC
 Baie de Seine orientale (France) SAC

Banc et récifs de Surtainville (France) SAC
Bancs des Flandres (France) SAC
Borkum-Riffgrund (Germany) SAC
Doggerbank (Germany) SAC**
Doggersbank (Dutch) SAC
Dråby Vig (Denmark) SAC
Estuaire de la Seine (France) SAC
Estuaires et littoral picards (baies de Somme et d'Authie) (France) SAC
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant (France) SAC
Gule Rev (Denmark) SAC
Hamburgisches Wattenmeer (UK) SAC
Helgoland mit Helgoländer Felssockel (Germany) SAC
Jyske Rev, Lillefiskerbanke (Denmark) SAC
Klaverbank (Netherlands) SAC**
Kosterfjorden-Väderöfjorden (Sweden) SAC
Løgstør Bredning, Vejlerne og Bulbjerg (Denmark) SAC
Lønstrup Rødgrund (Denmark) SAC
Nationalpark Niedersächsisches Wattenmeer (Germany) SAC
Noordzeekustzone (Netherlands) SAC
NTP S-H Wattenmeer und angrenzende Küstengebiete (Germany) SAC
Oosterschelde (Netherlands) SAC
Récifs et landes de la Hague (France) SAC
Récifs et marais arrière-littoraux du Cap Lévi à la Pointe de Saire (France) SAC
Récifs Gris-Nez Blanc-Nez (France) SAC
Ridens et dunes hydrauliques du détroit du Pas-de-Calais (France) SAC
Sandbanker ud for Thorsminde (Denmark) SAC
SBZ 1 / ZPS 1 (Belguim)
SBZ 2 / ZPS 2 (Belguim)
SBZ 3 / ZPS 3 (Belguim)
Skagens Gren og Skagerak (Denmark) SAC
SPA Östliche Deutsche Bucht (Germany) SCI
Steingrund (Germany) SAC
Store Rev (Denmark) SAC
Sydlige Nordsø (Denmark) SAC

Sylter Aubenriff (Germany) SCI
Thyborøn Stenvolde (Denmark) SAC
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde (Denmark) SAC
Venø, Venø Sund (Denmark) SAC
Vlakte van de Raan (Belguim/Netherlands) SAC
Vlaamse Banken (Belguim) SAC
Voordelta (Netherlands) SAC
Waddenzee (Netherlands) SAC
Westerschelde and Saeftinghe (Netherlands) SAC

** These sites are included in the matrices for the following (as other features have potential for LSE)

Doggersbank SAC
Klaverbank SAC
Doggersbank (Dutch) SAC
Klaverbank (Dutch) SAC
Bancs des Flandres (France) SAC
Vlaamse Banken (Belgium) SAC
SBZ 1 (Belgium) SAC
SBZ 2 (Belgium) SAC
SBZ 3 (Belgium) SAC
Vlakte van de Raan (Belguim/Netherlands) SAC
Westerschelde & Saeftinghe (Netherlands) SAC
Voordelta (Netherlands) SAC
Noordzeekustzone (Netherlands) SAC
Waddenzee (Netherlands) SAC

Matrix 20: Transboundary harbour porpoise sites (49 sites*)

Name of European site: Transboundary harbour porpoise sites (49 sites)																					
Distance to Hornsea Four: Sites range from 78 to 768 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour porpoise																					

Evidence supporting conclusions:

All screened out based on 26km EDR (all sites located beyond that range)

Matrix 21: Transboundary bottlenose dolphin sites (5 sites*)

Name of European site: Transboundary bottlenose dolphin sites (5 sites)																						
Distance to Hornsea Four: 339 to 519 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Bottlenose dolphin																						

Evidence supporting conclusions:

All screened out based on lack of connectivity to Hornsea Four

*Transboundary sites include:

Anse de Vauville (France) SAC

Baie de Seine orientale (France) SAC

Banc et récifs de Surtainville (France) SAC

Estuaires et littoral picards (baies de Somme et d'Authie) (France) SAC

Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardingen et Dunes de Wissant (France) SAC

Récifs et marais arrière-littoraux du Cap Lévi à la Pointe de Saire (France) SAC

Matrix 22: Transboundary bottlenose dolphin sites (5 sites*)

Name of European site: Transboundary bottlenose dolphin sites (5 sites)																					
Distance to Hornsea Four: 339 to 519 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Bottlenose dolphin																					

Evidence supporting conclusions:

All screened out based on lack of connectivity to Hornsea Four

Matrix 23: Doggersbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																						
Distance to Hornsea Four: 84 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour porpoise*																						

* Screened out based on 26km EDR (site located beyond that range)

Evidence supporting conclusions:

- Site within screening distance of the project for both harbour and grey seal. Therefore, there is the potential for some level of interaction between harbour seal and grey seal and underwater noise associated with Hornsea Four.

- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for both species of seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of harbour seal and grey seal may result in disturbance of harbour seal and grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of both species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁷) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Harbour seal and grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

¹⁷<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 24: Doggersbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																					
Distance to Hornsea Four: 84 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	✓a		✓b	✓c	✓c	✓b															
Harbour seal	✓a		✓b	✓c	✓c	✓b															
Harbour porpoise																					

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage area of harbour seal and grey seal may result in disturbance of harbour seal and grey seal in-combination. Potential for LSE.

Matrix 25: Klaverbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																					
Distance to Hornsea Four: 78 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reef																					
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	
Harbour seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	
Harbour porpoise*																					

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

- Site within screening distance of the project for both harbour and grey seal. Therefore, there is the potential for some level of interaction between harbour seal and grey seal and underwater noise associated with Hornsea Four.

- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for both species of seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of harbour seal and grey seal may result in disturbance of harbour seal and grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of both species, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁸) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Harbour seal and grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

¹⁸<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 26: Klaverbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																						
Distance to Hornsea Four: 78 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal	✓a		✓b	✓c	✓c	✓b																
Harbour porpoise																						

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage area of harbour seal and grey seal may result in disturbance of harbour seal and grey seal in-combination. Potential for LSE.

Matrix 27: Bancs des Flandres (France) SAC

Name of European site: Bancs des Flandres (France) SAC																						
Distance to Hornsea Four: 296 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal*																						
Harbour porpoise#																						

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019¹⁹) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

¹⁹<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 28: Bancs des Flandres (France) SAC

Name of European site: Bancs des Flandres (France) SAC																					
Distance to Hornsea Four: 296 km																					
European Site Feature	Likely Effects of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	✓a		✓b	✓c	✓c	✓b															
Harbour seal																					
Harbour porpoise																					

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 29: Vlaamse Banken (Belgium) SAC

Name of European site: Vlaamse Banken (Belgium) SAC																					
Distance to Hornsea Four: 278 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reef																					
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	
Harbour seal#																					
Harbour porpoise*																					
Shad																					
River lamprey																					
Sea lamprey																					

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

Evidence supporting conclusions:

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁰) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²⁰<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 30: Vlaamse Banken (Belgium) SAC

Name of European site: Vlaamse Banken (Belgium) SAC																						
Distance to Hornsea Four: 278 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal																						
Harbour porpoise																						
Shad																						
River lamprey																						
Sea lamprey																						

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 31: SBZ 1 (Belgium) SAC

Name of European site: SBZ 1 (Belgium) SAC																					
Distance to Hornsea Four: 313 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reef																					
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	
Harbour seal#																					
Harbour porpoise*																					
Shad																					
River lamprey																					
Sea lamprey																					

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²¹) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²¹<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 32: SBZ 1 (Belgium) SAC

Name of European site: SBZ 1 (Belgium) SAC																						
Distance to Hornsea Four: 313 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal																						
Harbour porpoise																						
Shad																						
River lamprey																						
Sea lamprey																						

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 33: SBZ 2 (Belgium) SAC

Name of European site: SBZ 2 (Belgium) SAC																					
Distance to Hornsea Four: 303 km																					
European Site Feature	Likely Effects of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reef																					
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi	
Harbour seal#																					
Harbour porpoise*																					
Shad																					
River lamprey																					
Sea lamprey																					

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²²) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²²<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 34: SBZ 2 (Belgium) SAC

Name of European site: SBZ 2 (Belgium) SAC																						
Distance to Hornsea Four: 303 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal																						
Harbour porpoise																						
Shad																						
River lamprey																						
Sea lamprey																						

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 35: SBZ 3 (Belgium) SAC

Name of European site: SBZ 3 (Belgium) SAC																						
Distance to Hornsea Four: 307 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal#																						
Harbour porpoise*																						
Shad																						
River lamprey																						
Sea lamprey																						

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²³) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²³<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 36: SBZ 3 (Belgium) SAC

Name of European site: SBZ 3 (Belgium) SAC																						
Distance to Hornsea Four: 307 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal																						
Harbour porpoise																						
Shad																						
River lamprey																						
Sea lamprey																						

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 37: Vlakte van de Raan (Belguim/Netherlands) SAC

Name of European site: Vlakte van de Raan (Belguim/Netherlands) SAC																						
Distance to Hornsea Four: 292 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	√a	Xb	√c	√d	√d	√c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal#																						
Harbour porpoise*																						

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁴) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²⁴<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 38: Vlakte van de Raan (Belguim/Netherlands) SAC

Name of European site: Vlakte van de Raan (Belguim/Netherlands) SAC																						
Distance to Hornsea Four: 292 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Grey seal	√a		√b	√c	√c	√b																
Harbour seal																						
Harbour porpoise																						

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 39: Westerschelde & Saeftinghe (Netherlands) SAC

Name of European site: Westerschelde & Saeftinghe (Netherlands) SAC																							
Distance to Hornsea Four: 301 km																							
European Site Feature	Likely Effects of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							

[illegible]

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- a) Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- b) The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- d) The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- e) Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- f) Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁵) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

²⁵<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

Matrix 40: Westerschelde & Saeftinghe (Netherlands) SAC

Name of European site: Westerschelde & Saeftinghe (Netherlands) SAC																							
Distance to Hornsea Four: 301 km																							
European Site Feature	Likely Effects of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							

Dunes with Hippophaë rhamnoides																				
Humid dune slacks																				
Grey seal	✓a		✓b	✓c	✓c	✓b														
Harbour seal																				
Harbour porpoise																				

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 41: Voordelta (Netherlands) SAC

Name of European site: Voordelta (Netherlands) SAC																						
Distance to Hornsea Four: 272 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Mudflats and sandflats not covered by seawater at low tide																						
Salicornia and other annuals colonizing mud and sand																						
Spartina swards																						
Atlantic salt meadows																						
Embryonic shifting dunes																						
Shifting dunes along the shoreline with Ammophila arenaria																						
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal#																						

Harbour porpoise*																				
Allis shad																				
Shad																				
Lampren																				
Great sea lamprey																				

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁶) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.

²⁶<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

Matrix 42: Voordelta (Netherlands) SAC

Name of European site: Voordelta (Netherlands) SAC																							
Distance to Hornsea Four: 272 km																							
European Site Feature	Likely Effects of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Grey seal	✓a		✓b	✓c	✓c	✓b																	
Harbour seal																							

Harbour porpoise																				
Allis shad																				
Shad																				
River lamprey																				
Sea lamprey																				

Evidence supporting conclusions:

- Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 43: Noordzeekustzone (Netherlands) SAC

Name of European site: Noordzeekustzone (Netherlands) SAC																						
Distance to Hornsea Four: 221 km																						
European Site Feature	Likely Effects of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Mudflats and sandflats not covered by seawater at low tide																						
Salicornia and other annuals colonizing mud and sand																						
Atlantic salt meadows																						
Embryonic shifting dunes																						
Shifting dunes along the shoreline with Ammophila arenaria																						
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc		Xi		
Harbour seal#																						
Harbour porpoise*																						

Shad																				
River lamprey																				
Sea lamprey																				

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.
- As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁷) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²⁷<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 44: Noordzeekustzone (Netherlands) SAC

Name of European site: Noordzeekustzone (Netherlands) SAC																						
Distance to Hornsea Four: 221 km																						
European Site Feature	Likely Effects of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Sandbanks which are slightly covered by sea water all the time																						
Mudflats and sandflats not covered by seawater at low tide																						
Salicornia and other annuals colonizing mud and sand																						
Atlantic salt meadows																						
Embryonic shifting dunes																						
Shifting dunes along the shoreline with Ammophila arenaria																						
Grey seal	✓a		✓b	✓c	✓c	✓b																
Harbour seal																						
Harbour porpoise																						

Sea lamprey

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 45: Waddenzee (Netherlands) SAC

Name of European site: Waddenzee (Netherlands) SAC																							
Distance to Hornsea Four: 229 km																							
European Site Feature	Likely Effects of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							

Dunes with Hippophaë rhamnoides																						
Dunes with Salix repens ssp argentea																						
Humid dune slacks																						
Grey seal	✓a	Xb	✓c	✓d	✓d	✓c	Xe	Xe	Xc	Xf	Xf	Xc	Xg	Xg	Xg	Xh	Xh	Xc			Xi	
Harbour seal#																						
Harbour porpoise*																						
Shad																						
River lamprey																						
Sea lamprey																						
Narrow-mouthed whorl snail																						

Evidence supporting conclusions:

* Screened out based on 26km EDR (site located beyond that range)

Screened out based on 120km screening range and lack of site connectivity

- Site within screening distance of the project for grey seal. Therefore, there is the potential for some level of interaction between grey seal and underwater noise associated with Hornsea Four.
- The distance between the array boundary and the SAC, together with the small scale and localised potential for effect during operation, result in a conclusion of no LSE for grey seal.
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- The location of the project relative to the at sea usage area of grey seal may result in disturbance of grey seal. Potential for LSE.
- Volume 2, Chapter 4: Marine Mammals of PEI considers marine mammal collision risk in paragraph 4.11.2.10 et seq., finding that it is not expected that Hornsea Four will increase the risk of mortality in marine mammals from collisions. Therefore no LSE has been identified for the project alone.
- Given the large foraging range of grey seal, and the conclusions of the PEI regarding fish and benthic ecology, the potential effect is considered to be negligible. Confirmed as not needing further assessment within Volume 2, Chapter 4: Marine Mammals in paragraph 4.11.1.114 et seq. No LSE identified.

- g) As noted in Section 8.9.1 of the RIAA, recent Planning Policy Guidance government advice (July 2019²⁸) has enabled confirmation that the commitments made within Table 3 of the RIAA, which are a standard requirement for such projects and unconnected to the HRA process, ensure that no LSE will arise with respect to accidental pollution.
- h) Grey seal frequently occur in relatively turbid environments and are thus adapted to locating prey in such conditions. The construction, operation & maintenance and decommissioning activities will be localised and intermittent in nature and the extent and duration of any increase in suspended sediment (and subsequent deposition) being negligible, no LSE applies.
- i) No physical habitat loss within the SAC boundary has been identified within the PEI. No LSE applies.

²⁸<https://www.gov.uk/guidance/appropriate-assessment#what-are-the-implications-of-the-people-over-wind-judgment-for-habitats-regulations-assessments>

Matrix 46: Waddenzee (Netherlands) SAC

Name of European site: Waddenzee (Netherlands) SAC																							
Distance to Hornsea Four: 229 km																							
European Site Feature	Likely Effects of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Physical habitat loss				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							

[illegible]

Evidence supporting conclusions:

- a) Hornsea Four is located within 145 km of the SAC. There is potential for a likely significant effect in-combination.
- b) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- c) The location of the project relative to the at sea usage of grey seal may result in disturbance of grey seal in-combination. Potential for LSE.

Matrix 47: Greater Wash SPA

Name of European site: Greater Wash SPA															
Distance to Hornsea Four: 0.4 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Red-throated diver	✓a	✓f	✓l	Xb		XL		Xb			Xd			Xe	
Common scoter	✓a	✓f	✓l	Xb		XL		Xb			Xd			Xe	
Little gull	Xc	Xb	XL	Xb		XL		Xb			✓h			Xi	
Sandwich tern	Xc	Xb	XL	Xb		XL		Xb			Xj			Xb	
Common tern	Xc	Xb	XL	Xb		XL		Xb			Xk			Xb	
Little tern	Xc	Xb	XL	Xb		XL		Xb			Xj			Xb	

Evidence supporting conclusions:

- a) A sensitive species, construction close to SPA
- b) Experience of other Offshore Wind Farms (OWFs) is no LSE
- c) Not sensitive to construction or maintenance and operation activities.
- d) Only present in low densities and a species that flies low to the water so is not at risk from collision
- e) Experience of other OWFs is no LSE when considering species is only present during the non-breeding bio-season and the array area is not a 'barrier' between roosting and feeding areas for this species
- f) A sensitive species, maintenance vessels may pass close to or through the SPA
- g) Only present in low numbers and a species that flies low to the water
- h) Potentially present in numbers during migration and proportion fly at potential collision height (PCH)
- i) Experience of other OWFs is no LSE as species only likely to occur on migration when any such effect is trivial or inconsequential
- j) No direct connection to array area as migratory routes and colonies are to the south and lie outside of foraging range during the breeding bio-season
- k) A species that flies low to the water with very low risk of collision
- l) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Matrix 48: Greater Wash SPA

Name of European site: Greater Wash SPA															
Distance to Hornsea Four: 0.4 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Red-throated diver	Xa	Xa	Xa												
Common scoter	Xa	Xa	Xa												
Little gull										√b					
Sandwich tern															
Common tern															
Little tern															

Evidence supporting conclusions:

- a) Assessments provided evidence of very small potential impacts / effects on common scoter and red-throated diver alone from Hornsea Four and therefore any in-combination effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- b) Assessments provided evidence of very small potential impacts / effects on all migratory seabird species both alone and in-combination from developments in the North Sea for little gull and therefore any in-combination effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 49: Flamborough & Filey Coast SPA

Name of European site: Flamborough & Filey Coast SPA															
Distance to Hornsea Four: 2.2 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar	Xa	Xb	Xm	Xb		Xm		Xa			Xd			Xa	
Gannet	Xa	✓e	✓m	Xb		Xm		Xa			✓f			Xa	
Shag	Xa	Xe	Xm	Xb		Xm		Xa			Xh			Xa	
Cormorant	Xa	Xg	Xm	Xb		Xm		Xa			Xh			Xa	
Kittiwake	Xa	Xg	Xm	Xb		Xm		Xa			✓f			Xa	
Herring gull	Xa	Xb	Xm	Xb		Xm		Xa			Xi			Xa	
Guillemot	✓c	✓k	✓m	Xb		Xm		Xa			Xd			✓l	
Razorbill	✓c	✓k	✓m	Xb		Xm		Xa			Xd			✓l	
Puffin	✓c	✓k	✓m	Xb		Xm		Xa			Xd			✓l	

Evidence supporting conclusions:

- a) Experience of other OWFs is no LSE
- b) Not sensitive to construction or operation and maintenance activities.
- c) Moderate sensitivity to construction activities.
- d) A species that flies low to the water with very low risk of collision
- e) Not sensitive to operation and maintenance activities, but due to likely avoidance of array area within the breeding bio-season due to proximity of colony there is potential for an effect
- f) Present in numbers and proportion fly at PCH during both the breeding and non-breeding bio-seasons
- g) Not sensitive to operation and maintenance activities and unlikely to forage within array area on regular basis during any bio-season
- h) Present in low or zero numbers within the array area and Experience of other OWFs is no LSE
- i) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony.
- j) Present in moderate numbers during the breeding bio-season and proportion fly at PCH with risk of collision
- k) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- l) Experience of other OWFs is no LSE, but due to proximity of array area to colony this potential impact may have effect on this colony during the breeding season
- m) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Matrix 50: Flamborough & Filey Coast SPA

Name of European site: Flamborough & Filey Coast SPA															
Distance to Hornsea Four: 2.2 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar	Xa	Xb	Xm	Xb		Xm		Xa			Xd			Xa	
Gannet	Xa	Xe	Xm	Xb		Xm		Xa			✓f			Xa	
Shag	Xa	Xe	Xm	Xb		Xm		Xa			Xh			Xa	
Cormorant	Xa	Xg	Xm	Xb		Xm		Xa			Xh			Xa	
Kittiwake	Xa	Xg	Xm	Xb		Xm		Xa			✓f			Xa	
Herring gull	Xa	Xb	Xm	Xb		Xm		Xa			Xi			Xa	
Guillemot	Xa	✓k	Xm	Xb		Xm		Xa			Xd			Xl	
Razorbill	Xa	✓k	Xm	Xb		Xm		Xa			Xd			Xl	
Puffin	Xa	✓k	Xm	Xb		Xm		Xa			Xd			Xl	

Evidence supporting conclusions:

- a) Experience of other OWFs is no LSE alone. Therefore LSE does not apply alone or in-combination.
- b) Not sensitive to construction or operation and maintenance activities associated with Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- c) Moderate sensitivity to construction activities alone and identified as a potential effect in-combination with other OWFs.
- d) A species that flies low to the water with very low risk of collision alone. Therefore LSE does not apply in-combination.
- e) Not sensitive to operation and maintenance activities, but any such effect is trivial or inconsequential alone when considering likely avoidance of array area within the breeding bio-season. Therefore LSE does not apply in-combination.
- f) Present in numbers and proportion fly at PCH during both the breeding and non-breeding bio-seasons and identified as a potential effect in-combination with other OWFs.
- g) Not sensitive to operation and maintenance activities and unlikely to forage within array area on regular basis during any bio-season. Therefore LSE does not apply in-combination.
- h) Present in low or zero numbers within the array area and Experience of other OWFs is no LSE alone. Therefore LSE does not apply in-combination.
- i) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony alone. Therefore LSE does not apply in-combination.
- j) Present in moderate numbers during the breeding bio-season and proportion fly at PCH with risk of collision
- k) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons alone and identified as a potential effect in-combination with other OWFs.
- l) Experience of other OWFs is no LSE and the assessment found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- m) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase. The assessments in the RIAA found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.

Matrix 51: Northumbria Coast SPA

Name of European site: Northumbria Coast SPA															
Distance to Hornsea Four: 144 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Arctic tern	Xa	Xa	Xa	Xb		Xd		Xb			✓c			Xe	
Little tern	Xa	Xa	Xa	Xb		Xd		Xb			✓c			Xe	
Turnstone															
Purple sandpiper															

Evidence supporting conclusions:

- a) Not sensitive to construction, operation and maintenance or decommissioning activities associated with Hornsea Four.
- b) Experience of other Offshore Wind Farms (OWFs) is no LSE
- c) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs

- d) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- e) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 52: Northumbria Coast SPA

Name of European site: Northumbria Coast SPA															
Distance to Hornsea Four: 144 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Arctic tern	Xa	Xa	Xa	Xb		Xd		Xb			Xc			Xe	
Little tern	Xa	Xa	Xa	Xb		Xd		Xb			Xc			Xe	
Turnstone															
Purple sandpiper															

Evidence supporting conclusions:

- Not sensitive to construction, operation and maintenance or decommissioning activities associated with Hornsea Four alone or in-combination.
- Experience of other Offshore Wind Farms (OWFs) is no LSE alone. Therefore, LSE does not apply in-combination.
- Potential connectivity to array area during migratory bio-seasons, but the assessments in the RIAA found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.

- d) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase. Those assessments in the RIAA found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- e) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 53: Humber Estuary SPA (onshore)

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km (distance from onshore components (onshore EEC and substation))																		
	Likely Effects of Hornsea Four (alone)																	
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Avocet	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Hen harrier	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Golden plover	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Black-tailed godwit	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Bar-tailed godwit	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Ruff	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Marsh harrier	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Shelduck	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Dunlin	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km (distance from onshore components (onshore EEC and substation))																		
	Likely Effects of Hornsea Four (alone)																	
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Redshank	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Red knot	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc	Xc	Xc	Xc
Bittern																		
Little tern																		
Assemblage qualification																		

Evidence supporting conclusions:

- The site does not physically overlap with the onshore Hornsea Four boundaries and therefore does not result in loss of habitat, disturbance, damage or fragmentation.
- Although it is possible that these species may use habitat within the onshore Hornsea Four boundaries, given the expansive landscape of similar habitat in the project surrounds and immediately adjacent to the Ramsar site. It is very unlikely that birds will expend large amounts of valuable energy flying over suitable habitat in order to use areas that may be affected by Hornsea Four that are more than 7 km away. Therefore, it is reasonable to conclude that there are no likely significant effects.
- The majority of water courses that could be affected by the construction and operation of the onshore elements of Hornsea Four drain to the River Hull and then eventually to the Humber. Construction of the project will involve the storage and handling of small volumes of potentially harmful materials. In the event of accidental pollution of a watercourse, and no mitigating action by

Hornsea Four, a small volume of polluting material would need to travel approximately ten to tens of kilometres of watercourse before reaching the Humber Ramsar site. A combination of the small volume of material and natural action over the time it takes to travel to the Humber will result in minimal risk of harm to the Ramsar site. However, Hornsea Four have included mitigation measures that are embedded within the project as a preventative and contingency mitigation. It is anticipated that a number of relevant plans will be agreed with the authorities and submitted with the application or during examination to address the risk of accidental pollution (e.g. a CoCP and EMMP); such plans are considered an integral part of the project, and would be required regardless of HRA matters. These plans will also address the risk of introduction of invasive non-native species.

Matrix 54: Humber Estuary SPA (onshore)

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km (distance from onshore components (onshore EEC and substation))																		
	Likely Effects of Hornsea Four (in-combination)																	
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Avocet																		
Hen harrier																		
Golden plover																		
Black-tailed godwit																		
Bar-tailed godwit																		
Ruff																		
Marsh harrier																		
Shelduck																		
Dunlin																		

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km (distance from onshore components (onshore EEC and substation))																		
	Likely Effects of Hornsea Four (in-combination)																	
	Temporary habitat loss (onshore)		Temporary disturbance / damage to habitats (onshore)		Habitat fragmentation or severance (onshore)		Visual and / or noise disturbance to species (onshore)		Invasive non-native species (onshore)		Accidental release of contaminants (onshore)							
Redshank																		
Red knot																		
Bittern																		
Little tern																		
Assemblage qualification																		

Evidence supporting conclusions:

No potential for LSE alone in all cases and therefore no potential for AEol in-combination

Matrix 55: Humber Estuary SPA (offshore)

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Likely Effects of Hornsea Four (alone)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Avocet		✓a	
Bar-tailed godwit		✓a	
Bittern			
Black-tailed godwit		✓a	
Dunlin		✓a	
Golden plover		✓a	
Hen harrier			
Little tern			
Marsh harrier			

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Likely Effects of Hornsea Four (alone)		
	Risk of collision		
Pink-footed goose		Xb	
Ruff		✓a	
Shelduck		✓a	
Red knot		✓a	
Redshank		✓a	
Wigeon		Xc	

Evidence supporting conclusions:

- a) Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. However, quantification of any potential impacts and effects may be required.
- b) Due to this species having migratory pathways to and from it's breeding grounds and the SPA that would not interact with the array area this species is considered to be subject to any effect.
- c) Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. In this instance as the species has a small population within the Humber Estuary any potential impacts and effects are likely to trivaial and inconsequential.

Matrix 56: Humber Estuary SPA (offshore)

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Likely Effects of Hornsea Four (in-combination)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Avocet		Xa	
Bar-tailed godwit		Xa	
Bittern			
Black-tailed godwit		Xa	
Dunlin		Xa	
Golden plover		Xa	
Hen harrier			
Little tern			
Marsh harrier			

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Likely Effects of Hornsea Four (in-combination)		
	Risk of collision		
Pink-footed goose			
Ruff		Xa	
Shelduck		Xa	
Red knot		Xa	
Redshank		Xa	
Wigeon		Xa	

Evidence supporting conclusions:

- a) Analysis of migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species both alone and in-combination from developments in the North Sea for all waterbird species and therefore any in-combination effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 57: Hornsea Mere SPA

Name of European site: Hornsea Mere SPA			
Distance to Hornsea Four: 12.9 km			
European Site Feature	Likely Effects of Hornsea Four (alone)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Gadwall		✓a	

Evidence supporting conclusions:

- a) Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. However, quantification of any potential impacts and effects may be required.

Matrix 58: Hornsea Mere SPA

Name of European site: Hornsea Mere SPA			
Distance to Hornsea Four: 12.9 km			
European Site Feature	Likely Effects of Hornsea Four (in-combination)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Gadwall		Xa	

Evidence supporting conclusions:

- Analysis of migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species both alone and in-combination from developments in the North Sea for all waterbird species and therefore any in-combination effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 59: Coquet Island SPA

Name of European site: Coquet Island SPA															
Distance to Hornsea Four: 167 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake		Xb			✓e			Xf		Xa	Xd	Xn	Xb		Xn
Black-headed gull		Xb			Xb			Xf		Xa	Xd	Xn	Xb		Xn
Herring gull		Xb			Xg			Xb		Xa	Xd	Xn	Xb		Xn
Lesser black-backed gull		Xb			Xg			Xb		Xa	Xd	Xn	Xb		Xn
Sandwich tern		Xb			✓i			Xf		Xa	Xd	Xn	Xb		Xn
Common tern		Xb			✓i			Xf		Xa	Xd	Xn	Xb		Xn
Arctic tern		Xb			✓i			Xf		Xa	Xd	Xn	Xb		Xn
Roseate tern		Xb			✓i			Xf		Xa	Xd	Xn	Xb		Xn
Puffin		Xb			Xl			Xm		✓c	✓k	✓n	Xb		Xn
Fulmar		Xb			Xo			Xf		Xa	Xd	Xn	Xb		Xn

Evidence supporting conclusions:

- a) Not sensitive to construction activities.
- b) Experience of other OWFs is no LSE.
- c) Moderate sensitivity to construction activities.
- d) Not sensitive to operation and maintenance activities
- e) Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision
- f) Experience of other OWFs is no LSE, as limited connectivity during most sensitive breeding bio-season
- g) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony.
- h) Not sensitive to operation and maintenance activities.
- i) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- j) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- k) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- l) A species that flies low to the water
- m) Experience of other OWFs is no LSE, particularly as connectivity is mostly during the non-breeding period.
- n) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- o) A species that flies low to the water with very low risk of collision.

Matrix 60: Coquet Island SPA

Name of European site: Coquet Island SPA															
Distance to Hornsea Four: 167 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake		Xb			Xe			Xf		Xa	Xd	Xn	Xb		Xn
Black-headed gull		Xb			Xg			Xf		Xa	Xd	Xn	Xb		Xn
Herring gull		Xb			Xg			Xf		Xa	Xd	Xn	Xb		Xn
Lesser black-backed gull		Xb			Xg			Xf		Xa	Xd	Xn	Xb		Xn
Sandwich tern		Xb			Xi			Xf		Xa	Xd	Xn	Xb		Xn
Common tern		Xb			Xi			Xf		Xa	Xd	Xn	Xb		Xn
Arctic tern		Xb			Xi			Xf		Xa	Xd	Xn	Xb		Xn
Roseate tern		Xb			Xi			Xf		Xa	Xd	Xn	Xb		Xn
Puffin		Xb			Xi			Xf		Xa	Xd	Xn	Xb		Xn
Fulmar		Xb			Xo			Xf		Xa	Xd	Xn	Xb		Xn

Evidence supporting conclusions:

- a) Not sensitive to construction activities associated with Hornsea Four alone. Therefore LSE does not apply in-combination.
- b) Experience of other OWFs is no LSE alone. Therefore LSE does not apply in-combination.
- c) Moderate sensitivity to construction activities, but findings in RIAA provide evidence of no LSE alone. Therefore LSE does not apply in-combination.
- d) Not sensitive to operation and maintenance activities alone or in-combination. Therefore LSE does not apply in-combination.
- e) Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision. However, the assessments in the RIAA found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- f) Experience of other OWFs is no LSE, as limited connectivity during most sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- g) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony. Therefore LSE does not apply alone or in-combination.
- h) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- i) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- j) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season.
- k) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- l) A species that flies low to the water with very low risk of collision with the assessments in the RIAA finding no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- m) Experience of other OWFs is no LSE, particularly as connectivity is mostly during the non-breeding period. Therefore LSE does not apply alone or in-combination.
- n) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase. The assessments in the RIAA found no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.
- o) A species that flies low to the water with very low risk of collision with the assessments in the RIAA finding no LSE for Hornsea Four alone. Therefore LSE does not apply alone or in-combination.

Matrix 61: Farne Islands SPA

Name of European site: Farne Islands SPA															
Distance to Hornsea Four: 198 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xb			Xm			Xb		Xa	Xf	Xo	Xb		Xo
Kittiwake		Xb			✓g			Xh		Xd	Xf	Xo	Xb		Xo
Black-headed gull		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Herring gull		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Lesser black-backed gull		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Great black-backed gull		Xb			Xp			Xb		Xa	Xf	Xo	Xb		Xo
Sandwich tern		Xb			✓j			Xk		Xa	Xf	Xo	Xb		Xo
Common tern		Xb			✓j			Xk		Xa	Xf	Xo	Xb		Xo
Arctic tern		Xb			✓j			Xk		Xa	Xf	Xo	Xb		Xo
Roseate tern		Xb			✓j			Xk		Xa	Xf	Xo	Xb		Xo
Guillemot		Xb			Xm			Xh		✓c	✓l	✓o	Xb		Xo

Name of European site: Farne Islands SPA															
Distance to Hornsea Four: 198 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Razorbill		Xb			Xm			Xh		Xq	Xq	Xq	Xb		Xo
Puffin		Xb			Xm			Xn		✓c	✓l	✓o	Xb		Xo
Shag		Xb			Xe			Xb			Xd				
Cormorant		Xb			Xe			Xb			Xd				

Evidence supporting conclusions:

- Not sensitive to construction activities
- Experience of other OWFs is no LSE.
- Moderate sensitivity to construction activities.
- Not sensitive to operation and maintenance activities and unlikely to forage within array area on regular basis during any bio-season
- Present in low or zero numbers within the array area and Experience of other OWFs is no LSE
- Not sensitive to operation and maintenance activities
- Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision
- Experience of other OWFs is no LSE, as limited connectivity during more sensitive breeding bio-season
- Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony.

- j) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is reduced when considering one off migratory movements through OWFs
- k) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- l) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- m) A species that flies low to the water
- n) Experience of other OWFs is no LSE, particularly as connectivity mostly during the non-breeding period.
- o) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.
- p) Present within array area and a proportion fly at PCH, but due to very small population of Farne Islands and the mixing of birds with wider North Sea population during the non-breeding seasons any potential impacts are highly likely to be trivial and inconsequential.
- q) Moderate sensitivity to construction and decommissioning and operational and maintenance activities during non-breeding seasons, but due to very small population of Farne Islands and the mixing of birds with wider North Sea population any potential impacts are highly likely to be trivial and inconsequential.

Matrix 62: Farne Islands SPA

Name of European site: Farne Islands SPA															
Distance to Hornsea Four: 198 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C															
Operation: O															
Decommissioning: D															
Fulmar		Xb			Xm			Xb		Xd	Xf	Xo	Xb		Xo
Kittiwake		Xb			Xm			Xb		Xa	Xf	Xo	Xb		Xo
Black-headed gull		Xb			Xg			Xh		Xd	Xf	Xo	Xb		Xo
Herring gull		Xb			Xg			Xh		Xd	Xf	Xo	Xb		Xo
Lesser black-backed gull		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Great black-backed gull		Xb			Xg			Xh		Xd	Xf	Xo	Xb		Xo
Sandwich tern		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Common tern		Xb			Xi			Xb		Xa	Xf	Xo	Xb		Xo
Arctic tern		Xb			Xp			Xb		Xa	Xf	Xo	Xb		Xo
Roseate tern		Xb			Xj			Xk		Xa	Xf	Xo	Xb		Xo
Guillemot		Xb			Xj			Xk		Xa	Xf	Xo	Xb		Xo

Name of European site: Farne Islands SPA														
Distance to Hornsea Four: 198 km														
European Site Feature	Likely Effects of Hornsea Four (in-combination)													
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour	
Puffin		Xb			Xj			Xk		Xa	Xf	Xo	Xb	
Shag		Xb			Xe			Xb			Xd			
Cormorant		Xb			Xe			Xb			Xd			

Evidence supporting conclusions:

- Not sensitive to construction activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- Moderate sensitivity to construction activities. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities and unlikely to forage within array area on regular basis during any bio-season. Therefore LSE does not apply alone or in-combination.
- Present in low or zero numbers within the array area and Experience of other OWFs is no LSE alone or in-combination.
- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision. The findings in the RIAA were no LSE alone, therefore LSE does not apply in-combination.
- Experience of other OWFs is no LSE, as limited connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony. Therefore LSE does not apply alone or in-combination.

- j) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is reduced when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- k) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- l) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons. However, the findings in the RIAA were no LSE alone. Therefore LSE does not apply alone or in-combination.
- m) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- n) Experience of other OWFs is no LSE, particularly as connectivity mostly during the non-breeding period. Therefore LSE does not apply alone or in-combination.
- o) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase. Therefore LSE does not apply alone or in-combination.
- p) Present within array area and a proportion fly at PCH, but due to very small population of Farne Islands and the mixing of birds with wider North Sea population during the non-breeding seasons any potential impacts are highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- q) Moderate sensitivity to construction and decommissioning and operational and maintenance activities during non-breeding seasons, but due to very small population of Farne Islands and the mixing of birds with wider North Sea population any potential impacts are highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 63: Forth Islands (UK) SPA

Name of European site: Forth Islands (UK) SPA												
Distance to Hornsea Four: 272 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			✓e			Xb	
Common tern		Xa			Xb			✓f			Xg	
Arctic tern		Xa			Xb			✓f			Xg	
Roseate tern		Xa			Xb			✓f			Xg	
Sandwich tern		Xa			Xb			✓f			Xg	
Puffin		✓h			Xb			Xc			Xi	
Guillemot		✓h			Xb			Xc			Xi	
Razorbill		✓h			Xb			Xc			Xi	
Lesser black-backed gull												
Shag												

Kittiwake												
Herring gull												
Cormorant												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of a significant effect during the breeding season
- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- Experience of other OWFs is no LSE, particularly as connectivity mostly during the non-breeding period.

Matrix 64: Forth Islands (UK) SPA

Name of European site: Forth Islands (UK) SPA												
Distance to Hornsea Four: 272 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Common tern		Xa			Xb			Xf			Xg	
Arctic tern		Xa			Xb			Xf			Xg	
Roseate tern		Xa			Xb			Xf			Xg	
Sandwich tern		Xa			Xb			Xf			Xg	
Puffin		Xh			Xb			Xc			Xi	
Guillemot		Xh			Xb			Xc			Xi	
Razorbill		Xh			Xb			Xc			Xi	
Lesser black-backed gull												
Shag												

Kittiwake												
Herring gull												
Cormorant												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of a significant effect during the breeding season. Therefore LSE does not apply alone or in-combination.
- e) Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season. However, the assessment in the RIAA found no LSE alone. Therefore LSE does not apply alone or in-combination.
- f) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. However, the assessment in the RIAA found no LSE alone. Therefore LSE does not apply alone or in-combination.
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. However, the assessment in the RIAA found no LSE alone. Therefore LSE does not apply alone or in-combination.
- i) Experience of other OWFs is no LSE, particularly as connectivity mostly during the non-breeding period. Therefore LSE does not apply alone or in-combination.

Matrix 65: Outer Firth of Forth and St Andrew's Complex pSPA

Name of European site: Outer Firth of Forth and St Andrew's Complex pSPA												
Distance to Hornsea Four: 241 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey and species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			✓e			Xb	
Guillemot		✓f			Xb			Xc			Xg	
Razorbill		✓f			Xb			Xc			Xg	
Puffin		✓f			Xb			Xc			Xg	
Red-throated diver												
Little gull												
Common tern												
Arctic tern												
Slavonian grebe												
Common eider												

Long-tailed duck												
Common scoter												
Velvet scoter												
Common goldeneye												
Red-breasted merganser												
Manx shearwater												
European shag												
Kittiwake												
Black-headed gull												
Common gull												
Herring gull												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season
- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 66: Outer Firth of Forth and St Andrew's Complex pSPA

Name of European site: Outer Firth of Forth and St Andrew's Complex pSPA												
Distance to Hornsea Four: 241 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Guillemot		Xf			Xb			Xc			Xg	
Razorbill		Xf			Xb			Xc			Xg	
Puffin		Xf			Xb			Xc			Xg	
Red-throated diver												
Little gull												
Common tern												
Arctic tern												
Slavonian grebe												
Common eider												

Long-tailed duck												
Common scoter												
Velvet scoter												
Common goldeneye												
Red-breasted merganser												
Manx shearwater												
European shag												
Kittiwake												
Black-headed gull												
Common gull												
Herring gull												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE alone. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season. Therefore LSE does not apply alone or in-combination.
- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season. Findings in RIAA were of no LSE alone. Therefore LSE does not apply alone or in-combination.
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 67: Fowlsheugh SPA

Name of European site: Fowlsheugh SPA												
Distance to Hornsea Four: 341 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			✓e			Xb	
Herring gull		Xd			Xb			Xf			Xb	
Guillemot		✓g			Xb			Xc			Xh	
Razorbill		✓g			Xb			Xc			Xh	

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- f) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 68: Fowlsheugh SPA

Name of European site: Fowlsheugh SPA												
Distance to Hornsea Four: 341 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Herring gull		Xd			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	
Razorbill		Xg			Xb			Xc			Xh	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in very low densities within the array area, though a proportion fly at PCH. Collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.**

Matrix 69: Buchan Ness to Collieston Coast SPA

Name of European site: Buchan Ness to Collieston Coast SPA												
Distance to Hornsea Four: 381 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			✓e			Xb	
Herring gull		Xd			Xb			Xf			Xh	
Guillemot		✓g			Xb			Xc			Xh	
Shag												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- f) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 70: Buchan Ness to Collieston Coast SPA

Name of European site: Buchan Ness to Collieston Coast SPA												
Distance to Hornsea Four: 381 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Herring gull		Xd			Xb			Xf			Xh	
Guillemot		Xg			Xb			Xc			Xh	
Shag												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in very low densities within the array area, though a proportion fly at PCH. Collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.**

Matrix 71: Troup, Pennan and Lion's Heads SPA

Name of European site: Troup, Pennan and Lion's Heads SPA												
Distance to Hornsea Four: 423 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			✓e			Xb	
Herring gull		Xd			Xb			Xf			Xb	
Guillemot		✓g			Xb			Xc			Xh	
Razorbill		✓g			Xb			Xc			Xh	

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential

- f) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 72: Troup, Pennan and Lion's Heads SPA

Name of European site: Troup, Pennan and Lion's Heads SPA												
Distance to Hornsea Four: 423 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Herring gull		Xd			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	
Razorbill		Xg			Xb			Xc			Xh	

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in very low densities within the array area, though a proportion fly at PCH. Collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 73: East Caithness Cliffs SPA

Name of European site: East Caithness Cliffs SPA												
Distance to Hornsea Four: 500 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			✓e			Xb	
Herring gull		Xd			Xb			Xg			Xb	
Great black-backed gull		Xd			Xb			✓g			Xb	
Guillemot		✓h			Xb			Xc			Xi	
Razorbill		✓h			Xb			Xc			Xi	
Peregrine												
Shag												
Puffin												
Cormorant												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- f) Present in very low densities within the array area, though a proportion fly at PCH. Preliminary collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance.
- g) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 74: East Caithness Cliffs SPA

Name of European site: East Caithness Cliffs SPA												
Distance to Hornsea Four: 500 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Herring gull		Xd			Xb			Xg			Xb	
Great black-backed gull		Xd			Xb			Xg			Xb	
Guillemot		Xh			Xb			Xc			Xi	
Razorbill		Xh			Xb			Xc			Xi	
Peregrine												
Shag												
Puffin												
Cormorant												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.†
- d) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in very low densities within the array area, though a proportion fly at PCH. Collision risk assessment estimated extremely low potential mortality rates that would be trivial or inconsequential to any colony, particularly those at such a distance. Therefore LSE does not apply alone or in-combination.
- g) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 75: North Caithness Cliffs SPA

Name of European site: North Caithness Cliffs SPA												
Distance to Hornsea Four: 534 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			✓e			Xb	
Guillemot		✓f			Xb			Xg			Xb	
Razorbill		✓f			Xb			Xc			Xg	
Puffin		✓f			Xb			Xc			Xg	
Peregrine												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- f) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 76: North Caithness Cliffs SPA

Name of European site: North Caithness Cliffs SPA												
Distance to Hornsea Four: 534 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Guillemot		Xf			Xb			Xg			Xb	
Razorbill		Xf			Xb			Xc			Xg	
Puffin		Xf			Xb			Xc			Xg	
Peregrine												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) **Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.**

Matrix 77: Copinsay SPA

Name of European site: Copinsay SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Great black-backed gull		Xd			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Not sensitive to operation and maintenance activities
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Colonsay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

- f) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Colonsay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 78: Copinsay SPA

Name of European site: Copinsay SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xd			Xb			Xe			Xb	
Great black-backed gull		Xd			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Colonsay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds

flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

- f) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Colonsay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 79: Hoy SPA

Name of European site: Hoy SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Kittiwake		Xa			Xb			Xf			Xb	
Great black-backed gull		Xa			Xb			Xg			Xb	
Guillemot		Xh			Xb			Xc			Xi	
Puffin		Xh			Xb			Xc			Xi	
Peregrine												
Red throated diver												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Potential connectivity to array area during migratory bio-seasons, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- f) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Hoy, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- g) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Hoy, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 80: Hoy SPA

Name of European site: Hoy SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Kittiwake		Xa			Xb			Xf			Xb	
Great black-backed gull		Xa			Xb			Xg			Xb	
Guillemot		Xh			Xb			Xc			Xi	
Puffin		Xh			Xb			Xc			Xi	
Peregrine												
Red throated diver												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Potential connectivity to array area during migratory bio-seasons, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea. Therefore LSE does not apply alone or in-combination.
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Hoy, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Hoy, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 81: Marwick Head SPA

Name of European site: Marwick Head SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake		Xa			Xb			Xc			Xb	
Guillemot		Xd			Xb			Xe			Xf	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities
- Experience of other OWFs is no LSE
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Marwick Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Marwick Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- A species that flies low to the water with very low risk of collision

- f) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 82: Marwick Head SPA

Name of European site: Marwick Head SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake		Xa			Xb			Xc			Xb	
Guillemot		Xd			Xb			Xe			Xf	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Marwick Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Marwick Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

- e) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- f) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination

Matrix 83: Rousay SPA

Name of European site: Rousay SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Arctic skua		Xa			Xb			Xd			Xa	
Kittiwake		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xf			Xg	
Guillemot		Xh			Xb			Xc			Xi	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Rousay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- f) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and also to migrate in a westerly direction from the Rousay colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Rousay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 84: Rousay SPA

Name of European site: Rousay SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Arctic skua		Xa			Xb			Xd			Xb	
Kittiwake		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xf			Xg	
Guillemot		Xh			Xb			Xc			Xi	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Rousay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and also to migrate in a westerly direction from the Rousay colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Rousay, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 85: Calf of Eday SPA

Name of European site: Calf of Eday SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xa			Xb			Xd			Xe	
Great black-backed gull		Xa			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	
Cormorant												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Calf of Eday, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds

flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential
- f) Present in very low numbers and proportion fly at PCH
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Calf of Eday, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 86: Calf of Eday SPA

Name of European site: Calf of Eday SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xa			Xb			Xd			Xe	
Great black-backed gull		Xa			Xb			Xf			Xb	
Guillemot		Xg			Xb			Xc			Xh	
Cormorant												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Calf of Eday, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in very low numbers and proportion fly at PCH therefore any effect likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Calf of Eday, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 87: West Westray SPA

Name of European site: West Westray SPA												
Distance to Hornsea Four: 605 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Arctic skua		Xa			Xb			Xd			Xa	
Kittiwake		Xa			Xb			Xe			Xb	
Guillemot		Xf			Xb			Xc			Xg	
Razorbill		Xf			Xb			Xc			Xg	
Arctic tern												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision

- d) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- f) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 88: West Westray SPA

Name of European site: West Westray SPA												
Distance to Hornsea Four: 605 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Arctic skua		Xa			Xb			Xd			Xa	

Kittiwake		Xa			Xb			Xe			Xb	
Guillemot		Xf			Xb			Xc			Xg	
Razorbill		Xf			Xb			Xc			Xg	
Arctic tern												

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Potential connectivity to array area during migratory bio-seasons, but limited effect when considering one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 89: Fair Isle SPA

Name of European site: Fair Isle SPA												
Distance to Hornsea Four: 607 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Great skua		Xa			Xb			Xf			Xb	
Arctic skua		Xa			Xb			Xf			Xb	
Kittiwake		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xg			Xh	
Guillemot		Xi			Xb			Xc			Xh	
Razorbill		Xj			Xb			Xc			Xh	
Puffin		Xi			Xb			Xc			Xh	
Arctic tern												
Fair Isle wren												

Shag

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Fair Isle, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- f) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Fair Isle and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- g) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and also to migrate in a westerly direction from the Fair Isle colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- i) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- j) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Fair Isle, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

Matrix 90: Fair Isle SPA

Name of European site: Fair Isle SPA												
Distance to Hornsea Four: 607 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Great skua		Xa			Xb			Xf			Xb	
Arctic skua		Xa			Xb			Xf			Xb	
Kittiwake		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xg			Xh	
Guillemot		Xi			Xb			Xc			Xh	
Razorbill		Xj			Xb			Xc			Xh	
Puffin		Xi			Xb			Xc			Xh	
Arctic tern												
Fair Isle wren												

Shag

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season. Therefore LSE does not apply alone or in-combination.
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Fair Isle, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Fair Isle and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and also to migrate in a westerly direction from the Fair Isle colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- i) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- j) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Fair Isle, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 91: Sumburgh Head SPA

Name of European site: Sumburgh Head SPA												
Distance to Hornsea Four: 639 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xa			Xb			Xd			Xb	
Arctic tern		Xa			Xb			Xe			Xf	
Guillemot		Xg			Xb			Xc			Xf	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities.
- Experience of other OWFs is no LSE
- A species that flies low to the water with very low risk of collision
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Sumburgh Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

- e) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Sumburgh Head colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- f) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

Matrix 92: Sumburgh Head SPA

Name of European site: Sumburgh Head SPA												
Distance to Hornsea Four: 639 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Kittiwake		Xa			Xb			Xd			Xb	
Arctic tern		Xa			Xb			Xe			Xf	
Guillemot		Xg			Xb			Xc			Xf	

Evidence supporting conclusions:

- Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Sumburgh Head, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

- e) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Sumburgh Head colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- f) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- g) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 93: Foula SPA

Name of European site: Foula SPA												
Distance to Hornsea Four: 678 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Kittiwake		Xa			Xb			Xf			Xb	
Arctic tern		Xa			Xb			Xg			Xh	
Guillemot		Xi			Xb			Xc			Xh	
Razorbill		Xj			Xb			Xc			Xh	
Puffin		Xi			Xb			Xc			Xh	
Leach's storm petrel												
Red throated diver												
Shag												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering as species more likely to migrate closer to coast and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Foula and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- f) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- g) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Foula colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- i) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- j) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential

Matrix 94: Foula SPA

Name of European site: Foula SPA												
Distance to Hornsea Four: 678 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Kittiwake		Xa			Xb			Xf			Xb	
Arctic tern		Xa			Xb			Xg			Xh	
Guillemot		Xi			Xb			Xc			Xh	
Razorbill		Xj			Xb			Xc			Xh	
Puffin		Xi			Xb			Xc			Xh	
Leach's storm petrel												
Red throated diver												

Shag

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering as species more likely to migrate closer to coast and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Foula and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Foula colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- h) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.
- i) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- j) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.

Matrix 95: Fetlar SPA

Name of European site: Fetlar SPA												
Distance to Hornsea Four: 712 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xf			Xg	
Red-necked Phalarope												
Dunlin												
Whimbrel												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.
- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision

- d) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Fetlar and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- f) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Fetlar colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 96: Fetlar SPA

Name of European site: Fetlar SPA												
Distance to Hornsea Four: 712 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Great skua		Xa			Xb			Xd			Xb	
Arctic skua		Xa			Xb			Xe			Xb	
Arctic tern		Xa			Xb			Xf			Xg	
Red-necked Phalarope												
Dunlin												
Whimbrel												

Evidence supporting conclusions:

- [Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.
- A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.

- d) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering as species more likely to migrate closer to coast and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- e) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering small population of Fetlar and the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Potential connectivity to array area during migratory bio-seasons, but limited potential for any effect as species more likely to migrate closer to coast and migratory movements being split between a westerly and easterly direction from the Fetlar colony, so any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs. Therefore LSE does not apply alone or in-combination.
- g) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

Matrix 97: Hermaness, Saxa Vord and Valla Field SPA

Name of European site: Hermaness, Saxa Vord and Valla Field SPA												
Distance to Hornsea Four: 733 km												
European Site Feature	Likely Effects of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Great skua		Xa			Xb			Xf			Xb	
Kittiwake		Xa			Xb			Xg			Xb	
Guillemot		Xh			Xb			Xc			Xi	
Puffin		Xh			Xb			Xc			Xi	
Red throated diver												
Shag												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities.

- b) Experience of other OWFs is no LSE
- c) A species that flies low to the water with very low risk of collision
- d) Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- f) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential
- g) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season

Matrix 98: Hermaness, Saxa Vord and Valla Field SPA

Name of European site: Hermaness, Saxa Vord and Valla Field SPA												
Distance to Hornsea Four: 733 km												
European Site Feature	Likely Effects of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar		Xa			Xb			Xc			Xb	
Gannet		Xd			Xb			Xe			Xb	
Great skua		Xa			Xb			Xf			Xb	
Kittiwake		Xa			Xb			Xg			Xb	
Guillemot		Xh			Xb			Xc			Xi	
Puffin		Xh			Xb			Xc			Xi	
Red throated diver												
Shag												

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities. Therefore LSE does not apply alone or in-combination.
- b) Experience of other OWFs is no LSE. Therefore LSE does not apply alone or in-combination.

- c) A species that flies low to the water with very low risk of collision. Therefore LSE does not apply alone or in-combination.
- d) Not sensitive to operation and maintenance activities during non-breeding season and too distant from array area to be the cause of an effect during the breeding season. Therefore LSE does not apply alone or in-combination.
- e) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- f) Potential connectivity to array area during migratory bio-seasons, but limited effect when considering the one off migratory movements through OWFs, as demonstrated in previous EIA / HRA assessments for OWFs in the English North Sea that any risk is highly likely to be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- g) Present in moderate densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to small population at Foula, birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- h) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, though connectivity limited due to birds at this colony more likely to migrate away from the colony into the Atlantic and those birds flying into the North Sea being mixed with considerably larger non-breeding bio-season North Sea populations and therefore any effect would be trivial and inconsequential. Therefore LSE does not apply alone or in-combination.
- i) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season. Therefore LSE does not apply alone or in-combination.

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Integrity Matrix - Potential Impacts

Potential impacts upon the European site(s) which are considered within the RIAA report to which the current Appendix is appended are provided in the table below. Impacts have been grouped where appropriate for ease of presentation.

The designated sites, features and effects assessed here (and where relevant listed below) are limited to those where potential for LSE has been identified in the screening matrix (appended to the RIAA as Appendix C). Where no LSE has been identified, there is no need to consider potential for AEol.

Impacts considered within the integrity matrices

Designation	Impacts in submission information
Southern North Sea SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance Collision risk
Flamborough Head SAC	<u>Alone:</u> Temporary increases in suspended sediments / smothering Invasive non-native species Change in physical processes <u>In-combination:</u> Temporary increases in suspended sediments / smothering Invasive non-native species Change in physical processes
Moray Firth SAC	<u>Alone:</u> None – all screened out of LSE (therefore not presented here) <u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
The Wash and North Norfolk Coast SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
River Derwent SAC	None – all screened out of LSE (therefore not presented here) None – all screened out of LSE (therefore not presented here)
Humber Estuary SAC	<u>Alone (grey seal):</u> Increase in underwater noise Vessel disturbance

Designation	Impacts in submission information
	<p><u>Alone (Atlantic salt meadows and Salicornia and other annuals colonising mud and sand):</u> Increased nitrogen deposition</p> <p><u>In-combination (grey seal):</u> Increase in underwater noise Vessel disturbance Collision risk</p>
Humber Estuary Ramsar	<p><u>Alone (grey seal):</u> Increase in underwater noise Vessel disturbance</p> <p><u>Alone (saltmarsh):</u> Increased nitrogen deposition</p> <p><u>In-combination (grey seal):</u> Increase in underwater noise Vessel disturbance Collision risk</p> <p><u>In-combination (ornithology):</u> None – all screened out of LSE (therefore not presented here)</p>
Humber Estuary SPA (onshore)	<p><u>Alone:</u> None – all screened out of LSE (therefore not presented here)</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Berwickshire and North Northumberland Coast SAC	<p><u>Alone:</u> Increase in underwater noise Vessel disturbance</p> <p><u>In-combination:</u> Increase in underwater noise Vessel disturbance</p>
Transboundary sites: harbour porpoise (49 sites)	<p><u>Alone:</u> None – all screened out of LSE (therefore not presented here)</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Transboundary sites: bottlenose dolphin (5 sites)	<p><u>Alone:</u> None – all screened out of LSE (therefore not presented here)</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Transboundary site: Doggersbank (Dutch) SAC	<p><u>Alone:</u> Increase in underwater noise Vessel disturbance</p>

Designation	Impacts in submission information
	<u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Klaverbank (Dutch) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Bancs des Flandres (France) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Vlaamse Banken (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: SBZ 1 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: SBZ 2 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: SBZ 3 (Belgium) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Vlake van de Raan (Belgium/Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise

Designation	Impacts in submission information
	Vessel disturbance
Transboundary site: Westerschelde & Saeftinghe (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Voordelta (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Noordzeekustzone (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Transboundary site: Waddenzee (Netherlands) SAC	<u>Alone:</u> Increase in underwater noise Vessel disturbance <u>In-combination:</u> Increase in underwater noise Vessel disturbance
Greater Wash SPA	<u>Alone:</u> Direct disturbance and displacement Risk of collision <u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Flamborough & Filey Coast SPA	<u>Alone:</u> Direct disturbance and displacement Risk of collision Barrier effect <u>In-combination:</u> Direct disturbance and displacement Risk of collision
Northumbria Coast SPA	<u>Alone:</u> Risk of collision <u>In-combination:</u> None – all screened out of LSE (therefore not presented here)
Humber Estuary SPA	<u>Alone:</u> Risk of collision <u>In-combination:</u> None – all screened out of LSE (therefore not presented here)

Designation	Impacts in submission information
Hornsea Mere SPA	<p><u>Alone:</u> Risk of collision</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Coquet Island SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Farne Islands SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Forth Islands (UK) SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Outer Firth of Forth and St Andrew's Complex pSPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Fowlsheugh SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Buchan Ness to Collieston Coast SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
Troup, Pennan and Lion's Heads SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
East Caithness Cliffs SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p> <p><u>In-combination:</u> None – all screened out of LSE (therefore not presented here)</p>
North Caithness Cliffs SPA	<p><u>Alone:</u> Risk of collision Direct disturbance and displacement</p>

Designation	Impacts in submission information
	In-combination: None – all screened out of LSE (therefore not presented here)

Integrity Matrix

The European Sites for which a likely significant effect has been identified are as follows:

- Southern North Sea SAC
- Flamborough Head SAC
- The Wash and North Norfolk Coast SAC
- Humber Estuary SAC
- Humber Estuary Ramsar
- Berwickshire and North Northumberland Coast SAC
- Transboundary site: Doggersbank (Dutch) SAC
- Transboundary site: Klaverbank (Dutch) SAC
- Transboundary site: Bancs des Flandres (France) SAC
- Transboundary site: Vlaamse Banken (Belgium) SAC
- Transboundary site: SBZ 1 (Belgium) SAC
- Transboundary site: SBZ 2 (Belgium) SAC
- Transboundary site: SBZ 3 (Belgium) SAC
- Transboundary site: Vlakte van de Raan (Belgium/Netherlands) SAC
- Transboundary site: Westerschelde & Saeflinghe (Netherlands) SAC
- Transboundary site: Voordelta (Netherlands) SAC
- Transboundary site: Noordzeekustzone (Netherlands) SAC
- Transboundary site: Waddenzee (Netherlands) SAC
- Greater Wash SPA
- Flamborough & Filey Coast SPA
- Northumbria Coast SPA
- Humber Estuary SPA
- Hornsea Mere SPA
- Coquet Island SPA
- Farne Islands SPA
- Forth Islands SPA
- Outer Firth of Forth and St Andrew's Complex pSPA
- Fowlsheugh SPA
- Buchan Ness to Collieston Coast SPA
- Troup, Pennan and Lion's Heads SPA
- East Caithness Cliffs SPA
- North Caithness Cliffs SPA

Evidence for the conclusions reached in integrity is detailed within the footnotes to the matrices below.

Matrix Key

✓: Adverse Effect on Integrity **cannot** be excluded

X: Adverse Effect on Integrity **can** be excluded

Lower case letters in the table relate to the evidence supporting the conclusions below.

C = construction

O = operation
D = decommissioning

Where effects were screened out from LSE in the Screening Matrices and are not applicable to a particular feature, these are greyed out.

Matrix 1: Southern North Sea SAC

Name of European site: Southern North Sea SAC																					
Distance to Hornsea Four: 0 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour porpoise	Xa	Xa	Xa	Xb	Xb	Xb															

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and according to the approach required by SNCBs. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, assessed on a spatial (20% per day) and temporal (10% across a season), similarly found the thresholds would not be exceeded by the project alone in all cases and therefore the conclusion is of no AEol. No potential for AEol to the supporting habitat and processes relevant to prey were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping, particularly in the context of the 80 vessel movements per day noted as the level above which a negative effect has been noted on harbour porpoise density. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 2: Southern North Sea SAC

Name of European site: Southern North Sea SAC																						
Distance to Hornsea Four: 0 km																						
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Harbour porpoise	Xa	Xa	Xa	Xb	Xb	Xb	Xc	Xc	Xc													

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation (where information on these activities is known for the projects assessed in-combination). All are considered on a worst case basis and according to the approach required by SNCBs. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, with the expectation that a similar requirement will be made of all projects considered in-combination, enabling a conclusion of no AEol in all cases. The potential for disturbance, assessed on a spatial (20% per day) and temporal (10% across a season), found a variable level of risk depending on the season and year being assessed. Key to that risk is how the projects assessed in-combination eventually come forward – both in terms of timeframe but also final project design. That risk will be managed through the Site Integrity Plan for Hornsea Four, with a similar document anticipated to be required on all such projects, and which will be in place for the application and provided for in the DCO. The SIP provides the framework within which certainty is provided that Hornsea Four alone and in-combination will not exceed the thresholds. No potential for AEol to the supporting habitat and processes relevant to prey were found. Therefore, the conclusion is

of no AEol with respect to underwater noise for Hornsea Four alone and in-combination at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping, particularly in the context of the 80 vessel movements per day noted as the level above which a negative effect has been noted on harbour porpoise density. The localised nature of effect associated with individual vessels and the widely dispersed nature of the projects considered in-combination is also noted. The conclusion is of no AEol with respect to vessel disturbance from Hornsea Four alone and in-combination at all stages of the project (construction, operation & maintenance and decommissioning).
- c) There is a lack of information on the frequency and occurrence of vessel collisions with respect to marine mammal mortality; from the evidence that exists in the UK, it is not considered a significant mortality risk. The nature of the vessel movements associated with Hornsea Four and the projects considered in-combination is such that most will follow existing shipping lanes (will be predictable to marine mammals) and will spend a proportion of the time stationary or moving slowly. In addition, Hornsea Four (similar to many of the projects considered) will implement a vessel management plan to minimise potential effects on marine mammals. It can therefore be concluded that Hornsea Four will not contribute to any in-combination collision risk to harbour porpoise and that there will be no AEol to the SNS SAC alone and in-combination.

Matrix 3: Flamborough Head SAC

Name of European site: Flamborough Head SAC																								
Distance to Hornsea Four: 1.17 km																								
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																							
	Temporary habitat loss/ disturbance			Temporary increases in suspended sediments /			Accidental pollution			Invasive non-native species			Changes to physical processes			Long-term physical loss of habitat			Introduction of hard substrate			EMF		
Construction: C	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Operation: O																								
Decommissioning: D																								
Reefs				Xa	Xb	Xa				Xc	Xc	Xc		Xd										
Vegetated sea cliffs of the Atlantic and Baltic Coasts																								
Submerged or partially submerged sea caves				Xa	Xb	Xa				Xc	Xc	Xc												

Evidence supporting conclusions:

- Effects from sediment deposition from ECC construction and decommissioning works would be limited to the immediate vicinity of the cable trench with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in a measurable thickness. Due to the short-term and temporary nature of the change, and the existing level of suspended sediment concentrations (SSC) in the area, the sites conservation objectives will be maintained in the long-term and therefore no AEol is concluded.
- Any effects of increase in SSC and deposition arising from operation and maintenance are likely to be less than those of construction. Therefore, the sites conservation objectives will be maintained in the long-term and therefore no AEol is concluded.

- c) A series of mitigation measures are proposed to minimise the risk of spread of invasive non-native species such as a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines. These will ensure that the risk of potential introduction and spread of INNS is minimised. Given the low risk of promoting the risk of spread of INNS a conclusion of no AEol is drawn.
- d) The potential effect of the project on the Flamborough Head SAC is considered as part of the Marine Geology, Oceanography and Physical Processes assessment. This concludes that impacts on hydrodynamic wave regimes will be of negligible significance and will not result in significant changes to sediment transport and consequently will not have any impacts on benthic ecology. A conclusion of no AEol is therefore reached for the effects on the SAC through changes in physical processes.

Matrix 4: Flamborough Head SAC

Name of European site: Flamborough Head SAC																								
Distance to Hornsea Four: 1.17 km																								
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																							
	Temporary habitat loss/ disturbance			Temporary increases in suspended sediments /			Accidental pollution			Invasive non-native species			Changes to physical processes			Long-term physical loss of habitat			Introduction of hard substrate			EMF		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reefs				Xa	Xa	Xa				Xb	Xb	Xb		Xc										
Vegetated sea cliffs of the Atlantic and Baltic Coasts																								
Submerged or partially submerged sea caves				Xa	Xa	Xa				Xb	Xb	Xb												

Evidence supporting conclusions:

- Two projects were considered in-combination with Hornsea Four: Bridlington Bay disposal site and Creyke Beck A and B offshore windfarm. For Bridlington Bay disposal site, if discharging of overspill of fine silt and sands in the nearshore from cable trenching were to occur at the same time that the disposal site is being used, there is the potential that a larger sediment plume may form. However, this will quickly disperse given the location of the spoil site in an area of faster flows and therefore the cumulative impact is considered negligible. With regard to the Creyke Beck landfall (1.5km south of Hornsea Four landfall), the expectation is that Creyke Beck will be completed before construction for Hornsea Four commences. This means that the potential for cumulative impacts of temporary increases in SSC is removed. Overall it is concluded that there is no potential for an AEol on the SAC through this in-combination increases in SSC and deposition.

- b) The risk of spread of INNS in-combination with Creyke Beck is considered. It is concluded that each project has a negligible risk of increase in the spread of INNS and in-combination there is no potential for an AEol on the SAC.
- c) The expectation is that the landfall works for Creyke Beck will be completed in advance of Hornsea Four construction commences. On this basis there is not expected to be any larger cumulative effects on the integrity of the local beach. A conclusion of no AEol on the SAC is therefore reached.

Matrix 5: The Wash and North Norfolk Coast SAC

Name of European site: The Wash and North Norfolk Coast SAC																					
Distance to Hornsea Four: 32 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Atlantic salt meadows																					
Coastal lagoons																					
Large shallow inlets and bays																					
Mediterranean and thermo-Atlantic halophilous scrubs																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Salicornia and other annuals colonising mud and sand																					
Sandbanks which are slightly covered by sea water all the time and																					
Harbour seal	Xa			Xa	Xb	Xb	Xb														
Otter																					

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst-case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, considers the number of harbour seal that could (as a worst case) be disturbed relative to the population within the SAC, finding a very small proportion of the site population could be temporarily affected. Therefore the conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of harbour seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 6: The Wash and North Norfolk Coast SAC

Name of European site: The Wash and North Norfolk Coast SAC																					
Distance to Hornsea Four: 32 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Atlantic salt meadows																					
Coastal lagoons																					
Large shallow inlets and bays																					
Mediterranean and thermo-Atlantic halophilous scrubs																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Salicornia and other annuals colonising mud and sand																					
Sandbanks which are slightly covered by sea water all the time and																					
Harbour seal	Xa			Xa	Xb	Xb	Xb														
Otter																					

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, considers the number of harbour seal that could (as a worst case) be disturbed relative to the population within the SAC, finding a very small proportion of the site population could be temporarily affected with the potential for effect from the project alone being so low that no contribution to any in-combination effect is predicted. Therefore the conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of harbour seal were found. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal density and sensitivity. Hornsea Four alone has the potential to disturb such a very small proportion of the site population that no contribution to any in-combination effect is predicted. Therefore the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 7: Humber Estuary SAC

Name of European site: Humber Estuary SAC																																
Distance to Hornsea Four: 32 km																																
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																															
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability			Accidental pollution			Temporary increases in suspended			Temporary habitat loss/disturbance			Long-term physical loss of habitat			Introduction of hard substrate			Changes to physical processes			Increased nitrogen deposition	
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Atlantic salt meadows																													Xd		Xc	
Coastal lagoons																																
Dunes with Hippophae rhamnoides;																																
Embryonic shifting dunes																																
Estuaries																																
Fixed dunes with herbaceous vegetation																																
Mudflats and sandflats not																																

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance considers the number of grey seal that could (as a worst case) be disturbed relative to the population within the SAC, in the context of the grey seal dose response assessment being an over estimate, the widespread availability of alternative foraging grounds and the very unlikely risk that survival or reproductive rates could be affected by such disturbance. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of grey seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

- c) The air quality assessment identified a risk of increased nitrogen deposition within a small area (2.9ha) of saltmarsh within the SAC. No AEol was concluded as only a small area of saltmarsh within the SAC would be affected, any effect would be temporary and the critical load for nitrogen would only be marginally exceeded.

Matrix 8: Humber Estuary SAC

Name of European site: Humber Estuary SAC																														
Distance to Hornsea Four: 32 km																														
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																													
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and			Accidental pollution			Temporary increases in suspended sediments			Temporary habitat loss/ disturbance			Long-term physical loss of habitat			Introduction of hard substrate			Changes to physical processes		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Atlantic salt meadows																														
Coastal lagoons																														
Dunes with Hippophae rhamnoides;																														
Embryonic shifting dunes																														
Estuaries																														
Fixed dunes with herbaceous vegetation																														
Mudflats and sandflats not covered																														

[illegible]

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance considered the potential for the 2 projects identified in-combination to result in an increase in the predicted (likely overly precautionary) disturbance from the project alone, with very little difference found between the assessment alone and in-combination. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of grey seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. No significant difference is found between the assessment for Hornsea Four alone and for Hornsea Four in-combination. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

- c) There is a lack of information on the frequency and occurrence of vessel collisions with respect to marine mammal mortality; from the evidence that exists in the UK, it is not considered a key mortality risk. The nature of the vessel movements associated with Hornsea Four and the projects considered in-combination is such that most will follow existing shipping lanes (will be predictable to marine mammals) and will spend a proportion of the time stationary or moving slowly. In addition, Hornsea Four (similar to many of the projects considered) will implement a vessel management plan to minimise potential effects on marine mammals. It can therefore be concluded that Hornsea Four will not contribute to any in-combination collision risk to grey seal and that there will be no AEol alone and in-combination.

Matrix 9: Humber Estuary Ramsar

Name of European site: Humber Estuary Ramsar																														
Distance to Hornsea Four: 32 km																														
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																													
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate			Increased nitrogen deposition		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Dune systems and humid dune slacks																														
Estuarine waters																														
Intertidal mud and sand flats																														
saltmarshes																												Xc		X
Coastal brackish/saline lagoons																														
Grey seal	Xa			Xa	Xb	Xb	Xb																							
Natterjack toad																														
Waterfowl																														

Name of European site: Humber Estuary Ramsar																													
Distance to Hornsea Four: 32 km																													
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																												
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate			Increased nitrogen deposition	
River lamprey																													
Sea lamprey																													
Golden plover																													
Dunlin																													
Black-tailed godwit																													
Bar-tailed godwit																													
Redshank																													
Shelduck																													
Red knot																													

Matrix 10: Humber Estuary Ramsar (continued)

Name of European site: Humber Estuary Ramsar (continued)																								
Distance to Hornsea Four: 32 km																								
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																							
	Changes to physical			Risk of collision			Temporary disturbance / damage to habitats			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C																								
Operation: O																								
Decommissioning: D																								
Dune systems and humid dune slacks																								
Estuarine waters																								
Intertidal mud and sand flats saltmarshes																								
Coastal brackish/saline lagoons																								
Grey seal																								
Natterjack toad																								
Waterfowl																								
River lamprey																								
Sea lamprey																								
Golden plover																								

Name of European site: Humber Estuary Ramsar (continued)																						
Distance to Hornsea Four: 32 km																						
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																					
	Changes to physical	Risk of collision	Temporary disturbance / damage to habitats	Habitat fragmentation or severance (onshore)	Visual and / or noise disturbance to species (onshore)	Invasive non-native species (onshore)	Temporary habitat loss (onshore)	Temporary disturbance / damage to habitats (onshore)														
Dunlin																						
Black-tailed godwit																						
Bar-tailed godwit																						
Redshank																						
Shelduck																						
Red knot																						

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance considers the number of grey seal that could (as a worst case) be disturbed relative to the population within the Ramsar, in the context of the grey seal dose response assessment being an over estimate, the widespread availability of alternative foraging grounds and the very unlikely risk that survival or reproductive rates could be affected by such disturbance. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of grey seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).
- c) The air quality assessment identified a risk of increased nitrogen deposition within a small area (2.9ha) of saltmarsh within the Ramsar. No AEol was concluded as only a small area of saltmarsh within the Ramsar would be affected, any effect would be temporary and the critical load for nitrogen would only be marginally exceeded.

Matrix 11: Humber Estuary Ramsar

Name of European site: Humber Estuary Ramsar																											
Distance to Hornsea Four: 32 km																											
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																										
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Dune systems and humid dune slacks																											
Estuarine waters																											
Intertidal mud and sand flats saltmarshes																											
Coastal brackish/saline lagoons																											
Grey seal	Xa			Xa	Xb	Xb	Xb	Xc	Xc	Xc																	
Natterjack toad																											
Waterfowl																											
River lamprey																											
Sea lamprey																											

Name of European site: Humber Estuary Ramsar																										
Distance to Hornsea Four: 32 km																										
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																									
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			Temporary habitat loss/disturbance			Introduction of hard substrate	
Golden plover																										
Dunlin																										
Black-tailed godwit																										
Bar-tailed godwit																										
Redshank																										
Shelduck																										
Red knot																										

Matrix 12: Humber Estuary Ramsar (continued)

Name of European site: Humber Estuary Ramsar (continued)																								
Distance to Hornsea Four: 32 km																								
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																							
	Changes to physical processes			Risk of collision			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)		
	C	O	D				C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C																								
Operation: O																								
Decommissioning: D																								
Dune systems and humid dune slacks																								
Estuarine waters																								
Intertidal mud and sand flats																								
saltmarshes																								
Coastal brackish/saline lagoons																								
Grey seal																								
Natterjack toad																								
Waterfowl																								
River lamprey																								

Name of European site: Humber Estuary Ramsar (continued)																								
Distance to Hornsea Four: 32 km																								
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																							
	Changes to physical processes			Risk of collision			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)		
Sea lamprey																								
Golden plover																								
Dunlin																								
Black-tailed godwit																								
Bar-tailed godwit																								
Redshank																								
Shelduck																								
Red knot																								

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance considered the potential for the 2 projects identified in-combination to result in an increase in the predicted (likely overly precautionary) disturbance from the project alone, with very little difference found between the assessment alone and in-combination. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural

habitat of grey seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. No significant difference is found between the assessment for Hornsea Four alone and for Hornsea Four in-combination. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).
- c) There is a lack of information on the frequency and occurrence of vessel collisions with respect to marine mammal mortality; from the evidence that exists in the UK, it is not considered a key mortality risk. The nature of the vessel movements associated with Hornsea Four and the projects considered in-combination is such that most will follow existing shipping lanes (will be predictable to marine mammals) and will spend a proportion of the time stationary or moving slowly. In addition, Hornsea Four (similar to many of the projects considered) will implement a vessel management plan to minimise potential effects on marine mammals. It can therefore be concluded that Hornsea Four will not contribute to any in-combination collision risk to grey seal and that there will be no AEol alone and in-combination.

Matrix 13: Berwickshire and North Northumberland Coast SAC

Name of European site: Berwickshire and North Northumberland Coast SAC																					
Distance to Hornsea Four: 171 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Large shallow inlets and bays																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Submerged and partially submerged sea caves																					
Grey seal	Xa		Xa	Xb	Xb	Xb															

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance considers the number of grey seal that could (as a worst case) be disturbed relative to the population

within the SAC, in the context of the grey seal dose response assessment being a likely over estimate, the distance between the array and the SAC and the widespread availability of alternative foraging grounds. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of grey seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 14: Berwickshire and North Northumberland Coast SAC

Name of European site: Berwickshire and North Northumberland Coast SAC																					
Distance to Hornsea Four: 171 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Large shallow inlets and bays																					
Mudflats and sandflats not covered by seawater at low tide																					
Reefs																					
Submerged and partially submerged sea caves																					
Grey seal	Xa		Xa	Xb	Xb	Xb															

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance considers the number of grey seal that could (as a worst case) be disturbed relative

to the population within the SAC, in the context of the grey seal dose response assessment being a likely over estimate, the distance between the array and the SAC, the widespread availability of alternative foraging grounds and the significant uncertainty around construction timings at the projects identified in-combination. The resulting conclusion is of no AEol. Similarly, no potential for AEol to the natural habitat of grey seal were found. Therefore, the conclusion is of no AEol as a result of Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. No significant difference was found between the assessment for Hornsea Four alone and for Hornsea Four in-combination. The conclusion is of no AEol as a result of Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 15: Doggersbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																					
Distance to Hornsea Four: 84 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	Xa			Xa	Xb	Xb															
Harbour seal	Xa			Xa	Xb	Xb															
Harbour porpoise																					

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, highlights that the at sea usage data for harbour seal and grey seal indicates that Hornsea Four does not appear to sit on a transit route between the SAC and the UK coastline, with greater potential for connectivity appearing to relate to mainland Europe. When combined with the distance between the array boundary and the SAC, a conclusion of no AEol has

been drawn. Similarly, no potential for AEol to the natural habitat of harbour seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal and grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 16: Doggersbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																					
Distance to Hornsea Four: 84 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	Xa		Xa	Xb	Xb	Xb															
Harbour seal	Xa		Xa	Xb	Xb	Xb															
Harbour porpoise																					

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, highlights that the at sea usage data for harbour seal and grey seal indicates that Hornsea Four does not appear to sit on a transit route between the SAC and the UK coastline, with greater potential for connectivity appearing to relate to mainland Europe. When combined with the distance between the array boundary and the

SAC, with Hornsea Four having a very low level contribution to any in-combination effect, enabling a conclusion of no AEol to be drawn. Similarly, no potential for AEol to the natural habitat of harbour seal were found. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal and grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 17: Klaverbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																						
Distance to Hornsea Four: 78 km																						
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																					
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat			
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	
Reef																						
Grey seal	Xa		Xa	Xb	Xb	Xb																
Harbour seal	Xa		Xa	Xb	Xb	Xb																
Harbour porpoise																						

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with both the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Similarly, no potential for AEol to the natural habitat of

harbour seal were found. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal and grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 18: Klaverbank (Dutch) SAC

Name of European site: Klaverbank (Dutch) SAC																					
Distance to Hornsea Four: 78 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C																					
Operation: O																					
Decommissioning: D																					
Reef																					
Grey seal	Xa		Xa	Xb	Xb	Xb															
Harbour seal	Xa		Xa	Xb	Xb	Xb															
Harbour porpoise																					

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis and with respect to the sites conservation objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The potential for disturbance, highlights that the at sea usage data for harbour seal and grey seal indicates that Hornsea Four does not appear to sit on a transit route between the SAC and the UK coastline, with greater potential for connectivity appearing to relate to mainland Europe. When combined with the distance between the array boundary and the SAC, with Hornsea Four having a very low level contribution to any in-combination effect, enabling a conclusion of no AEol to be

drawn. Similarly, no potential for AEol to the natural habitat of harbour seal were found. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of harbour seal and grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 19: Bancs des Flandres (France) SAC

Name of European site: Bancs des Flandres (France) SAC																							
Distance to Hornsea Four: 296 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding

grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 20: Bancs des Flandres (France) SAC

Name of European site: Bancs des Flandres (France) SAC																							
Distance to Hornsea Four: 296 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination limited to potential during the pre-construction period at Hornsea Four and projects with low certainty (yet to submit an application). When combined with the distance between the array boundary and the

SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 21: Vlaamse Banken (Belgium) SAC

Name of European site: Vlaamse Banken (Belgium) SAC																							
Distance to Hornsea Four: 278 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 22: Vlaamse Banken (Belgium) SAC

Name of European site: Vlaamse Banken (Belgium) SAC																							
Distance to Hornsea Four: 278 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 23: SBZ 1 (Belgium) SAC

Name of European site: SBZ 1 (Belgium) SAC																							
Distance to Hornsea Four: 313 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 24: SBZ 1 (Belgium) SAC

Name of European site: SBZ 1 (Belgium) SAC																							
Distance to Hornsea Four: 313 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 25: SBZ 2 (Belgium) SAC

Name of European site: SBZ 2 (Belgium) SAC																					
Distance to Hornsea Four: 303 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Reef																					
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	Xa			Xa	Xb	Xb	Xb														
Harbour seal																					
Harbour porpoise																					
Shad																					
River lamprey																					
Sea lamprey																					

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 26: SBZ 2 (Belgium) SAC

Name of European site: SBZ 2 (Belgium) SAC																							
Distance to Hornsea Four: 303 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 27: SBZ 3 (Belgium) SAC

Name of European site: SBZ 3 (Belgium) SAC																							
Distance to Hornsea Four: 307 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 28: SBZ 3 (Belgium) SAC

Name of European site: SBZ 3 (Belgium) SAC																							
Distance to Hornsea Four: 307 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Reef																							
Sandbanks which are slightly covered by sea water all the time																							
Grey seal	Xa		Xa	Xb	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							
Sea lamprey																							

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 29: Vlakte van de Raan (Belguim/Netherlands) SAC

Name of European site: Vlakte van de Raan (Belguim/Netherlands) SAC																					
Distance to Hornsea Four: 292 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	Xa		Xa	Xb	Xb	Xb															
Harbour seal																					
Harbour porpoise																					

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding

grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 30: Vlake van de Raan (Belguim/Netherlands) SAC

Name of European site: Vlake van de Raan (Belguim/Netherlands) SAC																					
Distance to Hornsea Four: 292 km																					
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																				
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Sandbanks which are slightly covered by sea water all the time																					
Grey seal	Xa		Xa	Xb	Xb	Xb															
Harbour seal																					
Harbour porpoise																					

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the

distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).

- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 31: Westerschelde & Saeftinghe (Netherlands) SAC

Name of European site: Westerschelde & Saeftinghe (Netherlands) SAC																							
Distance to Hornsea Four: 301 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							
Dunes with Hippophaë rhamnoides																							
Humid dune slacks																							

Grey seal	Xa		Xa	Xb	Xb	Xb														
Harbour seal																				
Harbour porpoise																				

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 32: Westerschelde & Saeftinghe (Netherlands) SAC

Name of European site: Westerschelde & Saeftinghe (Netherlands) SAC																							
Distance to Hornsea Four: 301 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C																							
Operation: O																							
Decommissioning: D																							
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							
Dunes with Hippophaë rhamnoides																							
Humid dune slacks																							

Grey seal	Xa		Xa	Xb	Xb	Xb														
Harbour seal																				
Harbour porpoise																				

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 33: Voordelta (Netherlands) SAC

Name of European site: Voordelta (Netherlands) SAC																							
Distance to Hornsea Four: 272 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C																							
Operation: O																							
Decommissioning: D																							
Sandbanks which are slightly covered by sea water all the time																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Grey seal	Xa			Xa	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Allis shad																							

Shad																				
River lamprey																				
Sea lamprey																				

Evidence supporting conclusions:

- a) The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 34: Voordelta (Netherlands) SAC

Name of European site: Voordelta (Netherlands) SAC																							
Distance to Hornsea Four: 272 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C																							
Operation: O																							
Decommissioning: D																							
Sandbanks which are slightly covered by sea water all the time																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Grey seal	Xa			Xa	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Allis shad																							

[illegible]

Evidence supporting conclusions:

- a) The assessment of the potential for AEoI in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEoI in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEoI has been drawn. Therefore, the conclusion is of no AEoI from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEoI considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEoI from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 35: Noordzeekustzone (Netherlands) SAC

Name of European site: Noordzeekustzone (Netherlands) SAC																							
Distance to Hornsea Four: 221 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C																							
Operation: O																							
Decommissioning: D																							
Sandbanks which are slightly covered by sea water all the time																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Grey seal	Xa			Xa	Xb	Xb	Xb																
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							

Matrix 36: Noordzeekustzone (Netherlands) SAC

Name of European site: Noordzeekustzone (Netherlands) SAC																							
Distance to Hornsea Four: 221 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Construction: C Operation: O Decommissioning: D																							
Sandbanks which are slightly covered by sea water all the time																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Grey seal	Xa			Xa	Xb	Xb																	
Harbour seal																							
Harbour porpoise																							
Shad																							
River lamprey																							

Sea lamprey

Evidence supporting conclusions:

- a) The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- b) The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 37: Waddenzee (Netherlands) SAC

Name of European site: Waddenzee (Netherlands) SAC																							
Distance to Hornsea Four: 229 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							
Dunes with Hippophaë rhamnoides																							
Dunes with Salix repens ssp argentea																							

Humid dune slacks																				
Grey seal	Xa		Xa	Xb	Xb															
Harbour seal																				
Harbour porpoise																				
Shad																				
River lamprey																				
Sea lamprey																				
Narrow-mouthed whorl snail																				

Evidence supporting conclusions:

- The assessment of the potential for AEol alone for marine mammals is presented in section 12.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 38: Waddenzee (Netherlands) SAC

Name of European site: Waddenzee (Netherlands) SAC																							
Distance to Hornsea Four: 229 km																							
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)																						
	Increase in underwater noise			Vessel disturbance			Collision risk			Changes in prey availability and behaviour			Accidental pollution			Temporary increases in suspended sediments			Long-term physical loss of habitat				
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D		
Sandbanks which are slightly covered by sea water all the time																							
Estuaries																							
Mudflats and sandflats not covered by seawater at low tide																							
Salicornia and other annuals colonizing mud and sand																							
Spartina swards																							
Atlantic salt meadows																							
Embryonic shifting dunes																							
Shifting dunes along the shoreline with Ammophila arenaria																							
Fixed coastal dunes with herbaceous vegetation																							
Dunes with Hippophaë rhamnoides																							
Dunes with Salix repens ssp argentea																							

Humid dune slacks																				
Grey seal	Xa		Xa	Xb	Xb															
Harbour seal																				
Harbour porpoise																				
Shad																				
River lamprey																				
Sea lamprey																				
Narrow-mouthed whorl snail																				

Evidence supporting conclusions:

- The assessment of the potential for AEol in-combination for marine mammals is presented in section 13.3. For underwater noise, the assessment considers noise from percussive piling, UXO clearance, geophysical and seismic survey and seabed preparation/cable installation. All are considered on a worst case basis, applying the appropriate objectives. The potential for injury (through PTS) is addressed through a combination of assessment and mitigation, enabling a conclusion of no AEol in all cases. The assessment of disturbance highlights that of the grey seals potentially disturbed, only a proportion (if any) are likely to show connectivity to the SAC, with projects in-combination located between Hornsea Four and the SAC. When combined with the distance between the array boundary and the SAC and the availability of alternative feeding grounds, a conclusion of no AEol has been drawn. Therefore, the conclusion is of no AEol from Hornsea Four alone and in-combination with respect to underwater noise at all stages of the project (construction, operation & maintenance and decommissioning).
- The assessment of the potential for vessel disturbance to result in AEol considers the increase in vessel movements relative to baseline levels of shipping and in the context of grey seal density and sensitivity. The conclusion is of no AEol from Hornsea Four alone and in-combination with respect to vessel disturbance at all stages of the project (construction, operation & maintenance and decommissioning).

Matrix 39: Greater Wash SPA

Name of European site: Greater Wash SPA															
Distance to Hornsea Four: 0.4 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C															
Operation: O															
Decommissioning: D															
Red-throated diver	✓a	✓b	✓c												
Common scoter	✓a	✓b	✓c												
Little gull											✓d				
Sandwich tern															
Common tern															
Little tern															

Evidence supporting conclusions:

- a) A sensitive species, construction close to SPA
- b) A sensitive species, maintenance vessels may pass close to or through the SPA
- c) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction
- d) Potentially present in numbers during migration and proportion fly at potential collision height (PCH)

Matrix 40: Greater Wash SPA

Name of European site: Greater Wash SPA															
Distance to Hornsea Four: 0.4 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C															
Operation: O															
Decommissioning: D															
Red-throated diver															
Common scoter															
Little gull															
Sandwich tern															
Common tern															
Little tern															

Matrix 41: Flamborough & Filey Coast SPA

Name of European site: Flamborough & Filey Coast SPA															
Distance to Hornsea Four: 2.2 km															
European Site Feature															
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C															
Operation: O															
Decommissioning: D															
Fulmar															
Gannet		✓a									✓c				
Shag															
Cormorant															
Kittiwake											✓c				
Herring gull															
Guillemot	✓b	✓d	✓e											✓f	
Razorbill	✓b	✓d	✓e											✓f	
Puffin	✓b	✓d	✓e											✓f	

Evidence supporting conclusions:

- a) Not sensitive to operation and maintenance activities, but due to likely avoidance of array area within the breeding bio-season due to proximity of colony there is potential for an effect
- b) Moderate sensitivity to construction activities.
- c) Present in numbers and proportion fly at PCH during both the breeding and non-breeding bio-seasons
- d) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- e) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase
- f) Experience of other OWFs is no LSE, but due to proximity of array area to colony this potential impact may have effect on this colony during the breeding season.

Matrix 42: Flamborough & Filey Coast SPA

Name of European site: Flamborough & Filey Coast SPA															
Distance to Hornsea Four: 2.2 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Construction: C															
Operation: O															
Decommissioning: D															
Fulmar															
Gannet											✓a				
Shag															
Cormorant															
Kittiwake											✓a				
Herring gull															
Guillemot		✓b													
Razorbill		✓b													
Puffin		✓b													

Evidence supporting conclusions:

- a) Present in numbers and proportion fly at PCH during both the breeding and non-breeding bio-seasons and identified as a potential effect in-combination with other OWFs.
- b) Moderate sensitivity to construction activities alone and identified as a potential effect in-combination with other OWFs.

Matrix 43: Northumbria Coast SPA

Name of European site: Northumbria Coast SPA															
Distance to Hornsea Four: 144 km															
European Site Feature	Likely Effects of Hornsea Four (alone)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Arctic tern											✓a				
Little tern											✓a				
Turnstone															
Purple sandpiper															

Evidence supporting conclusions:

- a) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs.

Matrix 44: Northumbria Coast SPA

Name of European site: Northumbria Coast SPA															
Distance to Hornsea Four: 144 km															
European Site Feature	Likely Effects of Hornsea Four (in-combination)														
	Direct disturbance and displacement			Changes in prey availability and behaviour			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Arctic tern															
Little tern															
Turnstone															
Purple sandpiper															

Matrix 45: Humber Estuary SPA (onshore)

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km																		
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Avocet																		
Bar-tailed godwit																		
Bittern																		
Black-tailed godwit																		
Dunlin																		
Golden plover																		
Hen harrier																		
Little tern																		
Marsh harrier																		
Pink-footed goose																		
Ruff																		

Name of European site: Humber Estuary SPA (onshore)																	
Distance to Hornsea Four: 9 km																	
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)	
Shelduck																	
Red knot																	
Redshank																	
Wigeon																	
All other: internationally important regularly occurring migratory species; Annex I wintering species and species occurring at levels of more than 1% of national populations or whose populations exceed 2,000 individuals																	

Matrix 46: Humber Estuary SPA (onshore)

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km																		
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Avocet																		
Bar-tailed godwit																		
Bittern																		
Black-tailed godwit																		
Dunlin																		
Golden plover																		
Hen harrier																		
Little tern																		
Marsh harrier																		
Pink-footed goose																		
Ruff																		

Name of European site: Humber Estuary SPA (onshore)																		
Distance to Hornsea Four: 9 km																		
	Temporary habitat loss (onshore)			Temporary disturbance / damage to habitats (onshore)			Habitat fragmentation or severance (onshore)			Visual and / or noise disturbance to species (onshore)			Invasive non-native species (onshore)			Accidental release of contaminants (onshore)		
Shelduck																		
Red knot																		
Redshank																		
Wigeon																		
All other: internationally important regularly occurring migratory species; Annex I wintering species and species occurring at levels of more than 1% of national populations or whose populations exceed 2,000 individuals																		

Matrix 47: Humber Estuary SPA (offshore)

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Avocet		✓a	
Bar-tailed godwit		✓a	
Bittern			
Black-tailed godwit		✓a	
Dunlin		✓a	
Golden plover		✓a	
Hen harrier			
Little tern			
Marsh harrier			
Pink-footed goose		Xb	
Ruff		✓a	
Shelduck		✓a	

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)		
	Risk of collision		
Red knot		✓a	
Redshank		✓a	
Wigeon		Xc	

Evidence supporting conclusions:

- Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. However, quantification of any potential impacts and effects may be required.
- Due to this species having migratory pathways to and from it's breeding grounds and the SPA that would not interact with the array area this species is considered to be subject to any effect.
- Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. In this instance as the species has a small population within the Humber Estuary any potential impacts and effects are likely to trivaial and inconsequential.

Matrix 48: Humber Estuary SPA (offshore)

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Avocet			
Bar-tailed godwit			
Bittern			
Black-tailed godwit			
Dunlin			
Golden plover			
Hen harrier			
Little tern			
Marsh harrier			
Pink-footed goose			
Ruff			
Shelduck			

Name of European site: Humber Estuary SPA (offshore)			
Distance to Hornsea Four: 32 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)		
	Risk of collision		
Red knot			
Redshank			
Wigeon			

Matrix 49: Hornsea Mere SPA

Name of European site: Hornsea Mere SPA			
Distance to Hornsea Four: 12.9 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Gadwall		✓a	

Evidence supporting conclusions:

- a) Experience from other OWF migratory modelling / apportionment assessments provided evidence of very small potential impacts / effects on all migratory waterbird species from individual developments in the North Sea. However, quantification of any potential impacts and effects may be required.

Matrix 50: Hornsea Mere SPA

Name of European site: Hornsea Mere SPA			
Distance to Hornsea Four: 12.9 km			
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)		
	Risk of collision		
Construction: C Operation: O Decommissioning: D	C	O	D
Gadwall			

Matrix 51: Coquet Island SPA

Name of European site: Coquet Island SPA															
Distance to Hornsea Four: 167 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake					✓a										
Black-headed gull															
Herring gull															
Lesser black-backed gull															
Sandwich tern					✓b										
Common tern					✓b										
Arctic tern					✓b										
Roseate tern					✓b										
Puffin										✓c	✓d	✓e			
Fulmar															

Evidence supporting conclusions:

- a) Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision
- b) Experience of other OWFs is no LSE, as no connectivity during more sensitive breeding bio-season
- c) Moderate sensitivity to construction activities.
- d) Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- e) The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Matrix 52: Coquet Island SPA

Name of European site: Coquet Island SPA															
Distance to Hornsea Four: 167 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake															
Black-headed gull															
Herring gull															
Lesser black-backed gull															
Sandwich tern															
Common tern															
Arctic tern															
Roseate tern															
Puffin															
Fulmar															

Matrix 53: Farne Islands SPA

Name of European site: Farne Islands SPA															
Distance to Hornsea Four: 198 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake					✓a										
Great black-backed gull															
Herring gull															
Lesser black-backed gull															
Sandwich tern					✓b										
Common tern					✓b										
Arctic tern					✓b										
Roseate tern					✓b										
Guillemot										✓c	✓d	✓e			
Razorbill															
Puffin										✓c	✓d	✓e			

Name of European site: Farne Islands SPA														
Distance to Hornsea Four: 198 km														
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)													
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour	
Fulmar														
Shag														
Cormorant														
Black-headed gull														

Evidence supporting conclusions:

- Potential connectivity within the breeding and non-breeding seasons in low numbers and proportion fly at PCH that may be at risk from collision
- Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is reduced when considering one off migratory movements through OWFs
- Moderate sensitivity to construction activities
- Moderate sensitivity to operation and maintenance activities with potential for an effect during both breeding and non-breeding seasons
- The impacts during the decommissioning phase are considered to be similar and potentially less than those outlined in the construction phase.

Matrix 54: Farne Islands SPA

Name of European site: Farne Islands SPA															
Distance to Hornsea Four: 198 km															
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)														
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar															
Kittiwake															
Black-headed gull															
Herring gull															
Lesser black-backed gull															
Great black-backed gull															
Sandwich tern															
Common tern															
Arctic tern															
Roseate tern															
Guillemot															

Name of European site: Farne Islands SPA														
Distance to Hornsea Four: 198 km														
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)													
	Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect			Direct disturbance and displacement			Changes in prey availability and behaviour	
Razorbill														
Puffin														
Shag														
Cormorant														

Matrix 55: Forth Islands (UK) SPA

Name of European site: Forth Islands (UK) SPA												
Distance to Hornsea Four: 272 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet								✓a				
Common tern								✓b				
Arctic tern								✓b				
Roseate tern								✓b				
Sandwich tern								✓b				
Puffin		✓c										
Guillemot		✓c										
Razorbill		✓c										
Lesser black-backed gull												
Shag												
Kittiwake												

Herring gull											
Cormorant											

Evidence supporting conclusions:

- a) Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sentivie breeding bio-season
- b) Potential connectivity to array area during migratory bio-seasons due to proximity, but limited effect as species known to migrate closer to coast and any risk is highly likely to be trivial and inconsequential when considering one off migratory movements through OWFs
- c) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 56: Forth Islands (UK) SPA

Name of European site: Forth Islands (UK) SPA												
Distance to Hornsea Four: 272 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Common tern												
Arctic tern												
Roseate tern												
Sandwich tern												
Puffin												
Guillemot												
Razorbill												
Lesser black-backed gull												
Shag												
Kittiwake												

Herring gull												
Cormorant												

Matrix 57: Outer Firth of Forth and St Andrew's Complex pSPA

Name of European site: Outer Firth of Forth and St Andrew's Complex pSPA												
Distance to Hornsea Four: 241 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet								√a				
Guillemot		√b										
Razorbill		√b										
Puffin		√b										
Red-throated diver												
Little gull												
Common tern												
Arctic tern												
Slavonian grebe												
Common eider												
Long-tailed duck												

Common scoter												
Velvet scoter												
Common goldeneye												
Red-breasted merganser												
Manx shearwater												
European shag												
Black-legged kittiwake												
Black-headed gull												
Common gull												
Herring gull												

Evidence supporting conclusions:

- a) Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- b) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 58: Outer Firth of Forth and St Andrew's Complex pSPA

Name of European site: Outer Firth of Forth and St Andrew's Complex pSPA												
Distance to Hornsea Four: 241 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Guillemot												
Razorbill												
Puffin												
Red-throated diver												
Little gull												
Common tern												
Arctic tern												
Slavonian grebe												
Common eider												
Long-tailed duck												

Common scoter											
Velvet scoter											
Common goldeneye											
Red-breasted merganser											
Manx shearwater											
European shag											
Black-legged kittiwake											
Black-headed gull											
Common gull											
Herring gull											

Matrix 59: Fowlsheugh SPA

Name of European site: Fowlsheugh SPA												
Distance to Hornsea Four: 341 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake								√a				
Herring gull												
Guillemot		√b										
Razorbill		√b										

Evidence supporting conclusions:

- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 60: Fowlsheugh SPA

Name of European site: Fowlsheugh SPA												
Distance to Hornsea Four: 341 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Herring gull												
Guillemot												
Razorbill												

Matrix 61: Buchan Ness to Collieston Coast SPA

Name of European site: Buchan Ness to Collieston Coast SPA												
Distance to Hornsea Four: 381 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake								√a				
Herring gull												
Guillemot		√b										
Shag												

Evidence supporting conclusions:

- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 62: Buchan Ness to Collieston Coast SPA

Name of European site: Buchan Ness to Collieston Coast SPA												
Distance to Hornsea Four: 381 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Herring gull												
Guillemot												
Shag												

Matrix 63: Troup, Pennan and Lion's Heads SPA

Name of European site: Troup, Pennan and Lion's Heads SPA												
Distance to Hornsea Four: 423 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake								√a				
Herring gull												
Guillemot		√b										
Razorbill		√b										

Evidence supporting conclusions:

- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 64: Troup, Pennan and Lion's Heads SPA

Name of European site: Troup, Pennan and Lion's Heads SPA												
Distance to Hornsea Four: 423 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Herring gull												
Guillemot												
Razorbill												

Matrix 65: East Caithness Cliffs SPA

Name of European site: East Caithness Cliffs SPA												
Distance to Hornsea Four: 500 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake								√a				
Herring gull												
Great black-backed gull								√c				
Guillemot		√b										
Razorbill		√b										
Peregrine												
Shag												
Puffin												
Cormorant												

Evidence supporting conclusions:

- a) Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- b) Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential
- c) Present in low densities and proportion fly at PCH during the non-breeding bio-seasons, though connectivity limited due to mixing of wider North Sea populations and therefore any effect likely to be trivial and inconsequential.

Matrix 66: East Caithness Cliffs SPA

Name of European site: East Caithness Cliffs SPA												
Distance to Hornsea Four: 500 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Herring gull												
Great black-backed gull												
Guillemot												
Razorbill												
Peregrine												
Shag												
Puffin												
Cormorant												

Matrix 67: North Caithness Cliffs SPA

Name of European site: North Caithness Cliffs SPA												
Distance to Hornsea Four: 534 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake								√a				
Guillemot		√b										
Razorbill		√b										
Puffin		√b										
Peregrine												

Evidence supporting conclusions:

- Present in moderate densities and proportion fly at PCH during both the breeding and non-breeding bio-seasons, though connectivity limited in more sensitive breeding bio-season
- Moderate sensitivity to operation and maintenance activities with potential for an effect during non-breeding season, but highly likely to be trivial and inconsequential.

Matrix 68: North Caithness Cliffs SPA

Name of European site: North Caithness Cliffs SPA												
Distance to Hornsea Four: 534 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Guillemot												
Razorbill												
Puffin												
Peregrine												

Matrix 69: Copinsay SPA

Name of European site: Copinsay SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Great black-backed gull												
Guillemot												

Matrix 70: Copinsay SPA

Name of European site: Copinsay SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Great black-backed gull												
Guillemot												

Matrix 71: Hoy SPA

Name of European site: Hoy SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Kittiwake												
Great black-backed gull												
Guillemot												
Puffin												
Peregrine												
Red-throated diver												

Matrix 72: Hoy SPA

Name of European site: Hoy SPA												
Distance to Hornsea Four: 558 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Kittiwake												
Great black-backed gull												
Guillemot												
Puffin												
Peregrine												
Red-throated diver												

Matrix 73: Marwick Head SPA

Name of European site: Marwick Head SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake												
Guillemot												

Matrix 74: Marwick Head SPA

Name of European site: Marwick Head SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Kittiwake												
Guillemot												

Matrix 75: Rousay SPA

Name of European site: Rousay SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												

Matrix 76: Rousay SPA

Name of European site: Rousay SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												

Matrix 77: Calf of Eday SPA

Name of European site: Calf of Eday SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Great black-backed gull												
Guillemot												
Cormorant												

Matrix 78: Calf of Eday SPA

Name of European site: Calf of Eday SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Great black-backed gull												
Guillemot												
Cormorant												

Matrix 79: West Westray SPA

Name of European site: West Westray SPA												
Distance to Hornsea Four: 605 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Arctic skua												
Kittiwake												
Guillemot												
Razorbill												
Arctic tern												

Matrix 80: Calf of Eday SPA

Name of European site: Calf of Eday SPA												
Distance to Hornsea Four: 595 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Great black-backed gull												
Guillemot												
Cormorant												

Matrix 81: Fair Isle SPA

Name of European site: Fair Isle SPA												
Distance to Hornsea Four: 607 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Great skua												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												
Razorbill												
Puffin												
Arctic tern												
Fair Isle wren												
Shag												

Matrix 82: Fair Isle SPA

Name of European site: Fair Isle SPA												
Distance to Hornsea Four: 607 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Great skua												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												
Razorbill												
Puffin												
Arctic tern												
Fair Isle wren												
Shag												

Matrix 83: Sumburgh Head SPA

Name of European site: Sumburgh Head SPA												
Distance to Hornsea Four: 639 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Arctic tern												
Guillemot												

Matrix 84: Sumburgh Head SPA

Name of European site: Sumburgh Head SPA												
Distance to Hornsea Four: 639 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Kittiwake												
Arctic tern												
Guillemot												

Matrix 85: Foula SPA

Name of European site: Foula SPA												
Distance to Hornsea Four: 678 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												
Razorbill												
Puffin												
Leach's storm petrel												
Red-throated diver												
Shag												

Matrix 86: Foula SPA

Name of European site: Foula SPA												
Distance to Hornsea Four: 678 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Kittiwake												
Arctic tern												
Guillemot												
Razorbill												
Puffin												
Leach's storm petrel												
Red-throated diver												
Shag												

Matrix 87: Fetlar SPA

Name of European site: Fetlar SPA												
Distance to Hornsea Four: 712 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Arctic tern												
Red-necked Phalarope												
Dunlin												
Whimbrel												

Matrix 88: Fetlar SPA

Name of European site: Fetlar SPA												
Distance to Hornsea Four: 712 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Great skua												
Arctic skua												
Arctic tern												
Red-necked Phalarope												
Dunlin												
Whimbrel												

Matrix 89: Hermaness, Saxa Vord and Valla Field SPA

Name of European site: Hermaness, Saxa Vord and Valla Field SPA												
Distance to Hornsea Four: 733 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (alone)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Great skua												
Kittiwake												
Guillemot												
Puffin												
Red-throated diver												
Shag												

Matrix 90: Hermaness, Saxa Vord and Valla Field SPA

Name of European site: Hermaness, Saxa Vord and Valla Field SPA												
Distance to Hornsea Four: 733 km												
European Site Feature	Adverse Effect on Integrity of Hornsea Four (in-combination)											
	Direct disturbance and displacement			Indirect impacts through effects on habitats and prey species			Risk of collision			Barrier effect		
Construction: C Operation: O Decommissioning: D	C	O	D	C	O	D	C	O	D	C	O	D
Fulmar												
Gannet												
Great skua												
Kittiwake												
Guillemot												
Puffin												
Red-throated diver												
Shag												

Appendix E – Summary of Designated Sites

Summary of Designated Sites

Summary information on each designated site screened in for potential LSE alone and/ or in combination is provided here in [Appendix E](#), including the designated feature(s), key literature sources describing the site and the features/ effects screened in under potential LSE. The conservation objectives for each site are also provided.

Flamborough Head SAC

The Flamborough Head SAC is a coastal site, designated for chalk reef, submerged and partially submerged sea caves and vegetated sea cliff. The site covers some 6,403 ha. The receptor group 'subtidal and intertidal benthic ecology' is relevant to the Flamborough Head SAC. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes](#);
- [Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology](#);
- [Volume 5, Annex 2.1: Benthic Subtidal and Intertidal Ecology Technical Report](#);
- Natural England Conservation Advice for Marine Protected Areas: Flamborough Head SAC and Advice on Operations (updated March 2019)¹;
- Natural England Flamborough Head European Marine Site Management Scheme (dated September 2016)²;
- Flamborough Head European Marine Site website³; and
- Flamborough Head SAC citation (dated May 2001 vs 1).

The site is designated for the following Annex I habitats:

- Reefs;
- Submerged or partially submerged sea caves; and
- Vegetated sea cliffs of the Atlantic and Baltic coasts.

No feature condition is provided under Natural England's Designated Sites View⁴.

The Flamborough Head SAC is located along the North Yorkshire coastline, and includes areas of hard and soft chalk cliffs. The location of the site, at the meeting point of two water bodies, is considered important in terms of algae and plankton, with the sublittoral and littoral reef habitats considered to be the the most diverse in the UK. The difference in chalk (hard and soft) means erosion differs, resulting in different habitats. There are a number of sub-features associated with the chalk reefs, specifically the following:

¹<https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0013036&SiteName=flambor&countyCode=&responsiblePerson=&SeaArea=&IFCAAarea=#SiteInfo>

² http://www.flamboroughheadsac.org.uk/documents/17-03-15%202016-2021%20Management%20Plan%20Final_2017%20Update.pdf

³ <http://www.flamboroughheadsac.org.uk/downloads/>

⁴<https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureCondition.aspx?SiteCode=UK0013036&SiteName=flambor&SiteNameDisplay=Flamborough+Head+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAAarea=>

- Circalittoral rock - characterised by subtidal faunal turf communities which are diverse assemblages of attached animals growing on subtidal hard substrata and are an important component of the reefs. Subtidal faunal turf makes up a significant proportion of the reef resource and extends below 2m depth;
- Infralittoral rock - kelp forests are found in the shallow subtidal waters and are a key structural and functional component of the reefs, supporting a wide variety of plants and animals in the infralittoral zone; and
- Intertidal rock - the rich and variable rocky shores are of considerable conservation value since they make a significant contribution to the structure and diversity of the site as a whole.

No sub features are listed for the submerged or partially submerged sea cave or vegetated sea cliff features.

Of the designated features, no LSE has been identified for the vegetated sea cliff feature with respect to Hornsea Four (Natural England agreed that terrestrial elements of the Flamborough Head SAC could be screened out during the Evidence Plan Process meeting on 12/09/2018, as flagged [Table 1](#)), with [Table 8](#) identifying the potential for LSE for the reef and submerged sea cave features only, under the following scenarios:

- Changes to physical processes (reef feature only, during O&M only);
- Temporary increase in suspended sediment (reef feature associated with all offshore aspects, submerged and partially submerged sea caves during works along the cable corridor only) (for both features during construction, O&M, decommissioning);
- Invasive non-native species (to the reef feature and submerged and partially submerged sea caves feature, during construction, O&M and decommissioning).

The 2016 European Site Management Plan identified that all features of the Flamborough Head SAC were in favourable condition⁵.

The Site Improvement Plan for Flamborough Head SAC was issued in February 2015⁶, as part of the Flamborough and Filey Coast. Reference to the features of the SAC is as follows:

- Reefs – investigate potential impacts of fisheries (specifically potting); and
- Vegetated sea cliffs – investigate the impact of invasive species (onshore risk in relation to illegal dumping of garden waste, e.g. the introduction of *Montbretia* on cliffs).

Advice on operations was last updated in March 2019⁷, including advice for offshore wind and cables (during construction, O&M and decommissioning). All relevant effects have been included within the broad potential effect terms applied here – with the equivalent terms clarified in [Table 7](#).

⁵http://www.flamboroughheadsac.org.uk/documents/17-03-15%202016-2021%20Management%20Plan%20Final_2017%20Update.pdf

⁶<http://publications.naturalengland.org.uk/publication/6404364100960256>

⁷<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0013036&SiteName=flambor&SiteNameDisplay=Flamborough+Head+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

Management measures were issued in September 2017⁸, with these limited to commercial fishing activities.

The Supplementary Advice for the Flamborough Head SAC was updated in September 2017⁹, with the targets provided being as follows (not all being applicable to both features screened in for potential LSE; where only applicable to one feature, this is noted):

- Maintain the presence and spatial distribution of communities;
- Maintain the total extent, spatial distribution and types of the features (and each reef subfeatures/sea caves subject to natural variation in sedimentation);
- Maintain OR Recover OR Restore the abundance of listed species, to enable each of them to be a viable component of the habitat;
- Maintain the characteristic morphology of the submerged and partially submerged sea cave habitat;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the surface and structural complexity of habitats, and the stability of the reef and rocky cave structures;
- Maintain the natural light availability to the caves;
- Maintain the species composition of component reef communities;
- Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes and stability, across the reef habitat;
- Restrict surface sediment contaminant levels to concentrations where they are not adversely impacting the infauna of the submerged and partially submerged cave feature;
- Maintain the natural physico-chemical properties of the water;
- Maintain the natural rate of sediment deposition;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status, avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status, avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

The Conservation Objectives for the site¹⁰ are as follows:

⁸<https://designatedsites.naturalengland.org.uk/SiteMMO.aspx?SiteCode=UK0013036&SiteName=flambor&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

⁹<https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0013036&SiteName=flambor&SiteNameDisplay=Flamborough+Head+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

¹⁰<https://designatedsites.naturalengland.org.uk/Marine/SiteDetail.aspx?SiteCode=UK0013036&SiteName=flambor&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=#hlco>

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of the qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of each of the qualifying species; and
- the distribution of qualifying species within the site.

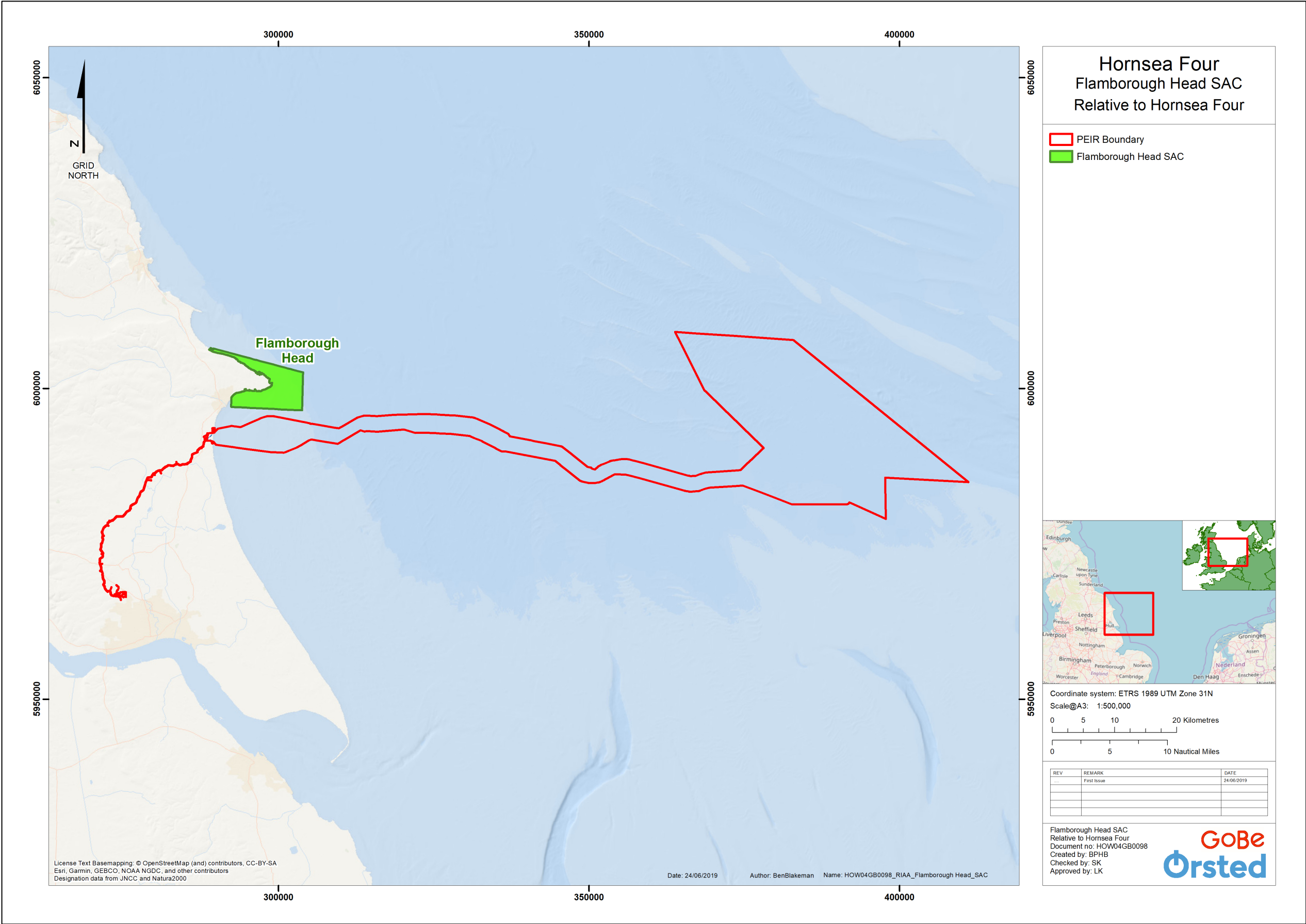


Figure 1: Flamborough Head SAC in Relation to Hornsea Four (not to scale).

Southern North Sea SAC

The Southern North Sea SAC, located to the east of England, stretches from the central North Sea (north of Dogger Bank) to the Straits of Dover in the south, covering an area of 36,951 km²¹¹. A major portion of the site lies offshore, though it does extend into coastal areas of Norfolk and Suffolk crossing the 12 nautical mile boundary. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammals Technical Report;**
- JNCC and Natural England SAC Selection Assessment Document (dated January 2017)¹²;
- JNCC and Natural England Conservation Objectives and Advice on Operations for Harbour Porpoise (*Phocoena phocoena*) SAC: Southern North Sea (dated March 2019)¹³;
- JNCC Natura 2000 Standard Data Form (dated 26th March 2019)¹⁴; and
- JNCC: A Conservation Literature Review for the Harbour Porpoise (*Phocoena phocoena*) (dated December 2015)¹⁵.

The site is designated for the following Annex II species only:

- Harbour porpoise (*Phocoena phocoena*).

The site assessment in the recent citation assigns a grade of A conservation, which is deemed 'excellent'¹⁶.

Following the formal designation of the site in February 2019, the Conservation Objectives and Advice on Activities (2019) have now been finalised by the SNCBs and therefore this document presents best available advice for impacts assessment of offshore wind activities.

Potential LSE has been identified for harbour porpoise with respect to Hornsea Four under the following scenarios:

- Increase in underwater noise (construction, operation & maintenance and decommissioning);
- Vessel disturbance (construction, operation & maintenance and decommissioning); and
- Collision risk in-combination only.

¹¹ <http://jncc.defra.gov.uk/page-7243>

¹² <http://jncc.defra.gov.uk/PDF/SouthernNorthSeaSelectionAssessmentDocument.pdf>

¹³ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

¹⁴ <http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030395.pdf>

¹⁵ http://jncc.defra.gov.uk/pdf/JNCCReport566_AConservationLiteratureReviewForTheHarbourPorpoise.pdf

¹⁶ <https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0030395.pdf>

The Conservation Objectives for the site¹⁷ are as follows:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters.

In the context of natural change, this will be achieved by ensuring that:

- Harbour porpoise is a viable component of the site;
- There is no significant disturbance of the species; and
- The condition of supporting habitats and processes, and the availability of prey is maintained.

¹⁷ http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

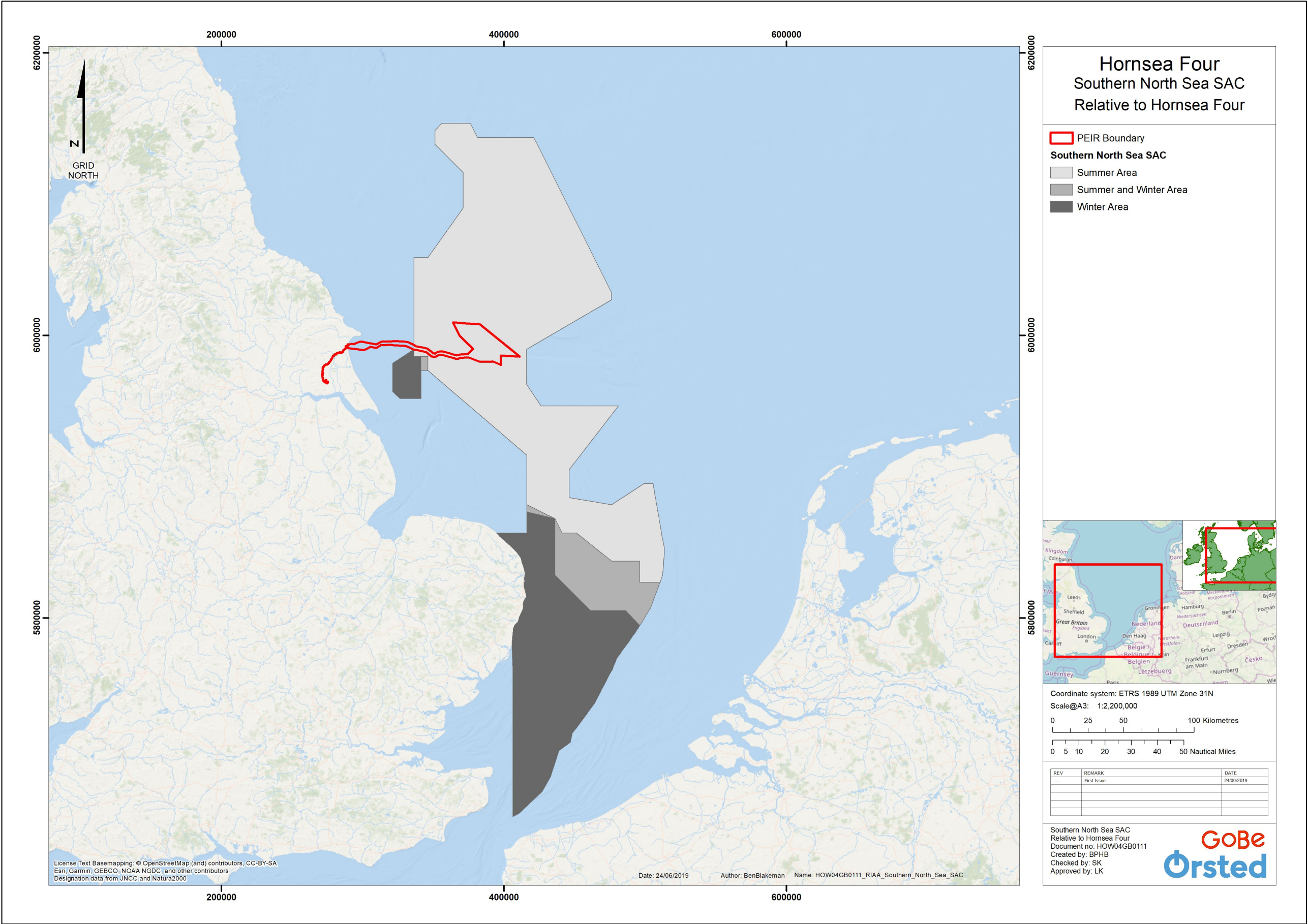


Figure 2: Southern North Sea SAC in Relation to Hornsea Four (not to scale).

The Wash and North Norfolk Coast SAC

Situated on the East Coast of England, The Wash and North Norfolk SAC covers some 1077.6 km² and encompasses the largest embayment in the UK¹⁸. Based on screening for potential LSE, the receptor group 'marine mammals' is relevant to The Wash and North Norfolk Coast SAC.

Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- Natural England Conservation Advice for Marine Protected Areas: The Wash and North Norfolk Coast SAC (dated March 2019)¹⁹;
- Natural England The Wash and North Norfolk SAC Advice on Operations²⁰ (dated March 2019);
- The Wash and North Norfolk Coast SAC Citation²¹; and
- JNCC Natura 2000 Standard Data Form²² (dated 25 January 2016).

The site is designated for the following Annex I habitats:

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Coastal lagoons;
- Large shallow inlets and bays;
- Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*);
- Mudflats and sandflats not covered by seawater at low tide;
- Reefs;
- Salicornia and other annuals colonising mud and sand;
- Sandbanks which are slightly covered by sea water all the time; and

Together with the following Annex II species:

- Harbour (common) seal (*Phoca vitulina*); and
- Otter (*Lutra lutra*).

For the feature screened in for potential LSE (harbour seal), the recent condition assessment does not provide an assessment²³.

Subtidal sandbanks and reefs are widespread throughout The Wash and North Norfolk Coast SAC. Commercially important fish species use sandbanks as nursery grounds and reefs are associated with elevated biodiversity and species abundance. The site has an outstanding example of the habitat *Sabellaria spinulosa* reef, large areas of intertidal sand and mudflats, often colonised by

¹⁸<https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and%20coast&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

¹⁹<https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0017075&SiteName=>

²⁰<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and%20coast&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

²¹<http://publications.naturalengland.org.uk/file/5068730392379392>

²²<http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0017075.pdf>

²³<https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureCondition.aspx?SiteCode=UK0017075&SiteName=&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

Salicornia sp. and saltmarsh communities. Coastal lagoons on the North Norfolk coast are maintained by the barrier beach system and inland coastal lagoons provide habitat for unique invertebrate communities. The site is also important for common seals *Phoca vitulina*, providing key habitat for breeding and hauling-out.

The Wash is over 64,000 ha and represents the large shallow inlet and bay feature on the English East Coast. This is a complex feature, which encompasses a number of other features, of which some have subfeatures associated with them, specifically the features 'mudflats and sandflats not covered by seawater at low tide', 'sandbanks which are slightly covered by sea water all the time' and 'reefs'. No sub features are listed for the features 'Atlantic salt meadows (*Glaucopuccinellietalia maritima*)', 'coastal lagoons', 'Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)' and 'Salicornia and other annuals colonising mud and sand'.

Of the site features, potential LSE has been identified for Harbour (common) seal (*Phoca vitulina*) only with respect to Hornsea Four under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, operation & maintenance and decommissioning).

Natural England carried out a feature condition assessment of some (but not all) site features and the results reported in January 2019 are presented in [Table 13](#).

Table 1: The Wash and North Norfolk Coast SAC Feature Condition Assessment²⁴.

Feature	Date Assessed	Favourable	Unfavourable recovering	Unfavourable No Change	Unfavourable Declining	Destroyed	Not assessed
H1110 Sandbanks which are slightly covered by sea water all the time	26/01/2019	72%	28%				
H1140 Mudflats and sandflats not covered by seawater at low tide	26/01/2019			99%	1%		
H1170 Reefs	26/01/2019	1%	37%	61%			1%
H1160 Large shallow inlets and bays	26/01/2019	39%		60%			1%

Advice on operations was last updated in March 2019, including advice for offshore wind and cables (during construction, O&M and decommissioning)²⁵. Management measures were issued in September 2017²⁶, with these limited to commercial fishing activities.

²⁴<https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureCondition.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

²⁵<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0017075&SiteName=&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

²⁶<https://designatedsites.naturalengland.org.uk/SiteMMO.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

The Site Improvement Plan for The Wash and North Norfolk Coast SAC was issued in December 2014, as part of The Wash and North Norfolk Coast EMS²⁷. Reference to the harbour seal feature of the SAC is in relation to public access/disturbance.

The Supplementary Advice for The Wash and North Norfolk Coast SAC was updated in March 2019²⁸. The only feature screened in for potential LSE for the site is harbour seal (*Phoca vitulina*). The targets applicable to this feature are listed below:

- Maintain the population size within the site;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and impacts of non-native species and pathogens;
- Maintain the extent and spatial distribution of the following supporting habitats: foraging and haul out sites;
- Maintain the abundance of preferred food items required by the species;
- Maintain the natural physico-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.

The Conservation Objectives for The Wash and North Norfolk Coast SAC²⁹ are as follows:

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of the qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of each of the qualifying species; and

²⁷ <http://publications.naturalengland.org.uk/publication/5327498292232192?category=4873023563759616>

²⁸ <https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

²⁹ <https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0017075&SiteName=the%20wash%20and&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=#hlco>

- the distribution of qualifying species within the site.

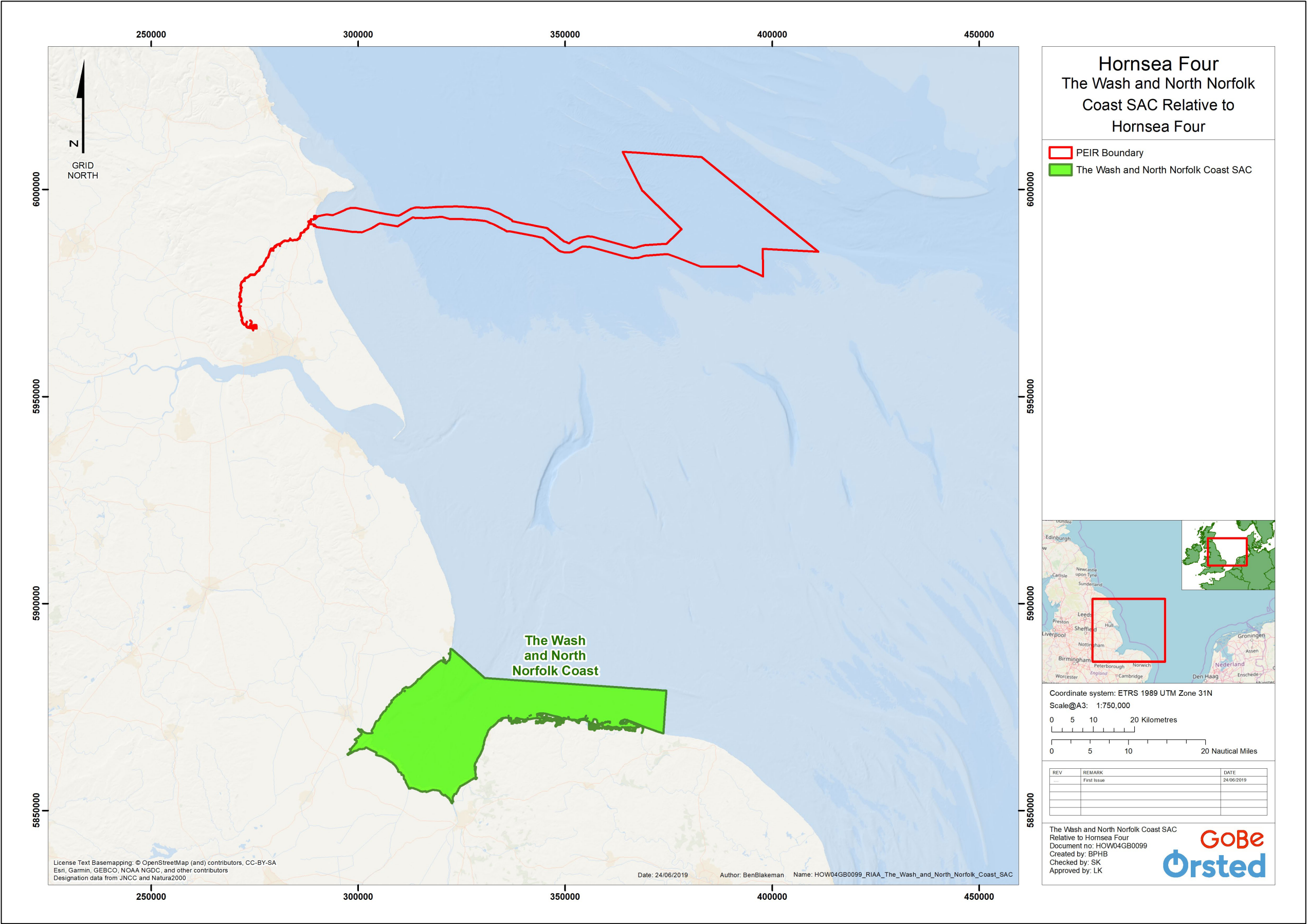


Figure 3: The Wash and North Norfolk Coast SAC in Relation to Hornsea Four (not to scale).

Humber Estuary SAC

The Humber Estuary SAC extends about 70 km from the mouth of the Humber, past the ports of Grimsby, Immingham, Hull and Goole and up to the limit of saline intrusion on the rivers Ouse and Trent and covers an area of around 366.57 km². The receptor groups 'benthic and intertidal habitats' and 'marine mammals' are relevant to the Humber Estuary SAC. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology;**
- **Volume 5, Annex 2.1: Benthic Subtidal and Intertidal Ecology Technical Report;**
- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 4, Annex 4.5: Subsea Noise Technical Report;**
- Natural England Conservation Advice for Marine Protected Areas: Humber Estuary SAC and Supplementary Advice on Conservation Objectives (dated September 2017);
- Humber Estuary Advice on Operations (dated March 2019) and Advice on Seasonality (dated March 2018);
- Humber Estuary SAC citation (dated November 2009 v2); and
- Environment Agency TraC Fish Counts ³⁰.

The site is designated for the following Annex I habitats:

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Coastal lagoons;
- Dunes with *Hippophae rhamnoides*;
- Embryonic shifting dunes;
- Estuaries;
- Fixed dunes with herbaceous vegetation ("Grey dunes")
- Mudflats and sandflats not covered by seawater at low tide
- *Salicornia* and other annuals colonising mud and sand
- Sandbanks which are slightly covered by sea water all the time; and
- Shifting dunes along the shoreline with *Ammophila arenaria* ("White dunes"); and

Together with the following Annex II species:

- Grey seal (*Halichoerus grypus*);
- Sea lamprey (*Petromyzon marinus*); and
- River lamprey (*Lampetra fluviatilis*).

The Humber is the largest coastal plain estuary on the east coast of Britain. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them. Habitats within the Humber Estuary SAC include Atlantic salt meadows and a range of sand dune types in the outer estuary, together with subtidal sandbanks, extensive intertidal mudflats, *Salicornia* saltmarsh and coastal lagoons. As salinity declines upstream,

³⁰ <https://data.gov.uk/dataset/41308817-191b-459d-aa39-788f74c76623/trac-fish-counts-for-all-species-for-all-estuaries-and-all-years>

reedbeds and brackish saltmarsh communities fringe the estuary. Significant fish species include river lamprey and sea lamprey, which breed in the River Derwent. Grey seals come ashore in autumn to form breeding colonies on the sandy shores of the south bank at Donna Nook.

The Humber estuary is a complex feature, which encompasses a number of other features, of which some have subfeatures associated with them, specifically 'Mudflats and sandflats not covered by seawater at low tide' and 'sandbanks which are slightly covered by sea water all the time'. No sub features are listed for the following habitat features: Atlantic salt meadows (*Glauco-Puccinellietalia maritima*), coastal lagoons, dunes with *Hippophae rhamnoides*, embryonic shifting dunes, fixed dunes with herbaceous vegetation ("grey dunes"), *Salicornia* and other annuals colonising mud and sand, shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes").

Of the designated features, potential for LSE has been identified for grey seal (*Halichoerus grypus*), and the two saltmarsh habitats (Atlantic salt meadows and *Salicornia* and other annuals colonising mud and sand) only, under the following scenarios:

- Increased nitrogen deposition - Atlantic salt meadows and *Salicornia* and other annuals colonising mud and sand (construction and decommissioning);
- Increase in underwater noise – grey seal only (construction and decommissioning);
- Vessel disturbance – grey seal only (construction, O&M and decommissioning); and
- Collision risk – grey seal in-combination only.

No information on feature condition is available following the 2016 Natural England's review³¹.

Advice on operations was last updated in March 2019³², including advice for offshore wind (during construction, O&M and decommissioning and cable laying, O&M and decommissioning).

Management measures were issued in September 2017³³, with these limited to commercial fishing activities.

The Environment Agency TraC data, which consists of information collected from fisheries monitoring work on rivers, lakes, transitional and coastal waters, were accessed in June 2019 (database updated: 17 June 2019)³⁴. For the Humber Estuary (all sites) the database (which extends back to 1981) included just 4 records of river lamprey and none of sea lamprey.

The Site Improvement Plan for Humber Estuary³⁵ that includes the Humber Estuary SAC was issued in July 2015. Reference to the features of the SAC screened in for potential LSE is as follows:

- Coastal squeeze (saltmarsh);
- Undergrazing (saltmarsh);
- Invasive species (saltmarsh);

³¹<https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureCondition.aspx?SiteCode=UK0030170&SiteName=humber%20estuary&SiteNameDisplay=Humber+Estuary+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAAraa=>

³²<https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0030170&SiteName=humber%20estuary&SiteNameDisplay=Humber+Estuary+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAAraa=>

³³<https://designatedsites.naturalengland.org.uk/SiteMMO.aspx?SiteCode=UK0030170&SiteName=humber%20estuary&countyCode=&responsiblePerson=&SeaArea=&IFCAAraa=>

³⁴ <https://data.gov.uk/dataset/41308817-191b-459d-aa39-788f74c76623/trac-fish-counts-for-all-species-for-all-estuaries-and-all-years>

³⁵<http://publications.naturalengland.org.uk/publication/5427891407945728?category=5171232873906176>

- Public access/disturbance (saltmarsh); and
- Air pollution (saltmarsh).

The Supplementary Advice for the Humber Estuary SAC was updated in September 2017³⁶. The targets applicable to the features screened in for potential LSE (grey seal (*Halichoerus grypus*), Atlantic salt meadows and Salicornia and other annuals colonising mud and sand are listed below (not all being applicable to all three features screened in for potential LSE; where only applicable to specific features, this is noted):

- Maintain the unrestricted usage of the estuary by adult and juvenile river lamprey including for migratory passage and juvenile development);
- Maintain the population size within the site (grey seal);
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to ensure recruitment, and / or to allow movement of migratory species (grey seal);
- Restore connectivity of estuarine features to surrounding rivers, freshwater, marine and coastal habitats, to ensure larval dispersal and recruitment, maintain nursery grounds for mobile species, and to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts (grey seal);
- Maintain the extent and spatial distribution of the following supporting habitats: haulout sites (grey seal);
- Maintain the extent and spatial distribution of the following supporting habitats: water column;
- Maintain the abundance of preferred food items required by the species;
- Maintain the cover / abundance of preferred food items required by the species (grey seal);
- Maintain the natural physico-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained (grey seal);
- Maintain all hydrodynamic and physical conditions such that natural water flow is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to Good Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels;
- Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features; and

³⁶<https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030170&SiteName=humber%20estuary&SiteNameDisplay=Humber+Estuary+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) in areas where this species is, or could be, present.

The Conservation Objectives for the site³⁷ are as follows:

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of the qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of each of the qualifying species; and
- the distribution of qualifying species within the site.

³⁷<https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030170&SiteName=humber%20estuary&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

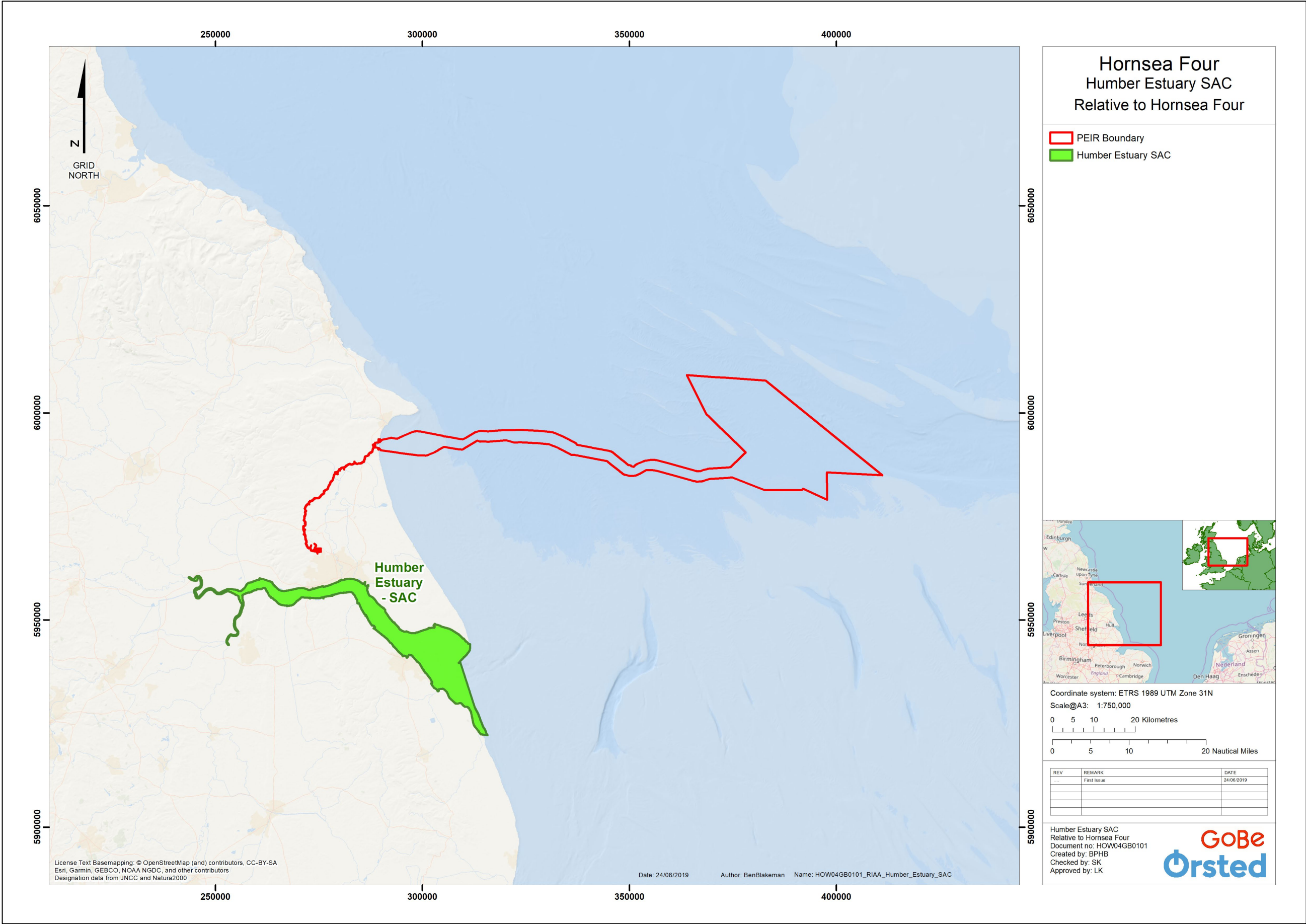


Figure 4: The Humber Estuary SAC in Relation to Hornsea Four (not to scale).

Humber Estuary SPA

The Humber Estuary is located on the east coast of England, and comprises extensive wetland and coastal habitats. The inner estuary supports extensive areas of reedbed, with areas of mature and developing saltmarsh backed by grazing marsh in the middle and outer estuary. On the north Lincolnshire coast, the saltmarsh is backed by low sand dunes with marshy slacks and brackish pools. The estuary supports important numbers of non-breeding waterbirds (especially geese, ducks and waders) during the migration periods and in winter. In summer, it supports important breeding populations of wetland bird species. The interest features of the site are described in the following documents:

- Humber Estuary SPA citation [version 2.0; July 2007]

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Bittern; breeding; 2 booming males (2000-2002);
- Bittern; non-breeding; 4 individuals (1998/99 – 2002/03);
- Shelduck; non-breeding; 4,464 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Marsh harrier; breeding; 10 females (1998-2002);
- Hen harrier; non-breeding; 8 individuals (1997/98 – 2001/02);
- Avocet; breeding; 64 pairs (1998 – 2002);
- Avocet; non-breeding; 59 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Golden plover; non-breeding; 30,709 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Knot; non-breeding; 28,165 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Dunlin; non-breeding; 22,222 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Ruff; non-breeding; 128 individuals (1996-2000);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Black-tailed godwit; non-breeding; 1,113 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Bar-tailed godwit; non-breeding; 2,752 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.

- Redshank; non-breeding; 4,632 individuals (1996/97 – 2000/01);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Little tern; breeding; 51 pairs (1998-2002);

The non-breeding waterbird assemblage; 153,934 average number of individuals (1996/97-2001/01); includes interest features listed above, additional named assemblage species; dark-bellied brent goose, wigeon, teal, mallard, pochard, scaup, goldeneye, oystercatcher, ringed plover, grey plover, lapwing, sanderling, whimbrel, curlew, greenshank and turnstone, as well as other non-named species including pink-footed goose.

The Conservation Objectives for the site were provided by Natural England in 2019 (version 4) as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

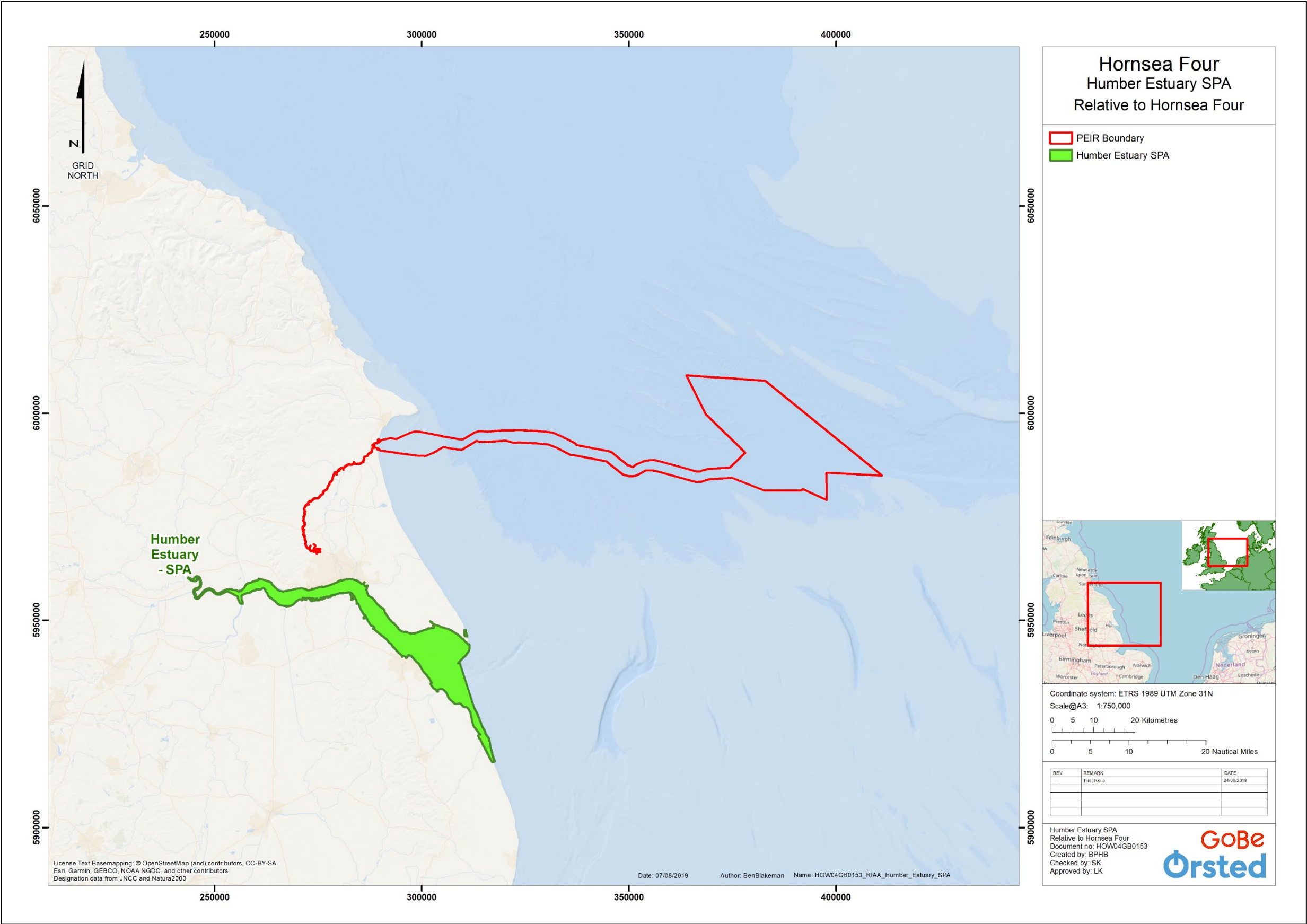


Figure 5: The Humber Estuary SAC in Relation to Hornsea Four (not to scale).

Humber Estuary Ramsar

The Humber Estuary is located on the boundary between the East Midlands Region and the Yorkshire and the Humber Region and is the largest macro-tidal estuary on the British North Sea coast. The Humber Estuary Ramsar site covers an area of 37,987.8 ha. The receptor groups saltmarsh' and 'marine mammals' are relevant to the Humber Estuary Ramsar. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 2: Benthic Subtidal and Intertidal Ecology;**
- **Volume 5, Annex 2.1: Benthic Subtidal and Intertidal Ecology Technical Report;**
- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammals Technical Report;**
- **Volume 4, Annex 4.5: Subsea Noise Technical Report;**
- **Humber Estuary Information Sheet on Ramsar Wetlands (dated August 2007).**

The site is designated for the following Ramsar criteria³⁸:

- Criterion 1: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.
- Criterion 3: The site supports a breeding colony of grey seals (*Halichoerus grypus*) at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. The dune slacks at Saltfleetby-Theddlethorpe are the most north-easterly breeding site in Great Britain of the natterjack toad (*Bufo calamita*).
- Criterion 5: Assemblages of international importance - 153,934 waterfowl, non-breeding season (5 year peak mean 1996/97-2000/2001).
- Criterion 6: species/populations occurring at levels of international importance: Eurasian golden plover (*Pluvialis apricaria altifrons* subspecies) wintering and on passage, Red knot (*Calidris canutus islandica* subspecies) wintering and on passage, Dunlin (*Calidris alpina alpina* subspecies) wintering and on passage, Black-tailed godwit (*Limosa limosa islandica* subspecies) wintering and on passage, Common redshank (*Tringa totanus brittanica* subspecies) wintering and on passage, Common shelduck (*Tadorna tadorna*) wintering, Bar-tailed godwit (*Limosa lapponica lapponica* subspecies) wintering.
- Criterion 8: The Humber Estuary acts as an important migration route for both river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*) between coastal waters and their spawning areas.

Of these, potential for LSE has been identified for grey seal (*Halichoerus grypus*), two lamprey species (*Petromyzon marinus* and *Lampetra fluviatilis*) and seven bird species under the following scenarios:

- Increased nitrogen deposition – saltmarsh only (construction and decommissioning);
- Increase in underwater noise – grey seal only (construction and decommissioning);
- Vessel disturbance – grey seal only (construction, O&M and decommissioning);
- Collision risk – grey seal in-combination only; and

³⁸ <http://jncc.defra.gov.uk/pdf/RIS/UK11031.pdf>

- Collision risk – golden plover, dunlin, black-tailed godwit, bar-tailed godwit, redshank, shelduck, red knot (O&M).

Natural England has not published any information on the condition of the site. The Site Improvement Plan for Humber Estuary³⁹ that includes the Humber Estuary Ramsar site was issued in July 2015. Reference to the criteria for which the sitesite was designated and in context of the features screened in for potential LSE is as follows:

- Undergrazing (saltmarsh);
- Invasive species (saltmarsh);
- Public access/disturbance (saltmarsh); and
- Air pollution (saltmarsh).

For Ramsar sites, a decision has been made by Defra and Natural England not to produce Conservation Advice packages, instead focussing on the production of High Level Conservation Objectives. However, no Conservation Objectives have yet been published for the Humber Estuary Ramsar. As the provisions on the Habitats Regulations relating to HRAs extend to Ramsar sites, Natural England considers the Conservation Advice packages for the overlapping European Marine Site designations to be, in most cases, sufficient to support the management of the Ramsar interests. Given that the features screened in for the Humber Estuary Ramsar are the same as those screened in for the Humber Estuary SAC, it is therefore reasonable to apply the relevant Humber Estuary SAC conservation objectives equally here. Those conservation objectives are provided above.

³⁹<http://publications.naturalengland.org.uk/publication/5427891407945728?category=5171232873906176>

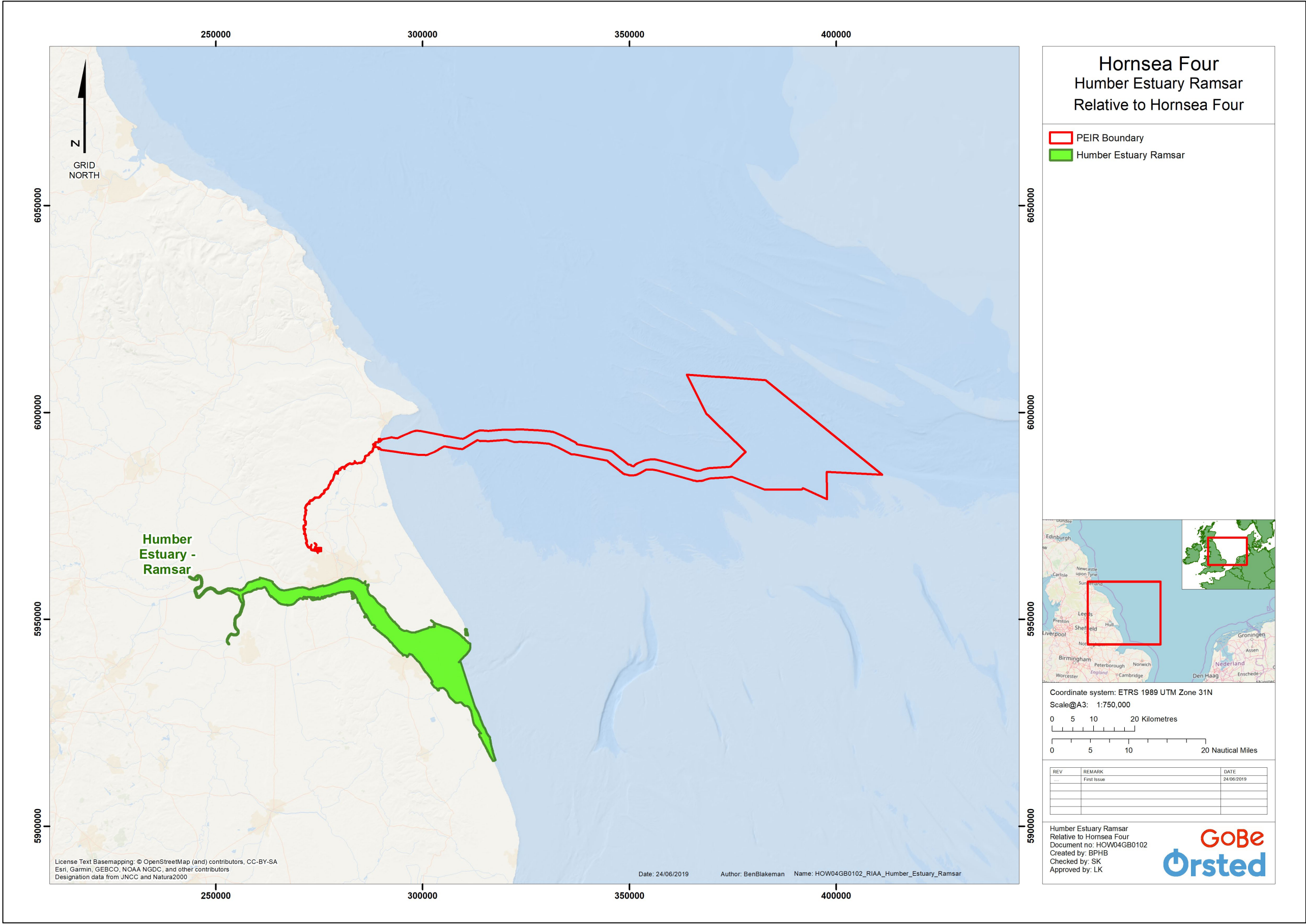


Figure 6: Humber Estuary Ramsar Site in Relation to Hornsea Four (not to scale).

Berwickshire and North Northumberland Coast SAC

The Berwickshire and North Northumberland Coast SAC covers a varied stretch of coastline, encompassing around 65,226 km². The receptor group 'marine mammals' is relevant to the Berwickshire and North Northumberland Coast SAC. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- The Natural England and SNH Regulation 33 Advice for the Berwickshire and North Northumberland Coast European Marine Site (2000)⁴⁰;
- Berwickshire and North Northumberland Coast Conservation Objectives (dated November 2018)⁴¹;
- Berwickshire and North Northumberland Coast SAC citation (dated July 2014⁴²); and
- SNH advice on Feature condition⁴³.

The site is designated for the following Annex I habitats:

- Large shallow inlets and bays;
- Mudflats and sandflats not covered by seawater at low tide;
- Reefs; and
- Submerged and partially submerged sea caves.

Together with the following Annex II species:

- Grey seal (*Halichoerus grypus*).

Of these, potential for LSE has been identified for grey seal (*Halichoerus grypus*) only (with no condition of the feature sourced), under the following scenarios:

- Increase in underwater noise – (construction and decommissioning); and
- Vessel disturbance – (construction, O&M and decommissioning).

The citation describes the site as being representative of grey seal breeding colonies in the south-east of its breeding range in the UK, supporting around 2.5% of annual UK pup production (noting that other sources give different numbers, eg the Regulation 33 document⁴⁴ cites 3%). The Regulation 33 document notes that the UK holds some 33% of the world population of grey seals and 95% of the European population. The Berwickshire and North Northumberland SAC population is one of the largest breeding colonies on the North Sea coast, with the area around the Farne

⁴⁰ <http://publications.naturalengland.org.uk/file/3495936>

⁴¹ <http://publications.naturalengland.org.uk/file/5347333881724928>

⁴² <http://publications.naturalengland.org.uk/file/4527238296895488>

⁴³ <https://sitelink.nature.scot/site/8207>

⁴⁴ <http://publications.naturalengland.org.uk/file/3495936>

Islands being the preferred food source for grey seals in this area. SNH lists the feature condition as 'favourable'.

The Advice on Activities is provided in the Regulation 33 Advice (dating from 2000), which for grey seal is a need to manage activities resulting in deterioration or disturbance to habitats or species resulting from the following:

- Visual disturbance and/or disturbance by noise; and
- Synthetic toxic contamination.

The relevant site improvement plan is dated April 2015⁴⁵, with measures linked to grey seal including public access to the site (disturbance) and direct threat from a third party. The measures identified were managing visitor access to the site and the provision of visitor information.

The Conservation Objectives for the site⁴⁶ are as follows:

With regard to the SAC and the natural habitats and/or species for which the site has been designated, and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species;
- the structure and function (including typical species) of qualifying natural habitats;
- the structure and function of the habitats of the qualifying species;
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- the populations of qualifying species; and
- the distribution of qualifying species within the site.

⁴⁵ <http://publications.naturalengland.org.uk/file/4788230077546496>

⁴⁶ <http://publications.naturalengland.org.uk/file/5347333881724928>

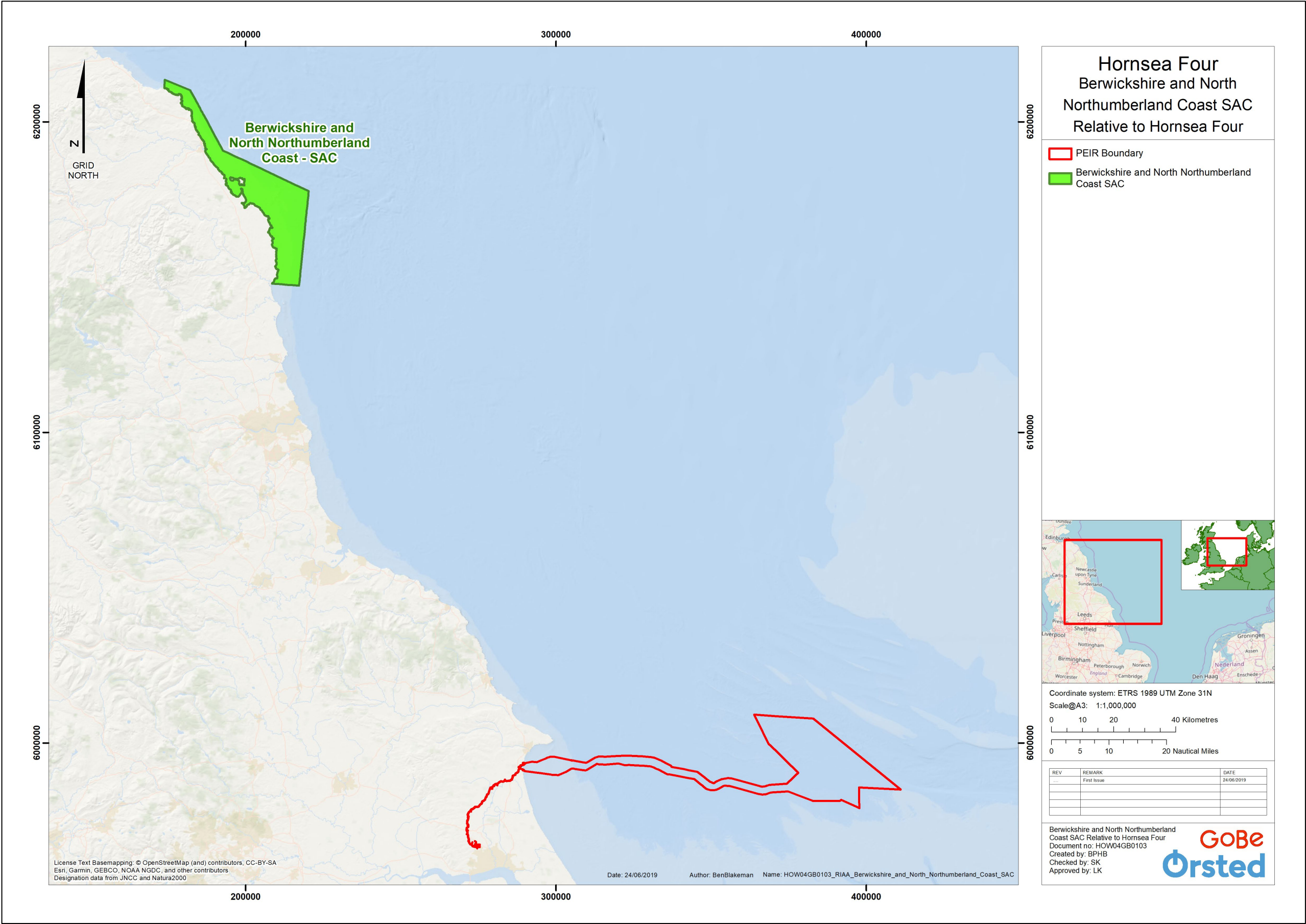


Figure 7: Berwickshire and North Northumberland Coast SAC in Relation to Hornsea Four (not to scale).

Doggersbank (Dutch) SAC

The Doggersbank SAC is located in the northern part of the Dutch North Sea and covers almost 4,745 km². The Dutch part of the Dogger Bank is part of the sandbank that extends over the British, Dutch, German and Danish Continental Shelves. It is an example of a shallow, permanently flooded sandbank, with the depth varying from 20 to 40 m. The receptor group 'marine mammals' is relevant to the Doggersbank SAC. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- Doggersbank SAC site information (in Dutch)⁴⁷.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by seawater all the time.

The following Annex II species:

- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Due to its shallow depth, orientation and scale, Dogger Bank has a major effect on marine processes. The fauna north of the Dogger Bank differs considerably from that of the southern North Sea. Tidal currents and wave action cause intense water mixing above the shallow parts of the bank. Dogger Bank is more productive than the surrounding areas due to high benthic primary production and strong growth of organisms in the water column.

Potential for LSE has been identified for harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Doggersbank SAC can be found on the Ministry of Agriculture, Nature and Food Quality website⁴⁸, and includes national conservation status and conservation targets for the site features. For all relevant features national conservation status is identified as 'moderately favourable'. The targets applicable to features for which potential LSE was identified are listed below:

- Conserve the area and quality of supporting habitat; and
- Conserve the population size.

⁴⁷<https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=13&id=n2k164&topic=introductie>

⁴⁸<https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=13&id=n2k164&topic=doelstelling>

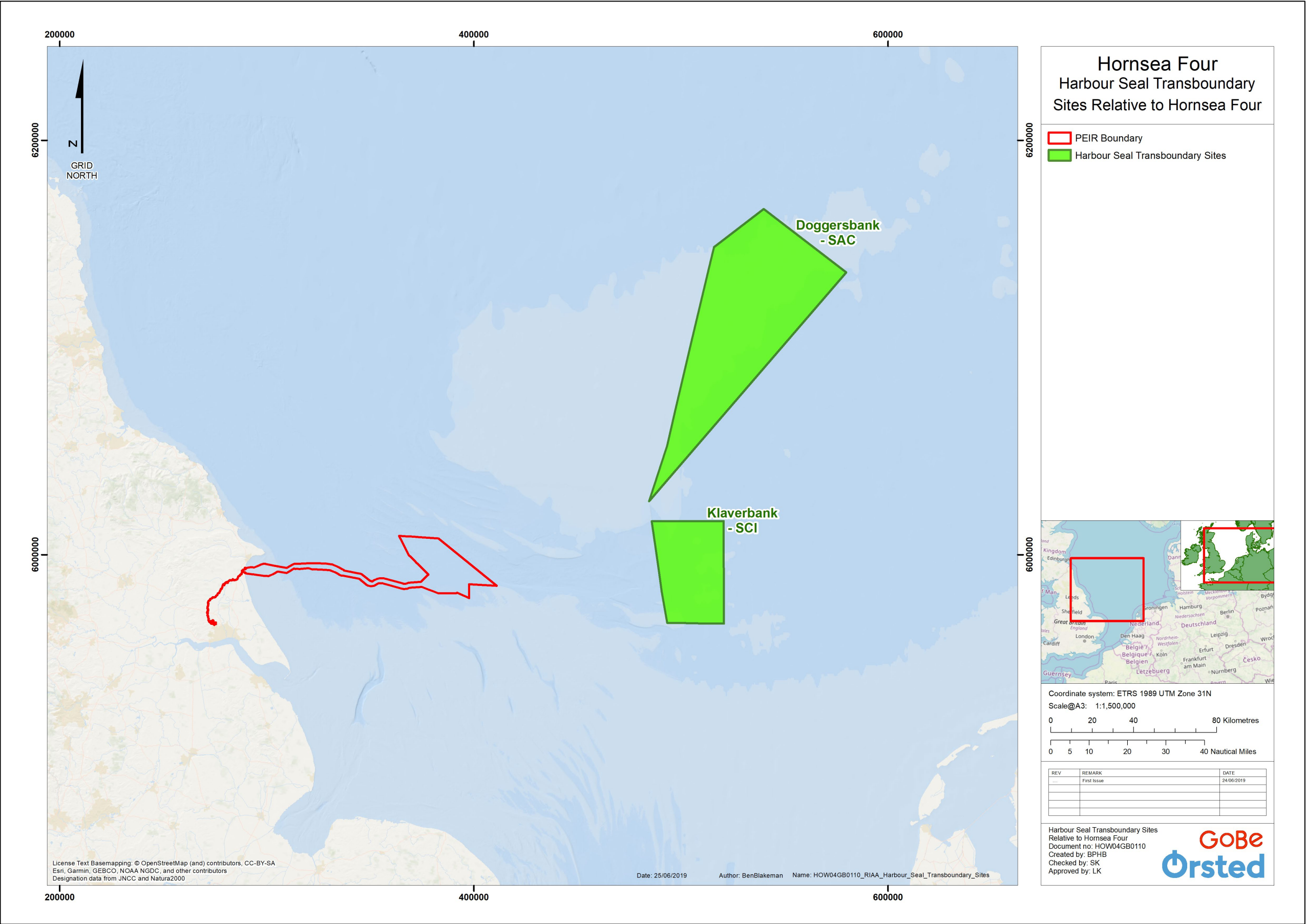


Figure 8: Doggersbank SAC in Relation to Hornsea Four (not to scale).

Klaverbank SCI

The Klaverbank is located in the northwestern part of the Dutch North Sea. The sediments consists of (coarse) gravel and larger stones in alternation with coarse sand and shell material. The presence of coarse sediment types offers a specific living environment for, among other things, organisms bound to substrate. The structure of the habitat type is formed by the growth of organisms that are connected to the substrate, and by algae that can fix the loose sediment together. The receptor group 'marine mammals' is relevant to the Klaverbank SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- Klaverbank SCI site information (in Dutch)⁴⁹.

The site is designated for the following Annex I habitat:

- Reefs.

The following Annex II species:

- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Klaverbank SCI can be found on the Ministry of Agriculture, Nature and Food Quality website⁵⁰, and includes national conservation status and conservation targets for the site features. For all relevant features national conservation status is identified as 'moderately favourable'. The targets applicable to features for which potential LSE was identified are listed below:

- Conserve the area and quality of supporting habitat; and
- Conserve the population size.

⁴⁹ <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=13&id=n2k165>

⁵⁰ <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=13&id=n2k165&topic=doelstelling>

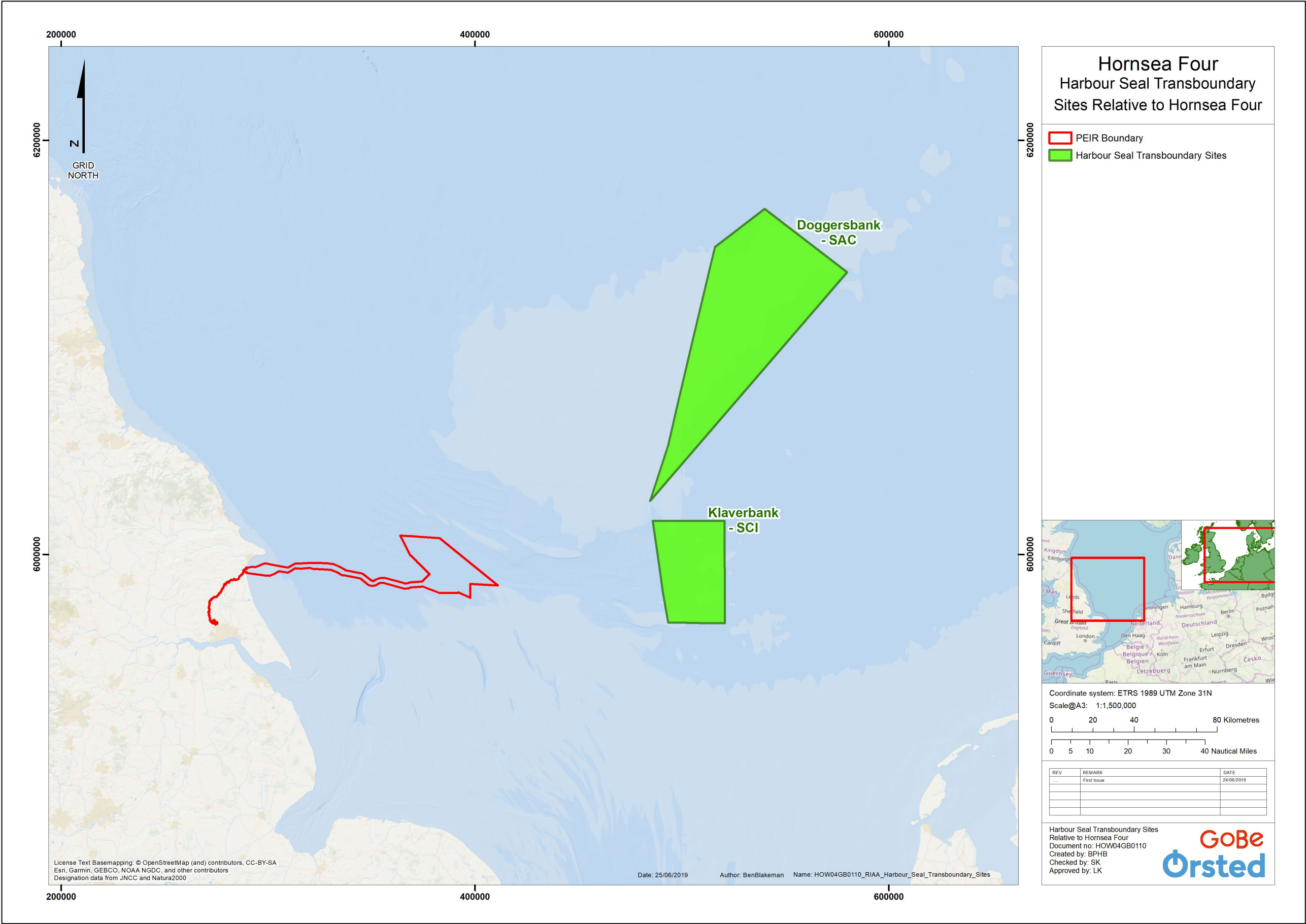


Figure 9: Klaverbank SCI in Relation to Hornsea Four (not to scale).

Bancs des Flandres SCI

The Bancs des Flandres SCI (Bank of Flanders) was first proposed in 2010, with the site information sourced dated May 2019⁵¹. The site is wholly marine and located in French waters and extends for some 112,919 ha. The receptor group 'marine mammals' is relevant to the Bancs des Flandres SCI. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 4, Annex 4.5: Subsea Noise Technical Report;**
- Bancs des Flandres SCI site information (in French)⁵².

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time.

The following Annex II species:

- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only, under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

No draft Conservation Objectives have been sourced for the Bancs des Flandres SCI, with no management plan available and the information indicating that an objectives document is yet to be produced⁵³. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁵¹ <https://inpn.mnhn.fr/site/natura2000/FR3102002>

⁵² <https://inpn.mnhn.fr/site/natura2000/FR3102002/tab/gestion>

⁵³ <https://inpn.mnhn.fr/site/natura2000/FR3102002/tab/gestion>

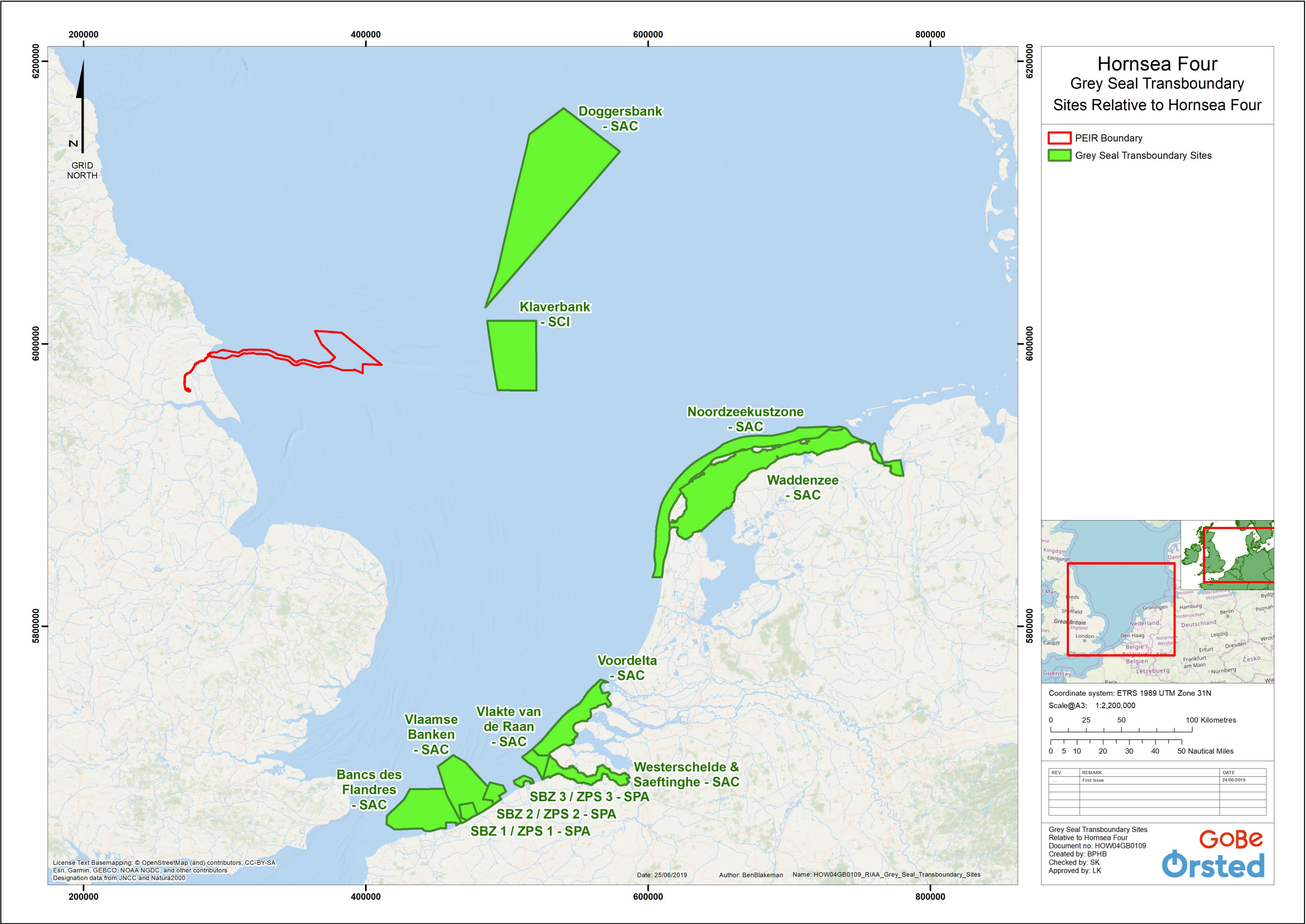


Figure 10: Klaverbank SCI in Relation to Hornsea Four (not to scale).

Vlaamse Banken SCI

The Vlaamse Banken SCI is located in Belgian waters and extends for some 109,940ha⁵⁴. The receptor group 'marine mammals' is relevant to the Vlaamse Banken SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- Vlaamse Banken SCI site information⁵⁵.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time;
- Reefs.

The following Annex II species:

- Twaite shad (*Alosa fallax*);
- River lamprey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Vlaamse Banken SCI can be found in the Natura 2000 data form⁵⁶; no information on conservation status or conservation targets for the site features have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁵⁴ <http://natura2000.eea.europa.eu/natura2000/SDF.aspx?site=BEMNZ0001#3>

⁵⁵ <http://natura2000.eea.europa.eu/natura2000/SDF.aspx?site=BEMNZ0001#3>

⁵⁶ <http://natura2000.eea.europa.eu/natura2000/SDF.aspx?site=BEMNZ0001#3>

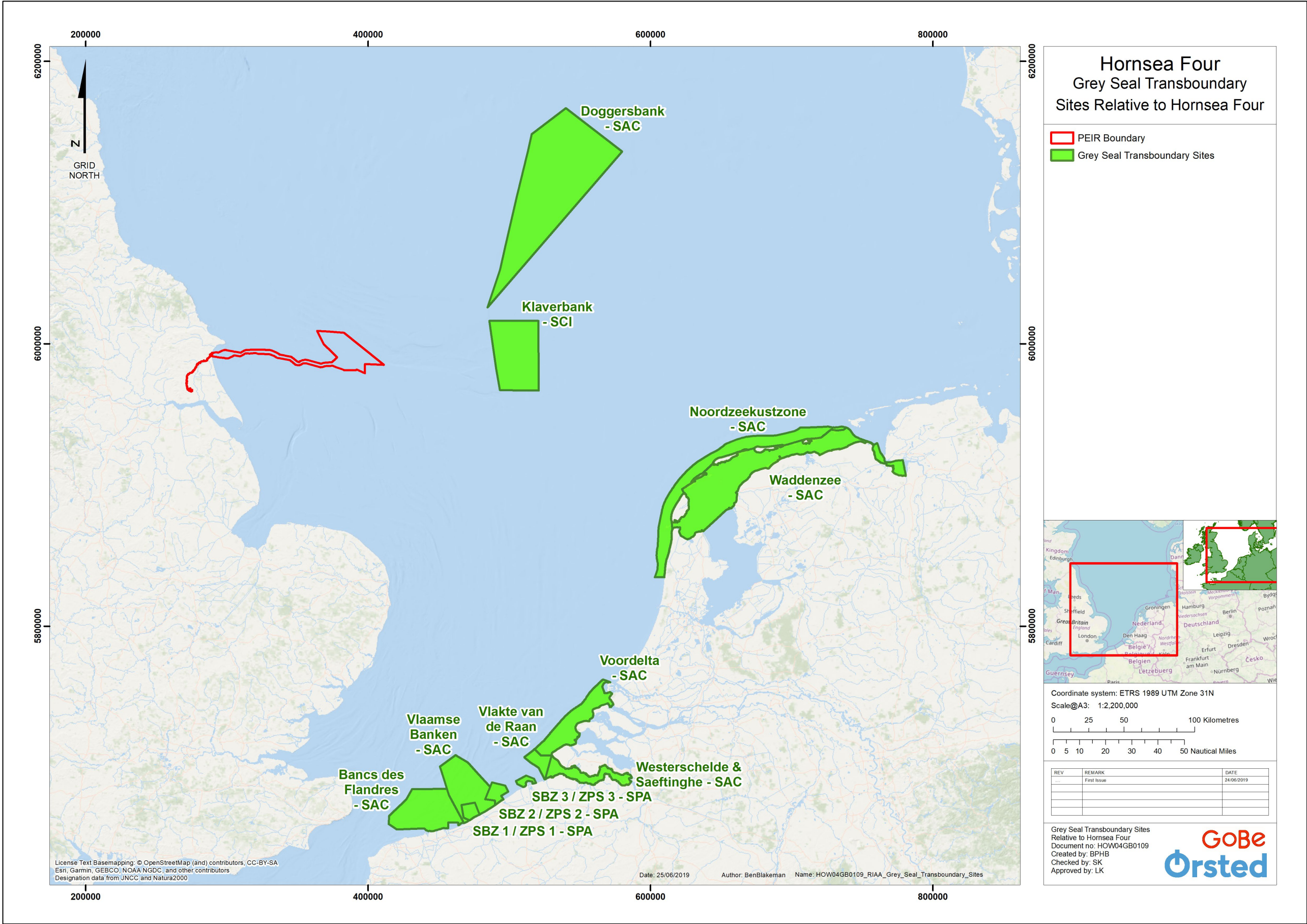


Figure 1.1: Vlaamse Banken SCI in Relation to Hornsea Four (not to scale).

SBZ 1 SCI

The SBZ 1 SCI is located in Belgian waters and extends for some 6,315.6 ha⁵⁷. The receptor group 'marine mammals' is relevant to the SBZ 1 SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- SBZ 1 SCI site information⁵⁸.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time;
- Reefs.

The following Annex II species:

- Twaité shad (*Alosa fallax*);
- River lamprey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the SBZ 1 SCI can be found in the Natura 2000 data form⁵⁹; no information on conservation status or conservation targets for the site features have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁵⁷ <http://eunis.eea.europa.eu/sites/BEMNZ0002>

⁵⁸ <http://eunis.eea.europa.eu/sites/BEMNZ0002>

⁵⁹ <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BEMNZ0002>

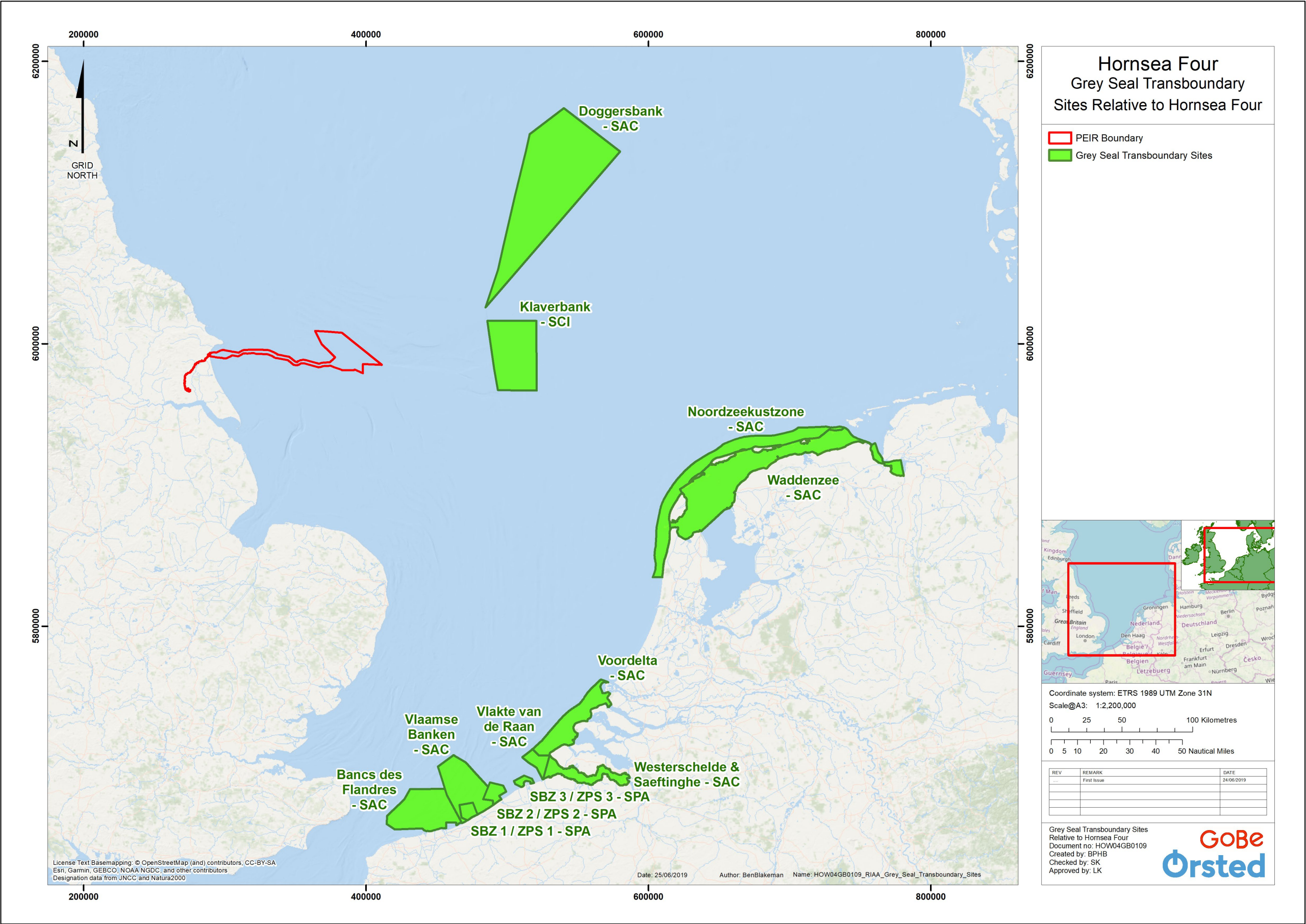


Figure 12: SBZ 1 SCI in Relation to Hornsea Four (not to scale).

SBZ 2 SCI

The SBZ 2 SCI is located in Belgian waters and extends for some 8,139.7ha⁶⁰. The receptor group 'marine mammals' is relevant to the SBZ 2 SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- SBZ 2 SCI site information⁶¹.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time;
- Reefs.

The following Annex II species:

- Twaité shad (*Alosa fallax*);
- River lamprey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the SBZ 2 SCI can be found in the Natura 2000 data form⁶²; no information on conservation status or conservation targets for the site features have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁶⁰ <http://eunis.eea.europa.eu/sites/BEMNZ0003>

⁶¹ <http://eunis.eea.europa.eu/sites/BEMNZ0003>

⁶² <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BEMNZ0003>

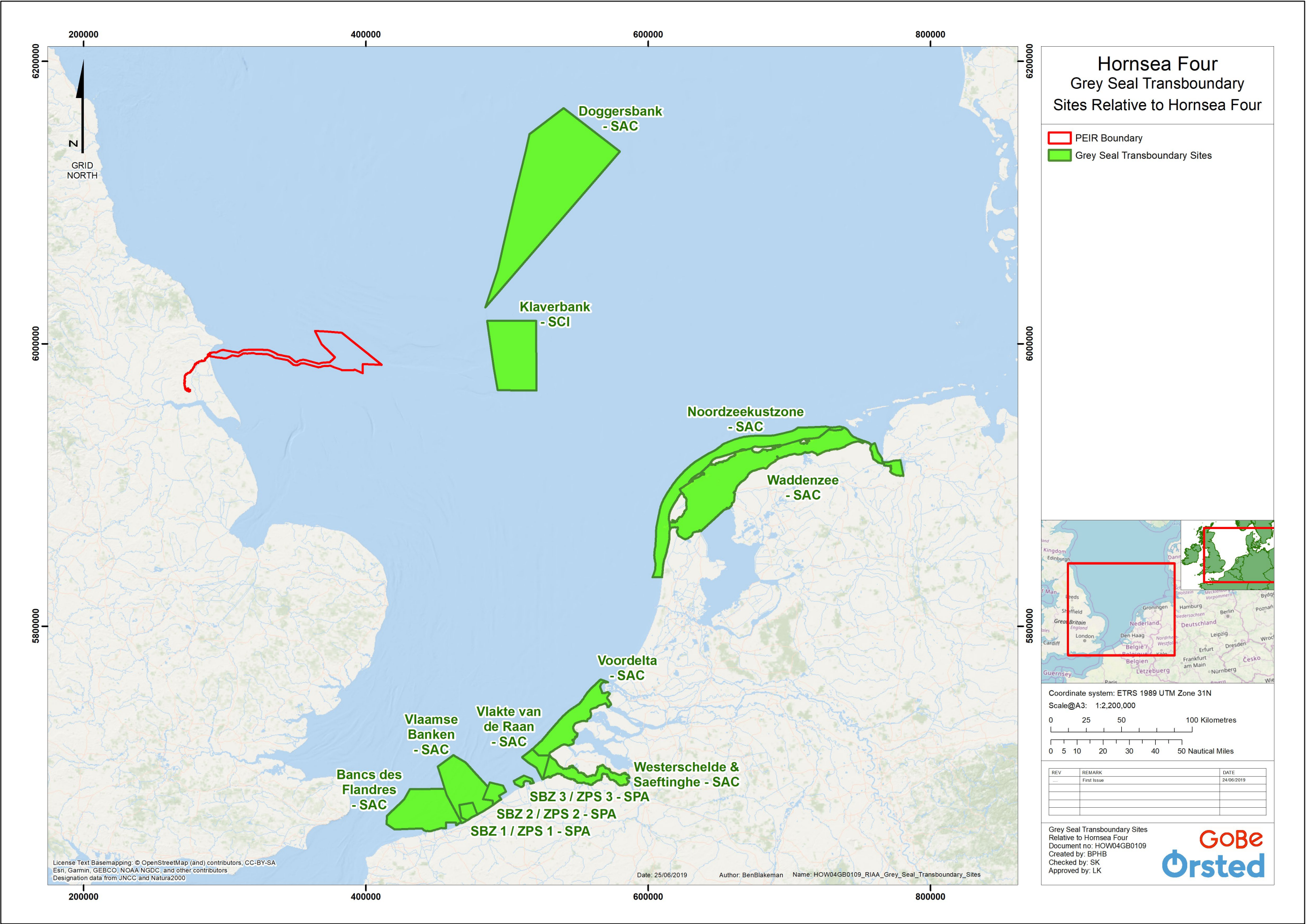


Figure 13: SBZ 2 SCI in Relation to Hornsea Four (not to scale).

SBZ 3 SCI

The SBZ 3 SCI is located in Belgian waters and extends for some 5,675.6 ha⁶³. The receptor group 'marine mammals' is relevant to the SBZ 3 SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- SBZ 3 SCI site information⁶⁴.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time;
- Reefs.

The following Annex II species:

- Twaité shad (*Alosa fallax*);
- River lamprey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the SBZ 3 SCI can be found in the Natura 2000 data form⁶⁵; no information on conservation status or conservation targets for the site features have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁶³ <http://eunis.eea.europa.eu/sites/BEMNZ0004>

⁶⁴ <http://eunis.eea.europa.eu/sites/BEMNZ0004>

⁶⁵ <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BEMNZ0004>

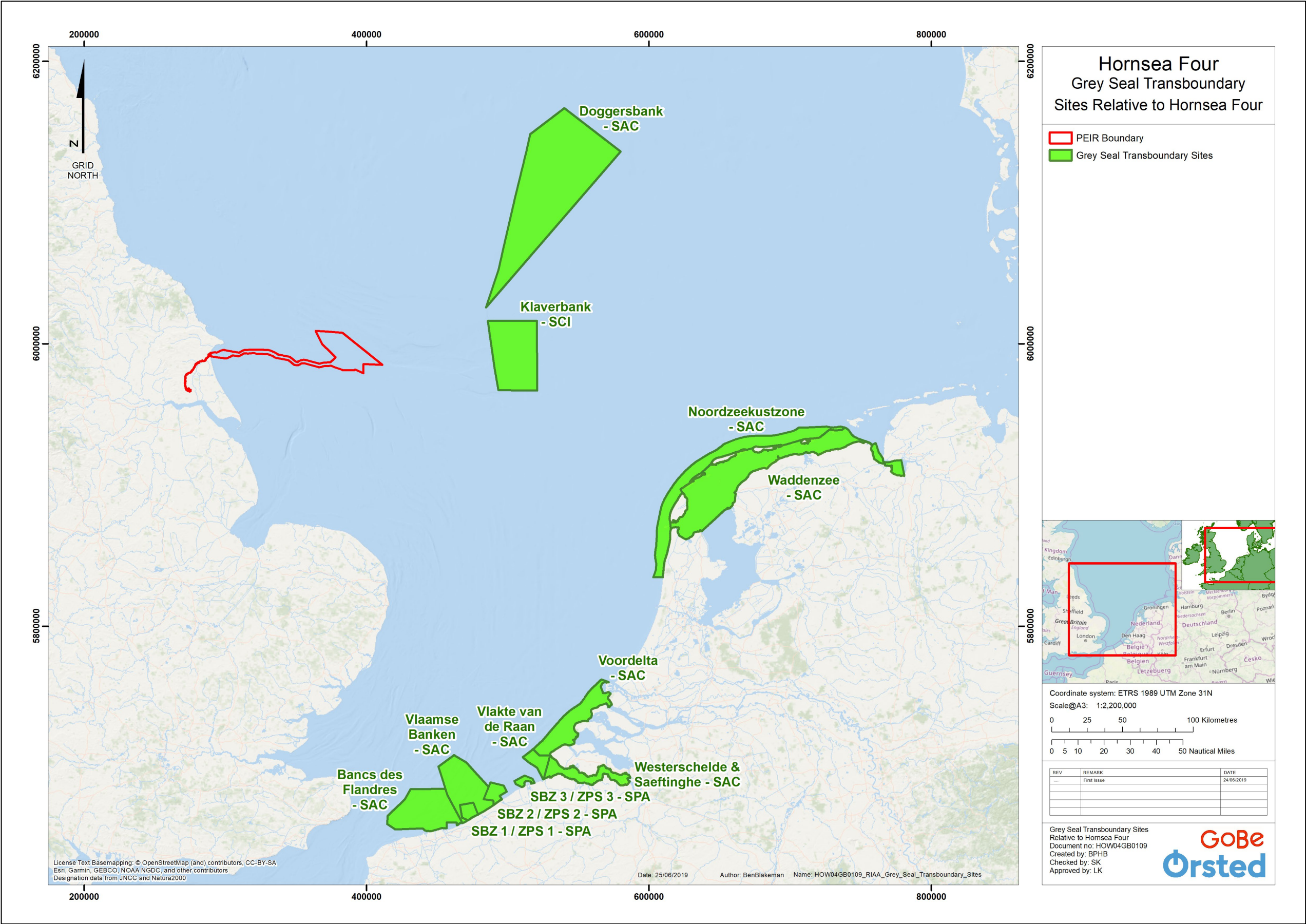


Figure 14: SBZ 3 SCI in Relation to Hornsea Four (not to scale).

Vlakte van de Raan SCI

The Vlakte van der Raan SCI is located in Belgian waters and extends for some 17,500 ha⁶⁶. The receptor group 'marine mammals' is relevant to the Vlakte van der Raan SCI. Key literature sources, including relevant project literature, are as follows:

- [Volume 2, Chapter 4: Marine Mammals](#);
- [Volume 5, Annex 4.1: Marine Mammal Technical Report](#);
- [Volume 4, Annex 4.5: Subsea Noise Technical Report](#);
- Vlakte van der Raan SCI site information⁶⁷.

The site is designated for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time.

The following Annex II species:

- Twaite shad (*Alosa fallax*);
- Sea lamprey (*Petromyzon marinus*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Vlakte van der Raan SCI can be found in the Natura 2000 data form⁶⁸; no information on conservation status or conservation targets for the site features have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

⁶⁶ https://www.rwsnatura2000.nl/Gebieden/VvdR_Vlakte+van+de+Raan/default.aspx

⁶⁷ https://www.rwsnatura2000.nl/Gebieden/VvdR_Vlakte+van+de+Raan/337009.aspx?t=Vlakte+van+de+Raan

⁶⁸ <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=BEMNZ0005>

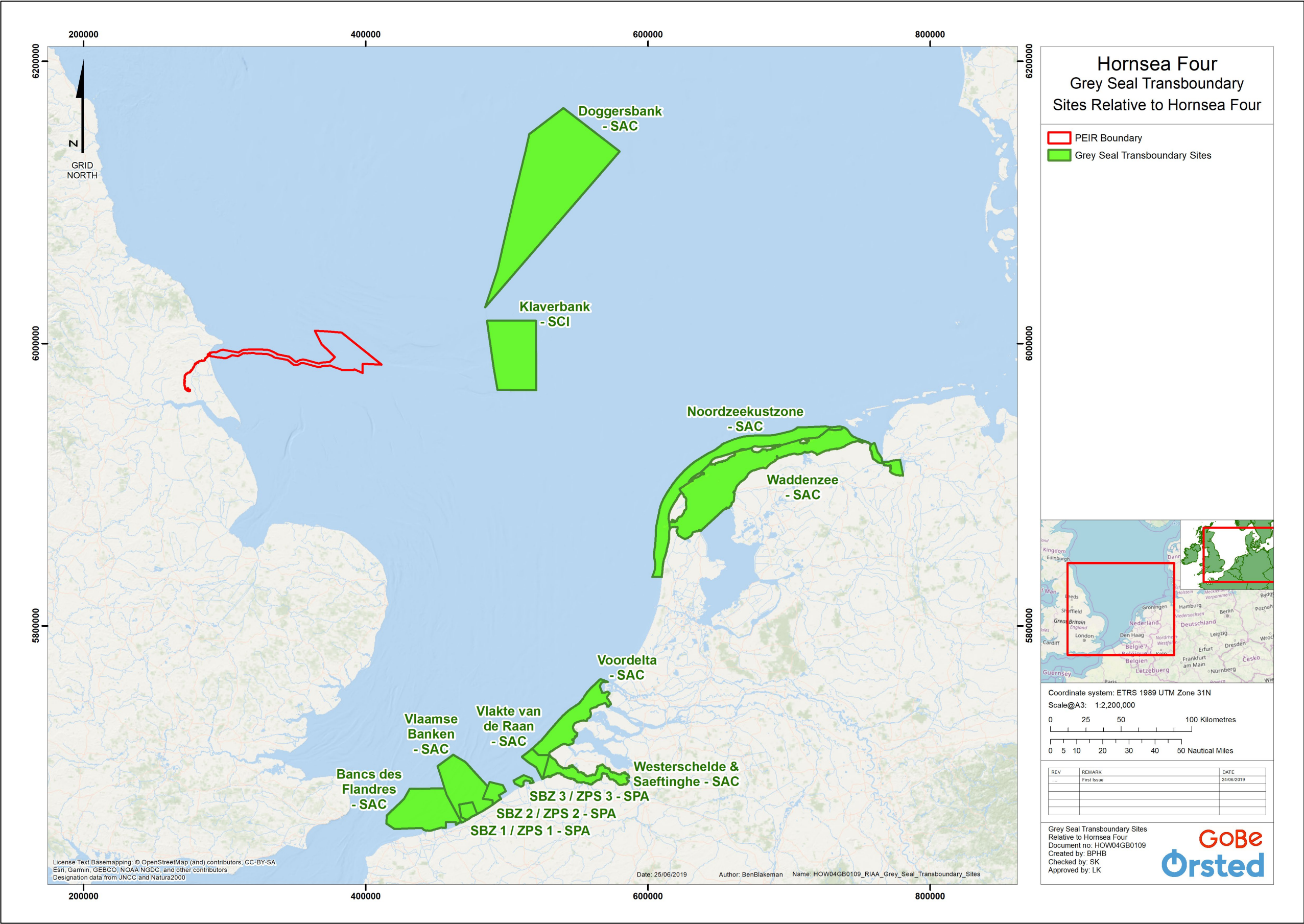


Figure 15: Vlakte van der Raan SCI in Relation to Hornsea Four (not to scale).

Westerschelde & Saeftinghe SCI

The Westerschelde & Saeftinghe SCI is located in Dutch waters and extends for some 44,052 ha⁶⁹. The receptor group 'marine mammals' is relevant to the Westerschelde & Saeftinghe SCI. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 4, Annex 4.5: Subsea Noise Technical Report;**
- Westerschelde & Saeftinghe SCI site information⁷⁰.

The site is designated for the following Annex I habitats:

- Sandbanks which are slightly covered by sea water all the time;
- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- *Salicornia* and other annuals colonising mud and sand;
- *Spartina* swards (*Spartinion maritimae*);
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Embryonic shifting dunes;
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes);
- Fixed coastal dunes with herbaceous vegetation (grey dunes);
- Dunes with *Hippophae rhamnoides*; and
- Humid dune slacks.

The following Annex II species:

- Twaite shad (*Alosa fallax*);
- River lamprey (*Lampetra fluviatilis*);
- Sea lamprey (*Petromyzon marinus*);
- Fen orchid (*Liparis loeselii*);
- Narrow-mouthed whorl snail (*Vertigo angustior*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Westerschelde & Saeftinghe SCI can be found in the Natura 2000 data form⁷¹; no information on conservation status or conservation targets for the site features

⁶⁹ <http://eunis.eea.europa.eu/sites/NL9803061>

⁷⁰ <http://eunis.eea.europa.eu/sites/NL9803061>

⁷¹ <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=NL9803061>

have been sourced. Therefore, as a proxy and to ensure consistency across the RIAA, the conservation objectives applied elsewhere for transboundary assessments for grey seal have been applied here. The focus of these is on conserving the habitat and population.

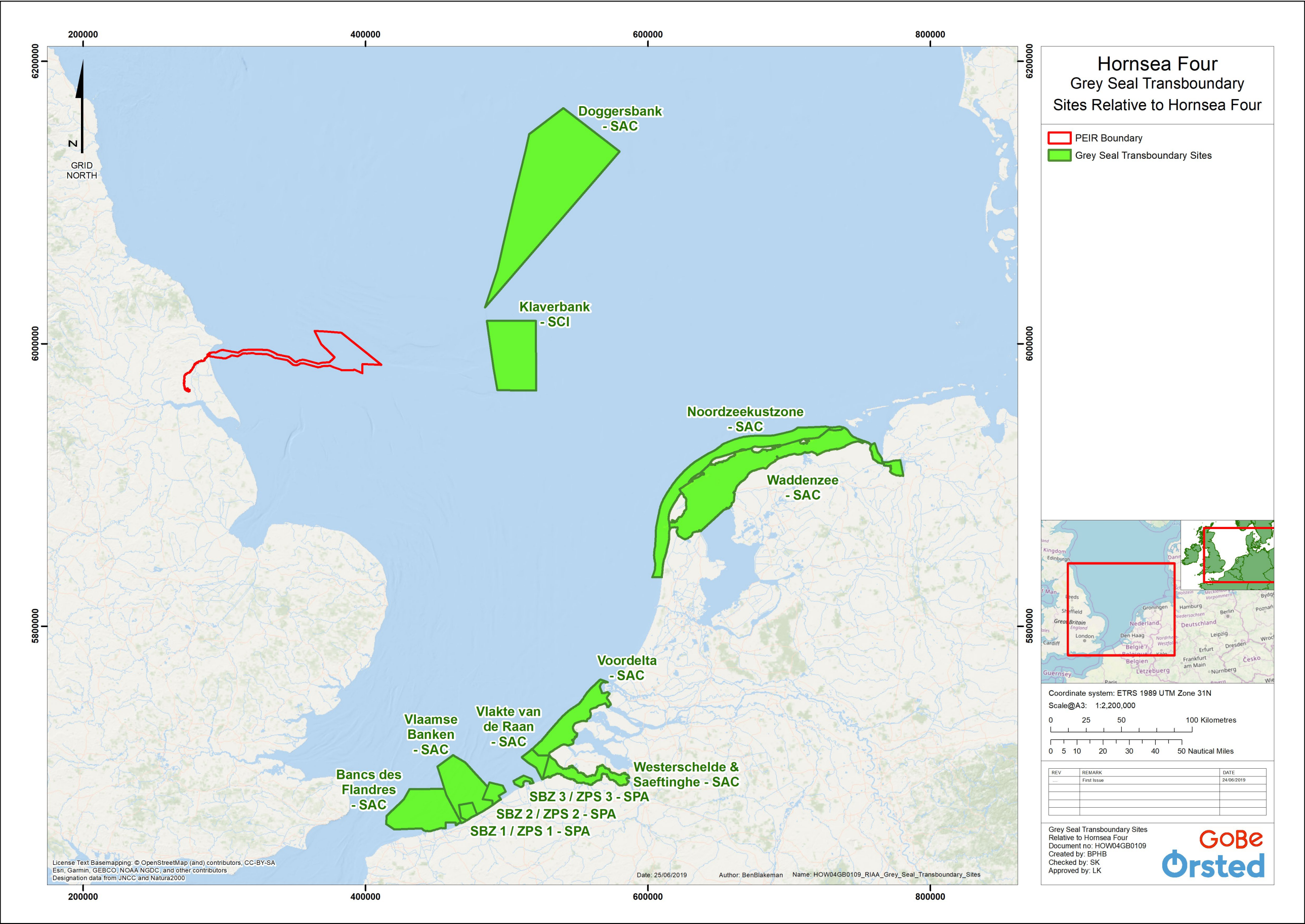


Figure 16: Westerschelde & Saeftinghe SCI in Relation to Hornsea Four (not to scale).

Voordelta SCI

The Voordelta includes the shallow sea portion of the Zeeland and South Holland Delta. The area is characterized by the presence of a varied and dynamic environment of coastal waters, intertidal zone and beaches, which forms a relatively sheltered transition zone between the (former) estuaries and the sea. After the closing of the Delta Works, this coastal area has been subject to major changes, resulting in an extensive system of tidal and deeper sandbanks with deeper channels in between. Due to erosion and sedimentation processes, shifts occur in the size of intertidal areas. The water quality is influenced in particular by the outflow of the Rhine and Maas through the Haringvliet locks. Partly due to this supply of nutrients, the Voordelta has a high food richness. There are a number of salt marshes and more intertidal areas in the edges of the area near Voorne and Goeree, with beaches and sand dunes among the Zeeland and South Holland islands. The receptor group 'marine mammals' is relevant to the Voordelta SCI. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 5, Annex 4.5: Subsea Noise Technical Report;**
- Voordelta SCI site information (in Dutch)⁷².

The site is designated for the following Annex I habitats:

- Sandbanks which are slightly covered by sea water all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- *Salicornia* and other annuals colonising mud and sand;
- *Spartina* swards (*Spartinion maritimae*);
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Embryonic shifting dunes; and
- Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes').

The following Annex II species:

- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*);
- Allis shad (*Alosa alosa*);
- Twaites shad (*Alosa fallax*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

⁷² <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=9&id=n2k113>

Additional information for the Voordelta SCI can be found on the Ministry of Agriculture, Nature and Food Quality website⁷³, and includes national conservation status and conservation targets for the site features. For grey seals national conservation status is identified as 'moderately favourable'. The targets applicable to grey seal are listed below:

- Conserve the area and quality of supporting habitat;
- Conserve the population size; and
- Conservation of intertidal areas for resting grey seal.

⁷³<https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=9&id=n2k113&topic=doelstelling>

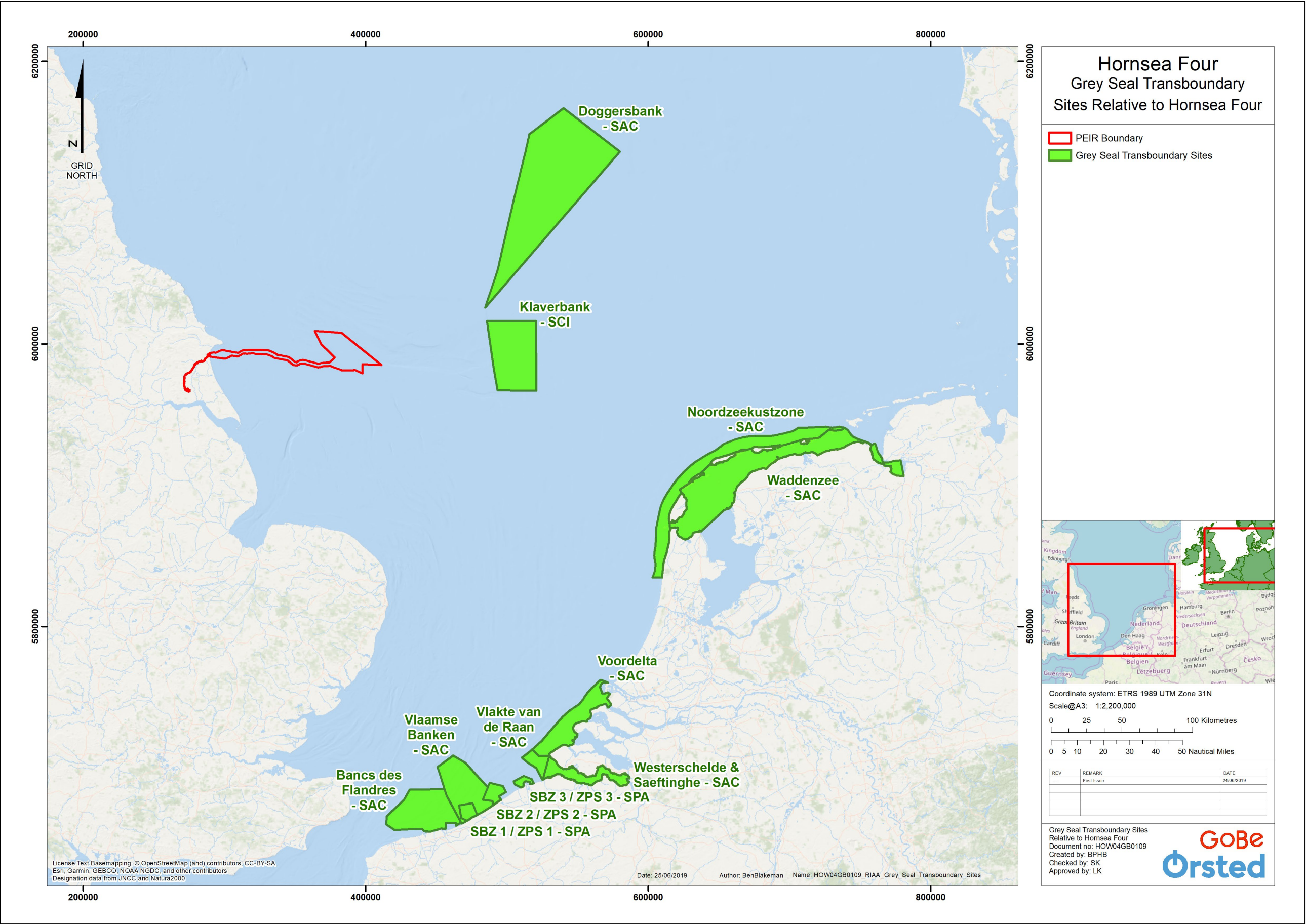


Figure 17: Voordelta SCI in Relation to Hornsea Four (not to scale).

Noordseekustzone SCI

The sandy coastal area along the North Sea consists of coastal waters, shallows, a few sandbanks (including Noorderhaaks) and the beaches of northern North Holland and the Wadden Islands. Sandbanks that are permanently flooded with seawater occur in particular in the outer deltas of the channels between the Wadden Islands. The receptor group 'marine mammals' is relevant to the Noordseekustzone SCI. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 4, Annex 4.5: Underwater Noise Technical Report;**
- Noordseekustzone SCI site information (in Dutch)⁷⁴.

The site is designated for the following Annex I habitats:

- Sandbanks which are slightly covered by sea water all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- *Salicornia* and other annuals colonising mud and sand;
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Embryonic shifting dunes; and
- Humid dune slacks.

The following Annex II species:

- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*);
- Fen orchid (*Liparis loeselii*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Noordseekustzone SCI can be found on the Ministry of Agriculture, Nature and Food Quality website⁷⁵, and includes national conservation status and conservation targets for the site features. For grey seal the national conservation status is identified as 'moderately favourable'. The targets applicable to grey seal are listed below:

- Conserve the area and quality of supporting habitat;
- Conserve the population size;

⁷⁴ <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k7>

⁷⁵ <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k7&topic=doelstelling>

- Improving the quality of habitat for marine mammals;
- Conservation of intertidal habitat for grey seal; and
- Maintain undisturbed resting places and optimal breeding habitat for grey seal.

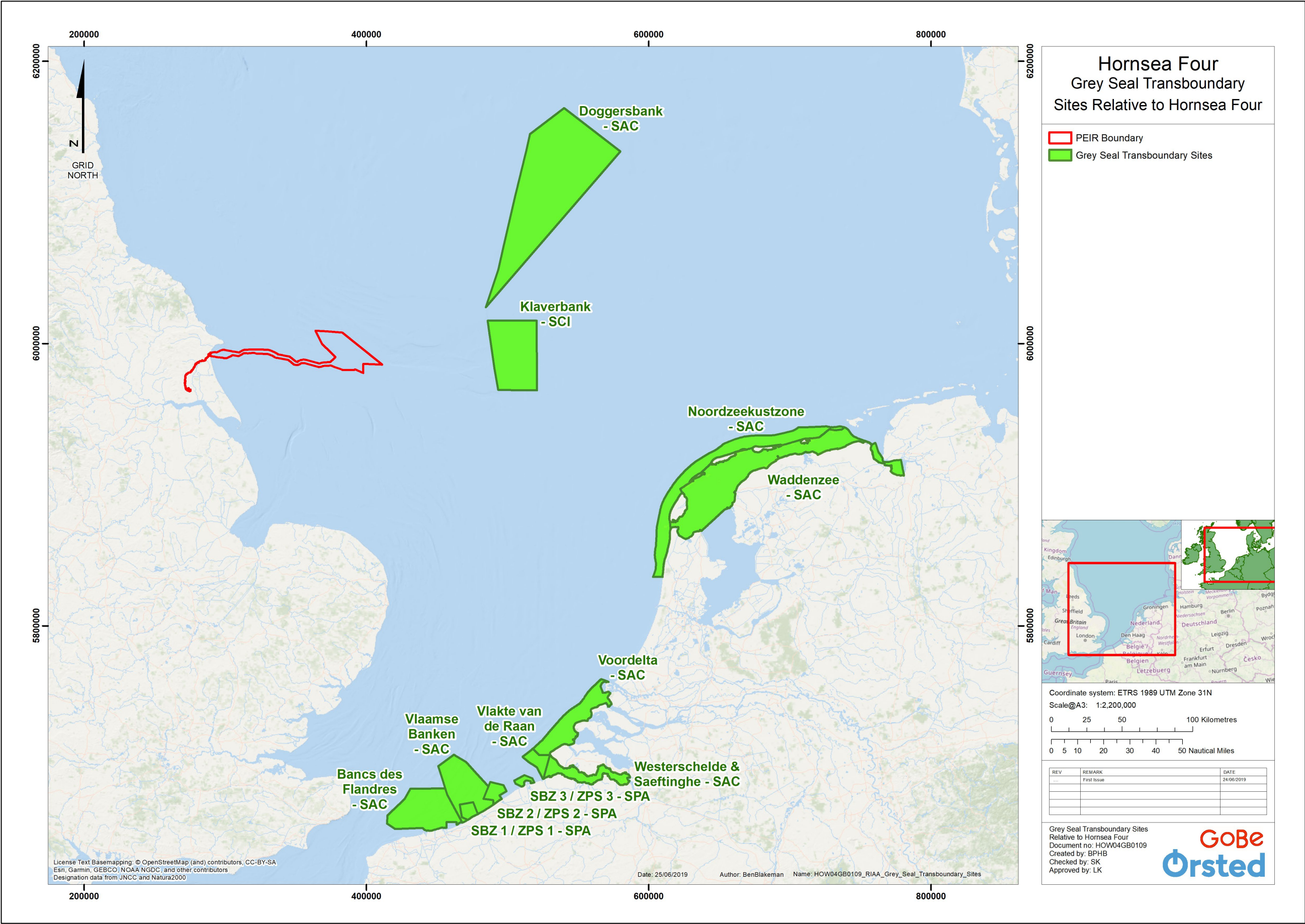


Figure 18: Noordseekustzone SCI in Relation to Hornsea Four (not to scale).

Waddenzee SCI

The Wadden Sea consists of a complex of deep channels and shallow water with sand and silt banks, large parts of which dry at low tide. These banks are intersected by a finely branched system of channels. Along the mainland and the islands there are scattered saltmarsh areas, which contribute to a very diverse flora and vegetation. The natural processes ensure the conservation and development of characteristic habitats and constantly change the boundaries of land and water. The receptor group 'marine mammals' is relevant to the Waddenzee SCI. Key literature sources, including relevant project literature, are as follows:

- **Volume 2, Chapter 4: Marine Mammals;**
- **Volume 5, Annex 4.1: Marine Mammal Technical Report;**
- **Volume 4, Annex 4.5: Underwater Noise Technical Report;**
- Waddenzee SCI site information (in Dutch)⁷⁶.

The site is designated for the following Annex I habitats:

- Sandbanks which are slightly covered by sea water all the time;
- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- *Salicornia* and other annuals colonising mud and sand;
- *Spartina* swards (*Spartinion maritimae*);
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Embryonic shifting dunes;
- Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes');
- Fixed dunes with herbaceous vegetation ('grey dunes');
- Dunes with *Hippophae rhamnoides*;
- Dunes with *Salix repens ssp. argentea* (*Salicion arenariae*); and
- Humid dune slackss.

The following Annex II species:

- Narrow-mouthed whorl snail (*Vertigo angustior*);
- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*);
- Twait shad (*Alosa fallax*);
- Tundra vole (*Microtus oeconomus*);
- Fen orchid (*Liparis loeselii*);
- Harbour porpoise (*Phocoena phocoena*);
- Harbour (common) seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Potential for LSE has been identified for grey seal (*Halichoerus grypus*) only under the following scenarios:

⁷⁶ <https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k1>

- Increase in underwater noise (construction and decommissioning); and
- Vessel disturbance (construction, O&M and decommissioning).

Additional information for the Waddenzee SCI can be found on the Ministry of Agriculture, Nature and Food Quality website⁷⁷, and includes national conservation status and conservation targets for the site features. For grey seal the conservation status is identified as 'moderately favourable'. The targets applicable to grey seal are listed below:

- Conserve the area and quality of supporting habitat;
- Conserve the population size;
- Conservation of intertidal habitat as resting places for grey seal; and
- Maintain undisturbed resting places and optimal breeding habitat for grey seal.

⁷⁷<https://www.synbiosys.alterra.nl/natura2000/gebiedendatabase.aspx?subj=n2k&groep=1&id=n2k1&topic=doelstelling>

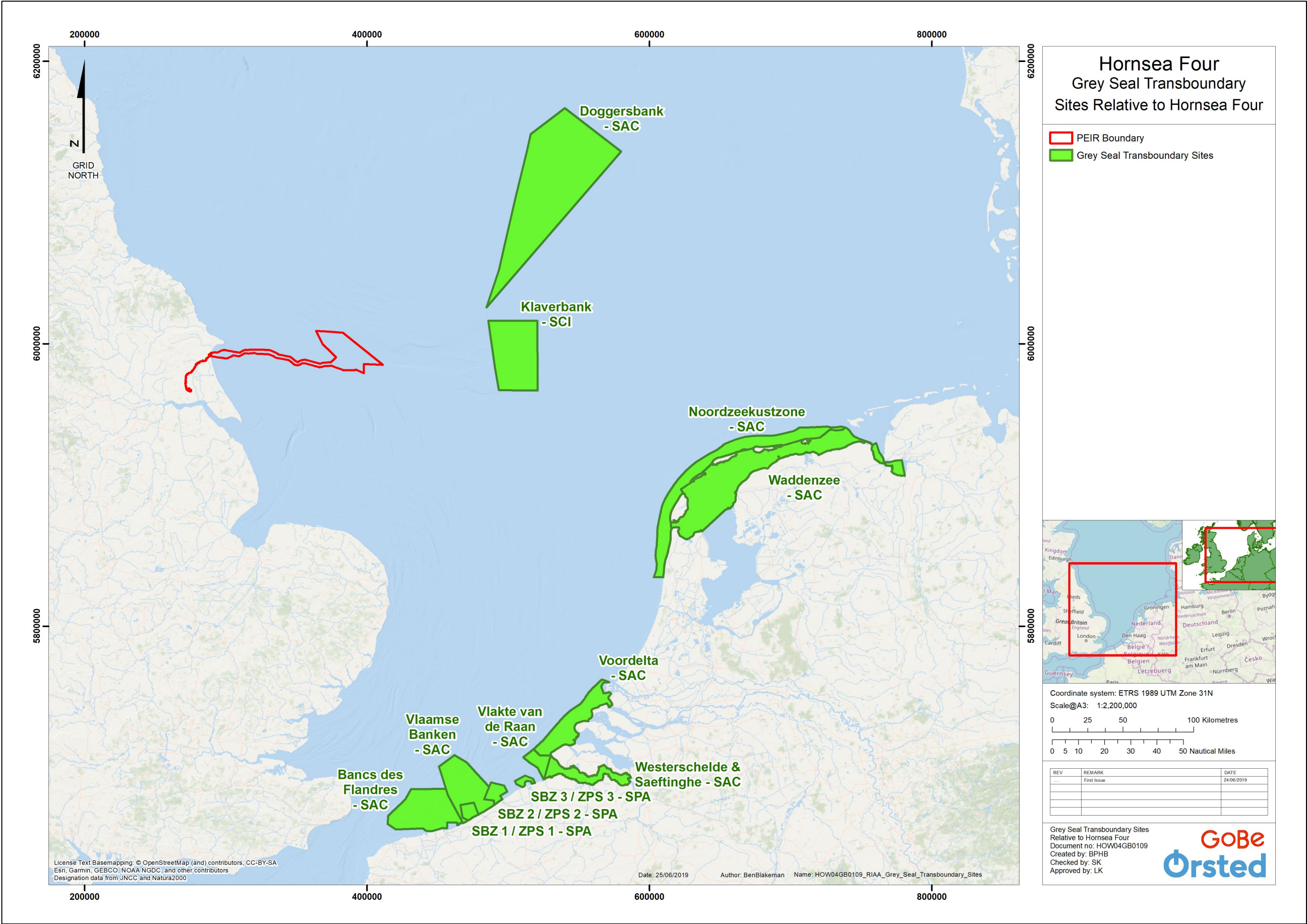


Figure 19: Waddenzee SCI in Relation to Hornsea Four (not to scale).

Greater Wash SPA

The Greater Wash SPA is a marine and coastal area from Barmston (Bridlington Bay) in the north to existing boundary of the Outer Thames Estuary SPA in the south. It comprises mostly sandy and coarse sediment beaches and seabeds and soft sediments offshore with subtidal sandbanks within the Wash, north and east Norfolk coasts that supports non-breeding waterbirds. The interest features of the site are described in the following documents:

- Annex 2 SPA Citation (2018);

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Red-throated diver; non-breeding; 1,407 individuals (2002/03-2005/06);
- Screened in for potential disturbance and displacement at the construction stage alone;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Common scoter; non-breeding; 3,449 individuals (2002/03-2007/08);
- Screened in for potential disturbance and displacement at the construction stage alone;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Little gull; non-breeding; 1,255 individuals (2002/03-2005/06);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Sandwich tern; breeding; 3,852 pairs (2010-14);
- Common tern; breeding; 510 pairs (2010-14); and
- Little tern; breeding; 798 pairs (2009-13).

The Conservation Objectives for the site were provided by Natural England in 2018 as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site may be classified (the 'Qualifying Features'), and subject to natural change, to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

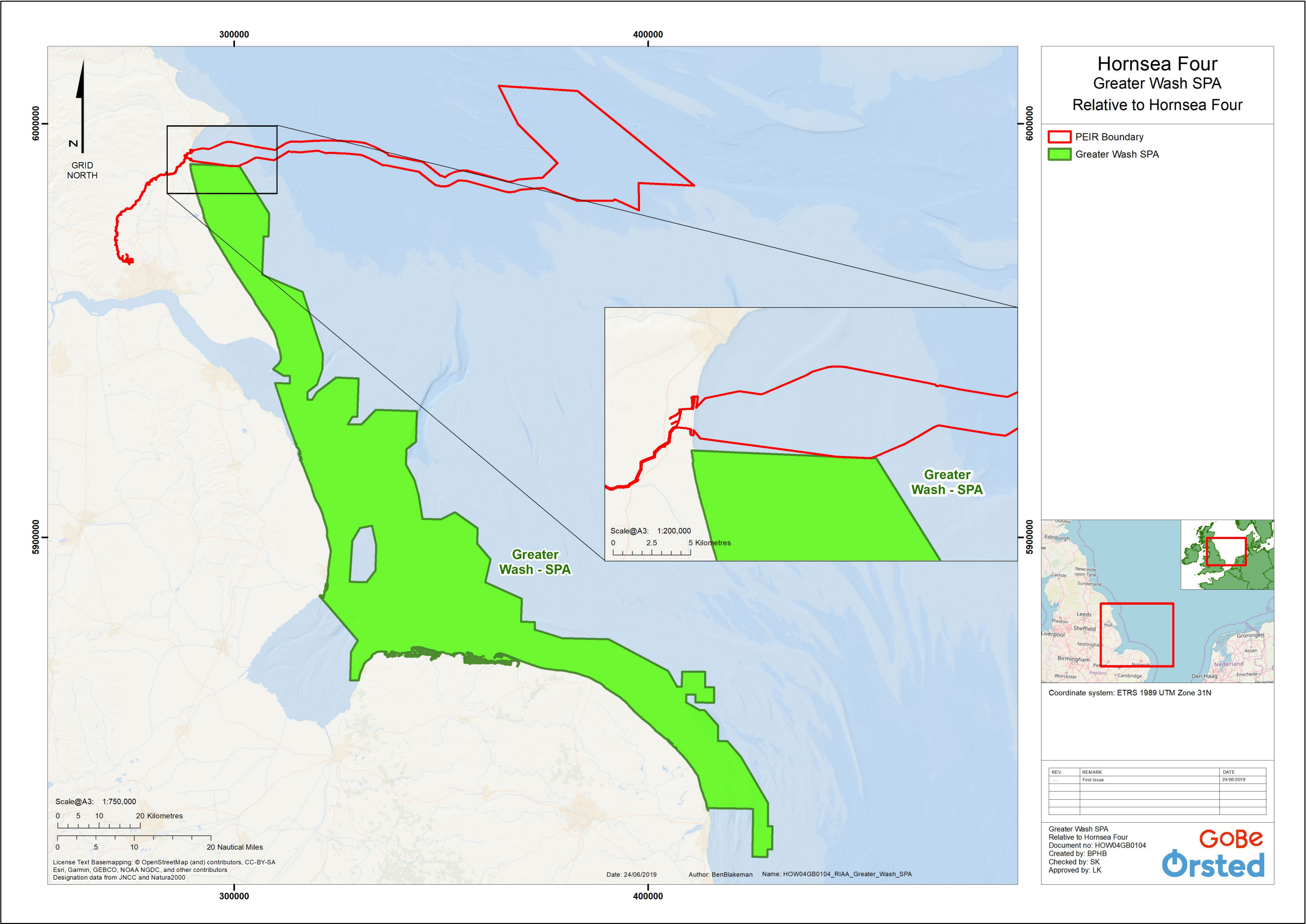


Figure 20: Greater Wash SPA in Relation to Hornsea Four (not to scale).

Flamborough and Filey Coast SPA

The Flamborough and Filey Coast (FFC) SPA is an 8,040 ha area of coastal and marine habitat supporting breeding seabirds in Yorkshire. Key literature sources, including relevant project literature, are as follows:

- [Hornsea Four EIA PEIR Volume 2, Part B Chapter 5 \(Offshore Ornithology\);](#)
- [Hornsea Four EIA PEIR Volume 2, Part B Chapter 3 \(Migratory Fish\);](#)
- [Hornsea Four EIA PEIR Volume 2, Part B Chapter 2 \(Benthic Ecology\);](#)
- [Hornsea Four EIA Benthic Ecology Technical Report;](#)
- [Hornsea Four EIA Fish Technical Report;](#)
- [Hornsea Four EIA Ornithology Technical Report;](#)
- [Hornsea Four EIA Noise Technical Report;](#)
- [Hornsea Four EIA PEIR Volume 2, Part B Chapter on Designated Sites;](#) and
- [Natural England Citation for FFC SPA \(dated August 2019\).](#)

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Gannet; breeding; 8,469 pairs (2008-12);
- Screened in for potential disturbance and displacement at the operational stage alone.
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Kittiwake; breeding; 44,520 pairs (2008-11);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Guillemot; breeding; 41,607 pairs; (2008-11);
- Screened in for potential disturbance and displacement at the construction and decommissioning stages alone;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Screened in for potential barrier effect at the operational stage alone and in-combination.
- Razorbill; breeding; 10,570 pairs (2008-11);
- Screened in for potential disturbance and displacement at the construction and decommissioning stages alone;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Screened in for potential barrier effect at the operational stage alone and in-combination.
- Breeding seabird assemblage; 216,730 average number of individuals (2008-12); including interest features listed above, additional named assemblage species; fulmar, shag, cormorant, herring gull and puffin as well as other non-named species.
- Puffin screened in for potential disturbance and displacement at the construction and decommissioning stages alone;

- Puffin screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Puffin screened in for potential barrier effect at the operational stage alone and in-combination.
- Fulmar; breeding; 1,257 pairs (2017);
- Shag; breeding; 25 pairs (2017);
- Cormorant; breeding; 27 pairs (2017); and
- Herring gull; breeding; 466 pairs (2017);

The Conservation Objectives for the site were provided by Natural England in 2018 as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site may be classified (the 'Qualifying Features'), and subject to natural change, to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

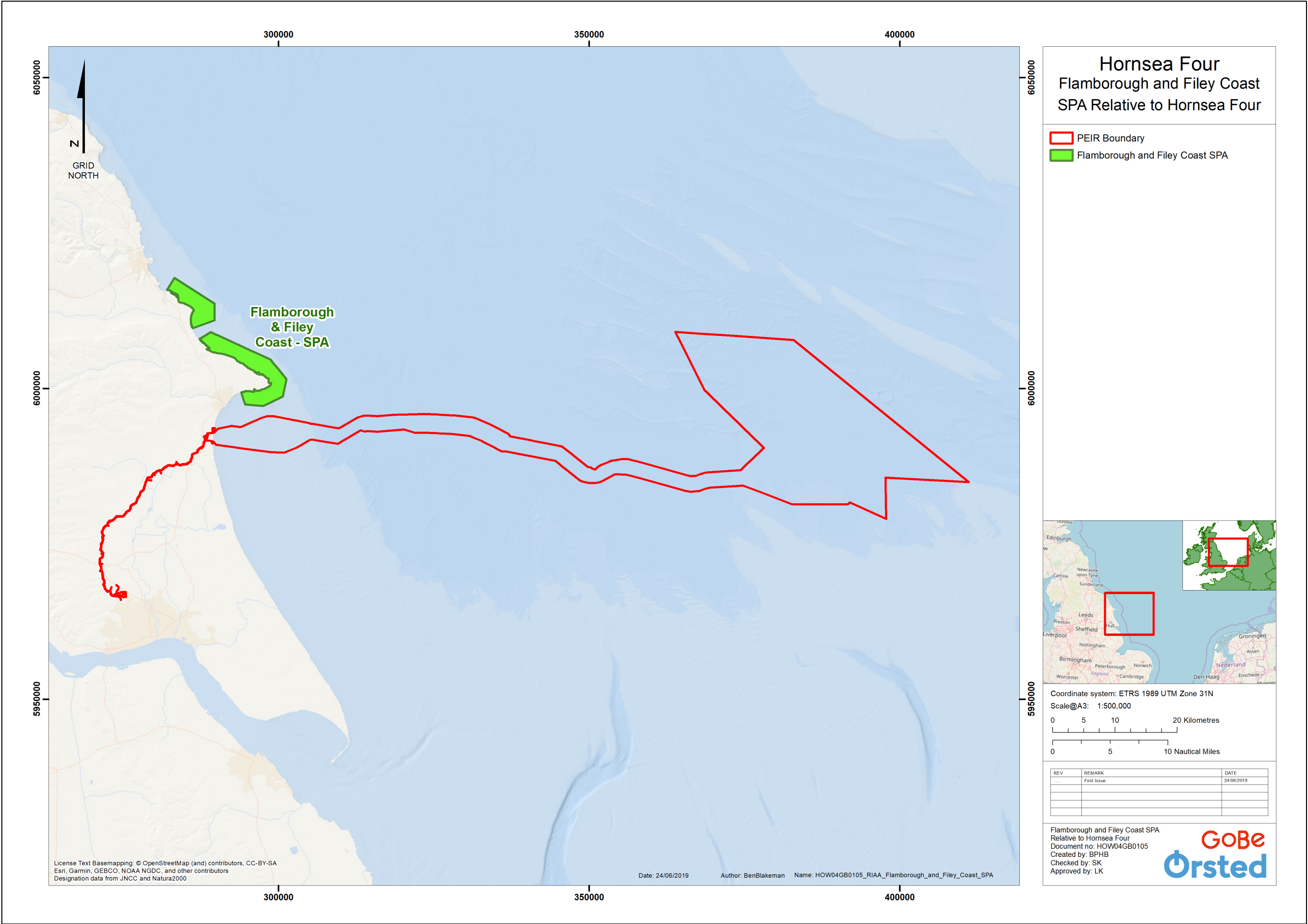


Figure 21: Flamborough and filey Coast SPA in Relation to Hornsea Four (not to scale).

Northumbria Coast SPA

The Northumbria Coast SPA includes much of the coastline between the River Tweed and River Tees estuaries. The site consists mainly of rocky shore with boulder and cobble beaches that supports breeding seabirds and non-breeding waterbirds. The interest features of the site are described in the following documents:

- Annex 2 SPA Citation (2017).

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Arctic tern; breeding; 1,549 pairs (2010-14);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Little tern; breeding; 40 pairs (1993-97);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Turnstone; non-breeding; 1,739 individuals (1992/93-1996/97);
- Purple sandpiper; non-breeding; 787 individuals (1992/93-1996/97);

The Conservation Objectives for the site were provided by Natural England in 2018 as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site may be classified (the 'Qualifying Features'), and subject to natural change, to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

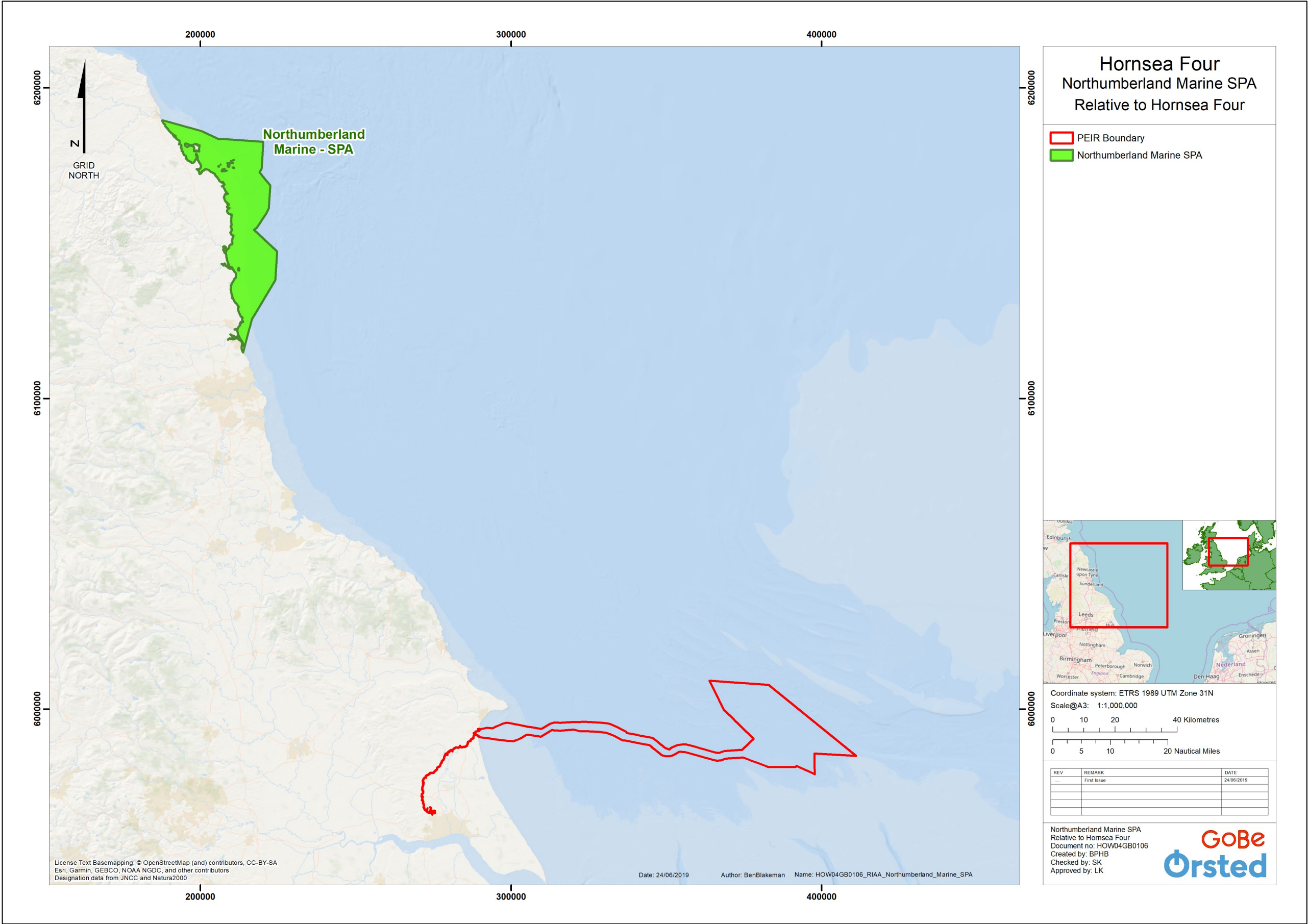


Figure 22: Northumberland Marine SPA in Relation to Hornsea Four (not to scale).

Coquet Island SPA

Coquet Island SPA is a small flat-topped island 1 km off the coast of Northumberland, that supports breeding seabirds. The interest features of the site are described in the following documents:

- Annex 2 SPA Citation (2017).

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Common tern; breeding; 1,189 pairs (2010-2014);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Arctic tern; breeding; 1,230 pairs (2010-14);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Roseate tern; breeding; 80 pairs; (2010-14)
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Sandwich tern; breeding; 1,300 pairs (2010-14);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Breeding seabird assemblage; 47,662 average number of individuals (2010-14); including interest features listed above, additional named assemblage species; black-headed gull (7,772 breeding adults) and puffin (31,686 breeding adults) as well as other non-named species (including fulmar, black-headed gull, herring gull and lesser black-backed gull).
- Kittiwake screened in for potential collision mortality at the operational stage alone and in-combination.
- Puffin screened in for potential disturbance and displacement at the construction and decommissioning stages alone;
- Puffin screened in for potential disturbance and displacement at the operational stage alone and in-combination.

The Conservation Objectives for the site were provided by Natural England in 2018 as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site may be classified (the 'Qualifying Features'), and subject to natural change, to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

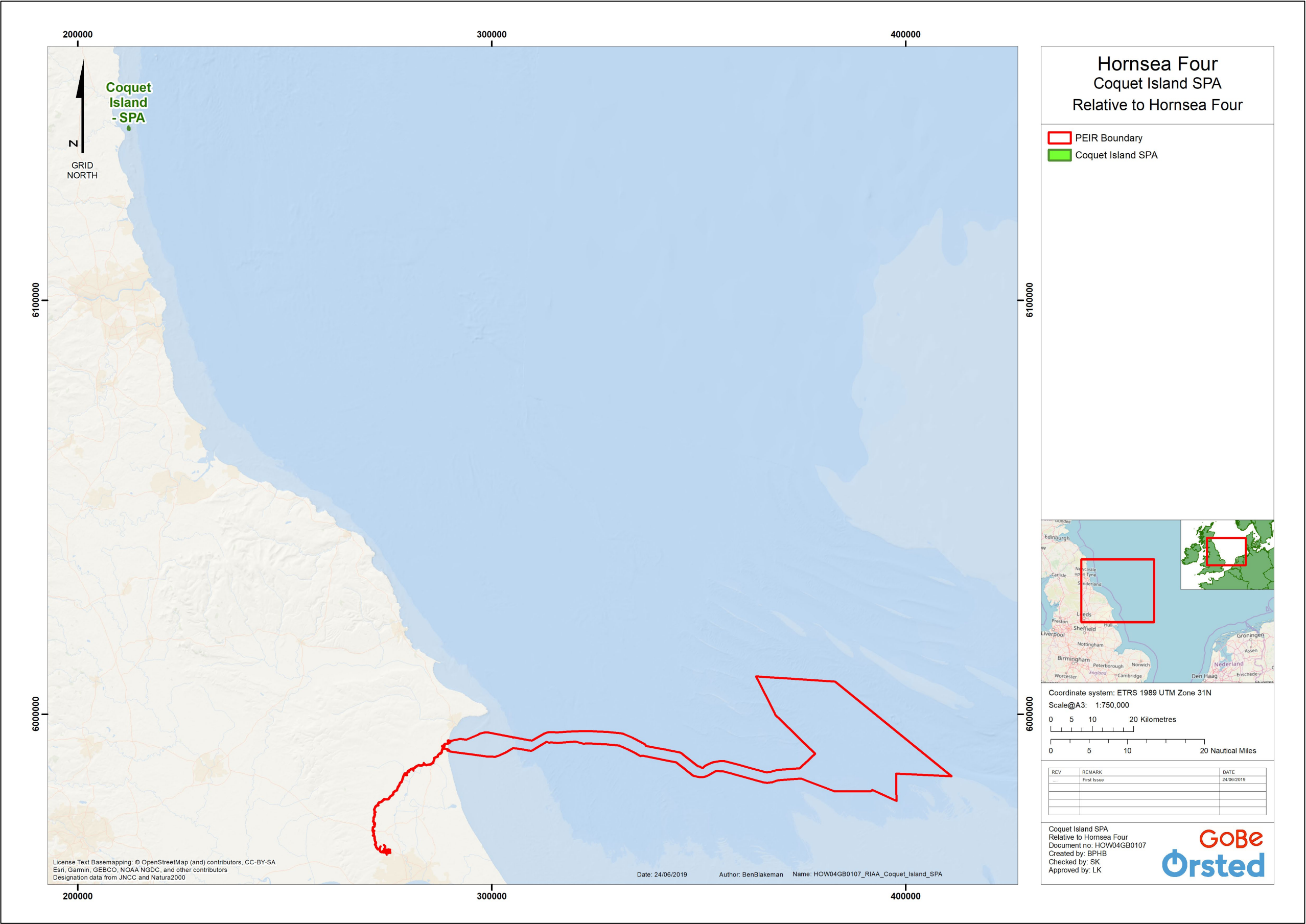


Figure 23: Coquet Island SPA in Relation to Hornsea Four (not to scale).

Forth Islands SPA

The Forth Islands (UK) SPA is consists of a series of islands supporting the main seabirds colonies in the Firth of Forth, off the coast of Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including extended site and marine extension) Citation for SPA (SNH, May 2018).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification, except where amended by the 2001 Review) and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Gannet; breeding; 21,600 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Common tern; breeding; 334 pairs (1997-2001);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Arctic tern; breeding; 540 pairs (1992-96);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Roseate tern; breeding; 8 pairs; (1997-2001)
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Sandwich tern; breeding; 440 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Shag; breeding; 2,400 pairs;
- Lesser black-backed gull; breeding; 1,500 pairs;
- Puffin; breeding; 14,000 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Breeding seabird assemblage; 90,000 average number of individuals (2008-12); including interest features listed above, additional named assemblage species; cormorant (200 pairs), kittiwake (8,400 pairs), herring gull (6,600 pairs), guillemot (16,000) and razorbill (1,400 pairs).
- Guillemot screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill screened in for potential disturbance and displacement at the operational stage alone and in-combination.

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2018 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species

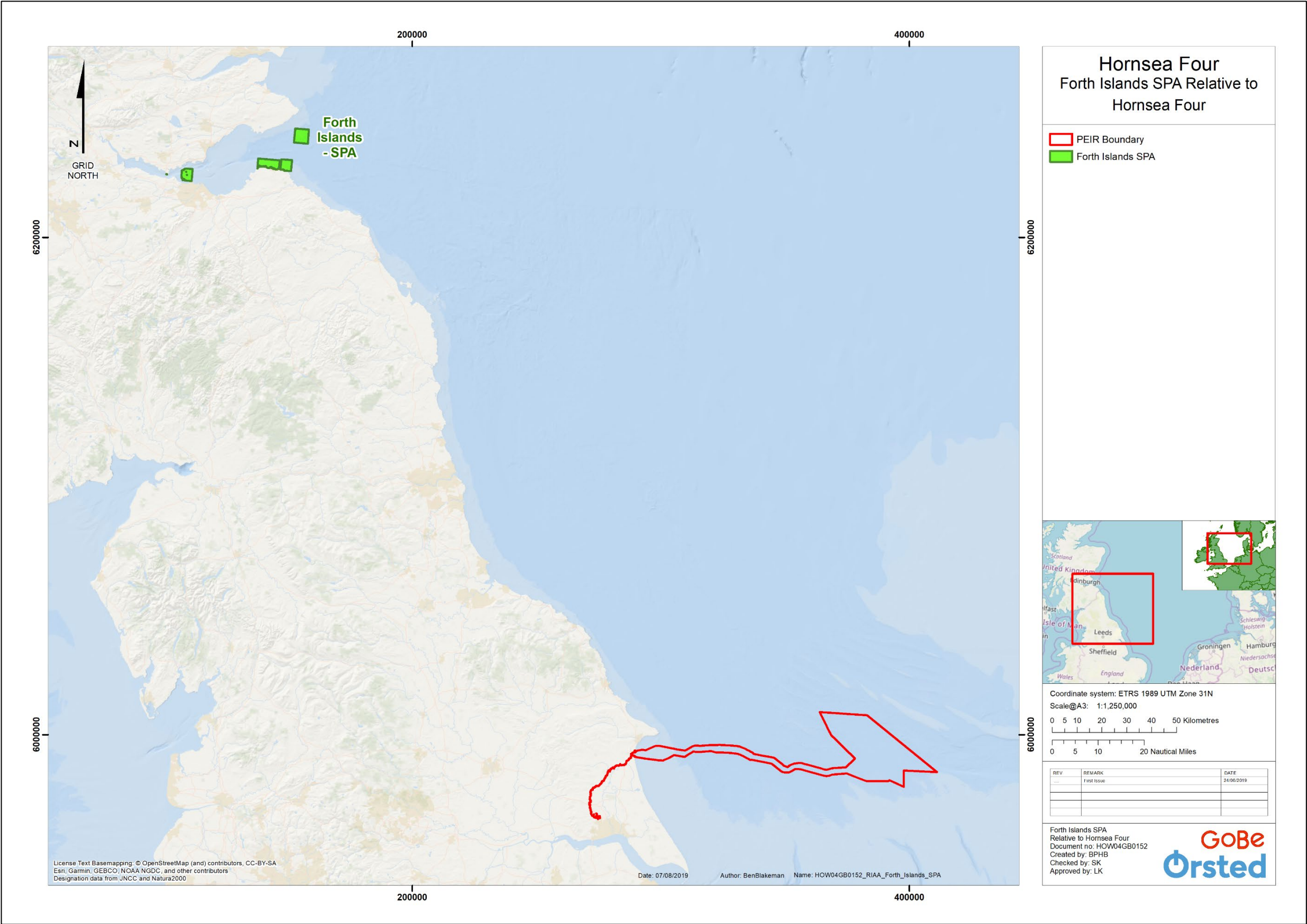


Figure 24: Forth Islands SPA in Relation to Hornsea Four (not to scale).

Farne Islands SPA

The Farne Islands SPA is a 101 ha area of coastal habitat, including a group of low lying islands 2-6 km off the coast of Northumberland, that support breeding seabirds. The interest features of the site are described in the following documents:

- Natura 2000 standard data form;
- Updated Annex 2 SPA Citation (2017).

The interest features of this site are listed below along with the population for which the classification was made, and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Common tern; breeding; 183 pairs (1985);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Arctic tern; breeding; 4,006 pairs (2010-14);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Roseate tern; breeding; 13 pairs; (1985)
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Sandwich tern; breeding; 862 pairs (2008-14);
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Guillemot; breeding; 32,875 pairs (2010-14);
- Screened in for potential disturbance and displacement at the construction and decommissioning stages alone;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Breeding seabird assemblage; 163,819 average number of individuals (2010-14); including interest features listed above, additional named assemblage species; shag (1,677 breeding adults), cormorant (230 breeding adults), kittiwake (8,241 breeding adults) and puffin (76,798 breeding adults) as well as other non-named species (including fulmar, black-headed gull, razorbill and great black-backed gull).
- Kittiwake screened in for potential collision mortality at the operational stage alone and in-combination
- Puffin screened in for potential disturbance and displacement at the construction and decommissioning stages alone;
- Puffin screened in for potential disturbance and displacement at the operational stage alone and in-combination.

The Conservation Objectives for the site were provided by Natural England in 2018 as follows:

With regard to the SPA and the individual species and/ or assemblage of species for which the site may be classified (the 'Qualifying Features'), and subject to natural change, to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

The extent and distribution of the habitats of the qualifying features

The structure and function of the habitats of the qualifying features

The supporting processes on which the habitats of the qualifying features rely

The population of each of the qualifying features, and,

The distribution of the qualifying features within the site.

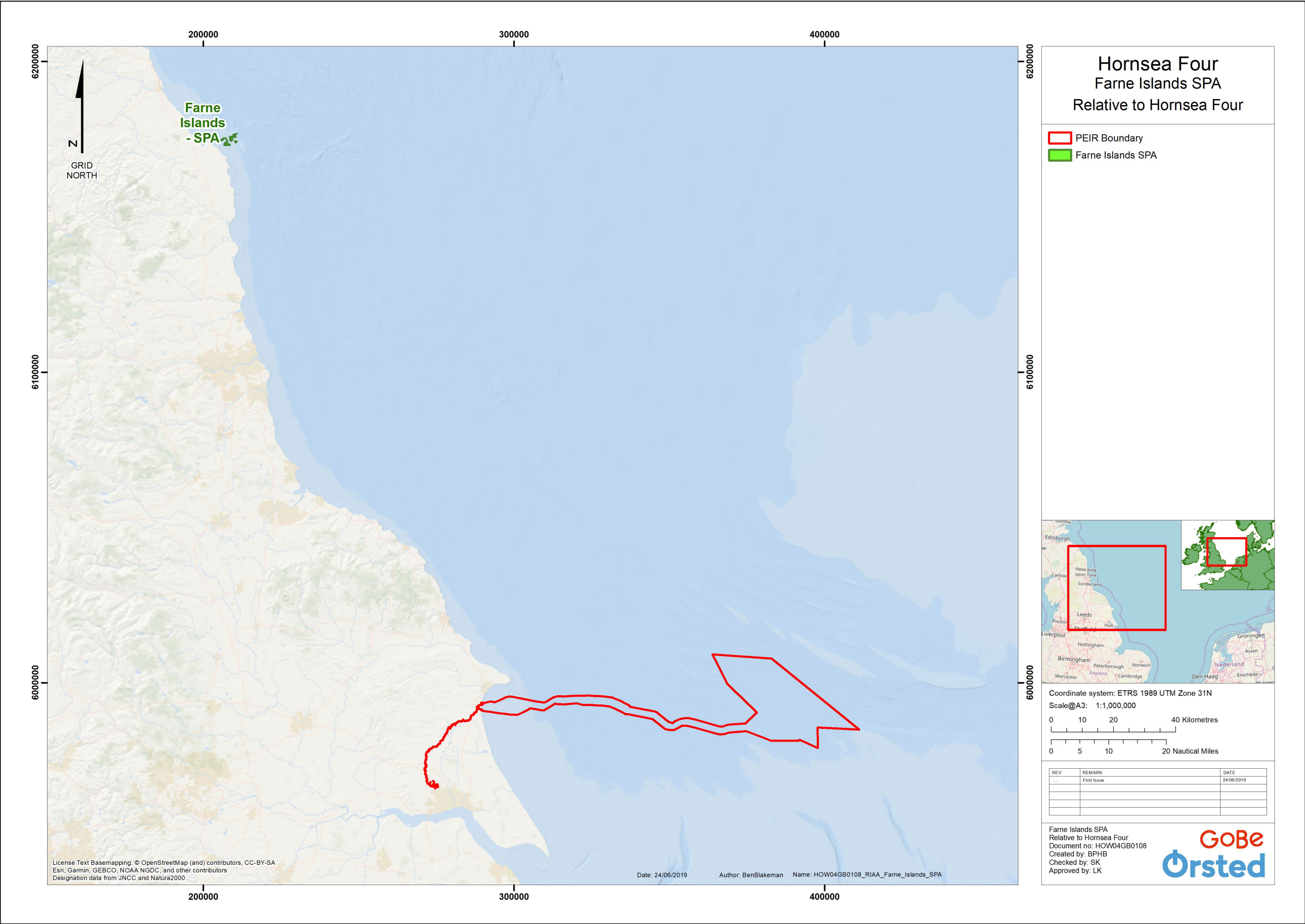


Figure 25: Farne Islands SPA in Relation to Hornsea Four (not to scale).

Outer Firth of Forth and St Andrew's Complex pSPA

The Outer Firth of Forth and St Andrew's Complex SPA is a large estuarine / marine site on the south-east coast of Scotland consisting of the two closely adjacent Firth of Forth and Tay that support breeding and non-breeding seabirds and waterbirds. Key literature sources, including relevant project literature, are as follows:

- Citation for proposed SPA (SNH, June 2016).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification, except where amended by the 2001 Review), and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Gannet; breeding; 21,600 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination.
- Breeding seabird assemblage; in excess of 20,000 individuals; including; guillemot (28,123 individuals), razorbill (5,481 individuals) and puffin (61,086 individuals).
- Guillemot screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Puffin screened in for potential disturbance and displacement at the operational stage alone and in-combination.

There are no set conservation objectives for this site at present, as it is a proposed SPA.

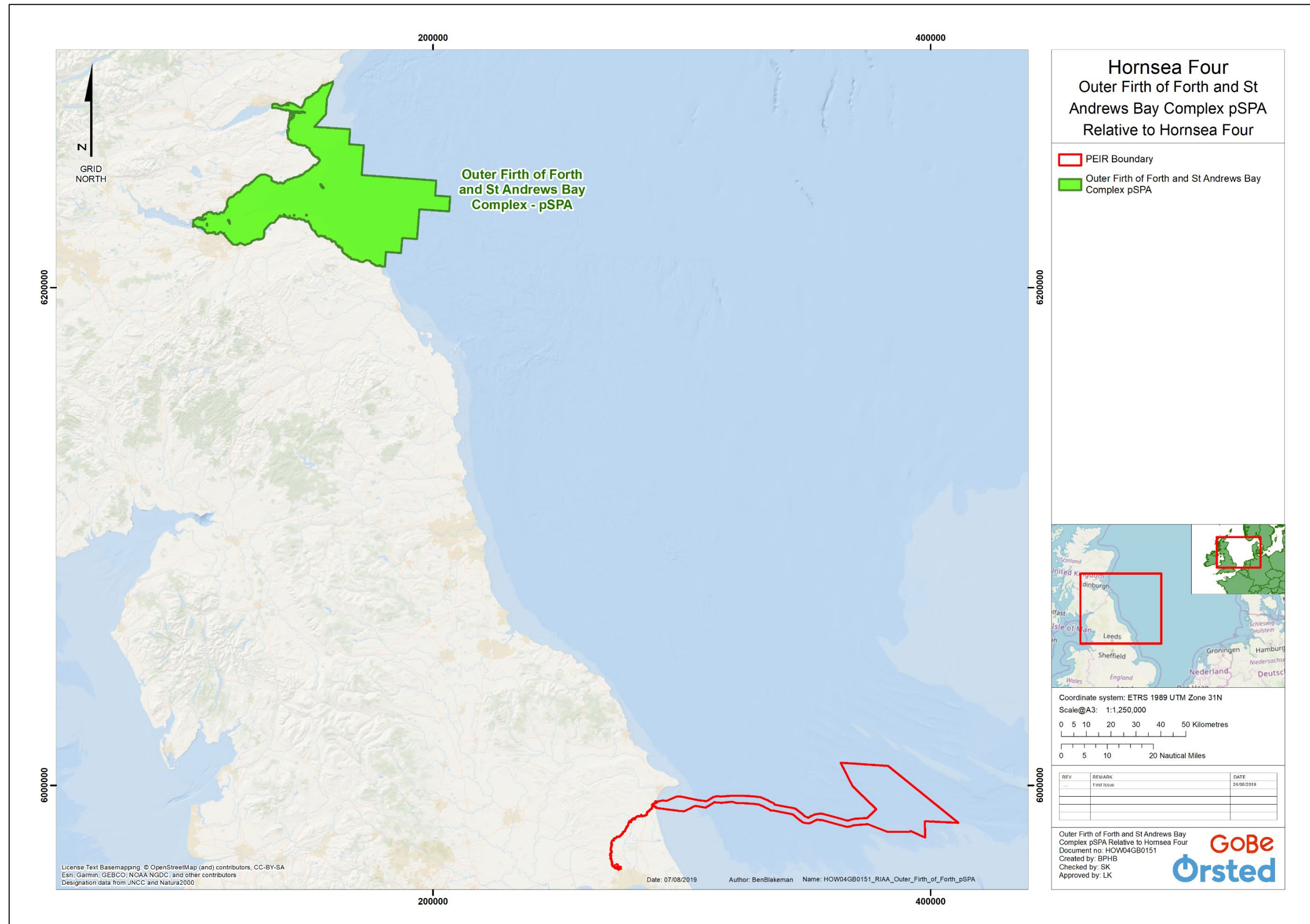


Figure 26: Outer Firth of Forth and St Andrew's Complex pSPA in Relation to Hornsea Four (not to scale).

Fowlsheugh SPA

The Fowlsheugh SPA is a stretch of sheer cliffs in north-east Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including marine extension) Citation for SPA (SNH, Sept 2009).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification, except where amended by the 2001 Review), and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Kittiwake; breeding; 36,650 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Guillemot; breeding; 56,450 individuals;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill; breeding; 5,800 individuals;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Fulmar; breeding; 1,170 pairs; and
- Herring gull: breeding; 3,190 pairs.

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2009 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species

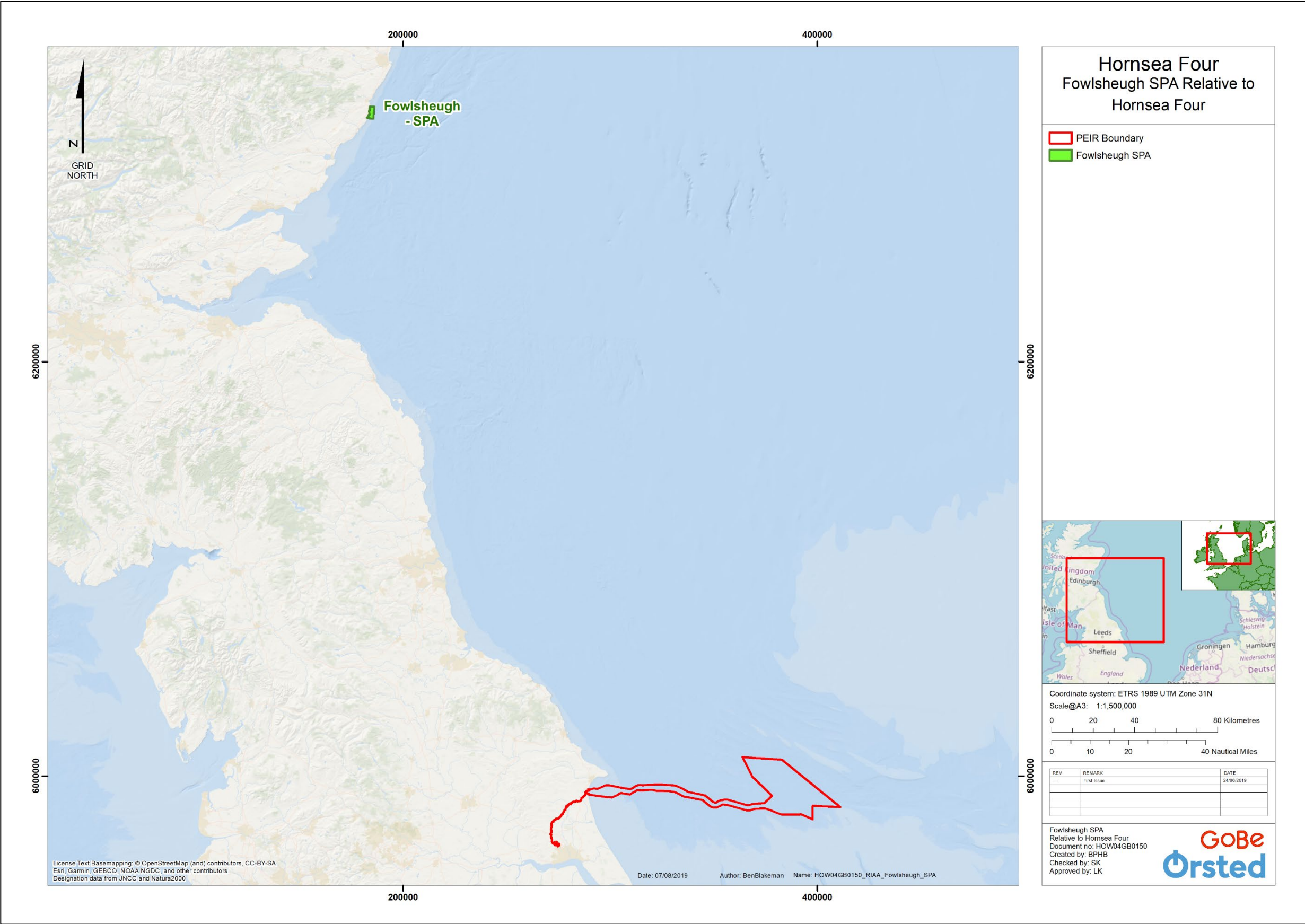


Figure 27: Fowlsheugh SPA in Relation to Hornsea Four (not to scale).

Buchan Ness to Collieston Coast SPA

The Buchan Ness to Collieston SPA is a 15 km stretch of south-east facing cliffs in eastern Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including marine extension) Citation for SPA (SNH, Sept 2009).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification, except where amended by the 2001 Review), and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Kittiwake; breeding; 30,452 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Guillemot; breeding; 8,640 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Fulmar; breeding; 1,765 pairs;
- Shag; breeding; 1,045 pairs; and
- Herring gull; breeding; 4,292 pairs.

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2009 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species



Troup, Pennan and Lion's Heads SPA

The Troup, Pennan and Lion's Heads SPA is a 9 km stretch of sea cliffs along the east coast of Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including marine extension) Citation for SPA (SNH, Sept 2009).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification, except where amended by the 2001 Review), and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Kittiwake; breeding; 31,600 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Guillemot; breeding; 44,600 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill; breeding; 4,800 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Fulmar; breeding; 4,400 pairs; and
- Herring gull; breeding; 4,200 pairs.

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2009 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species

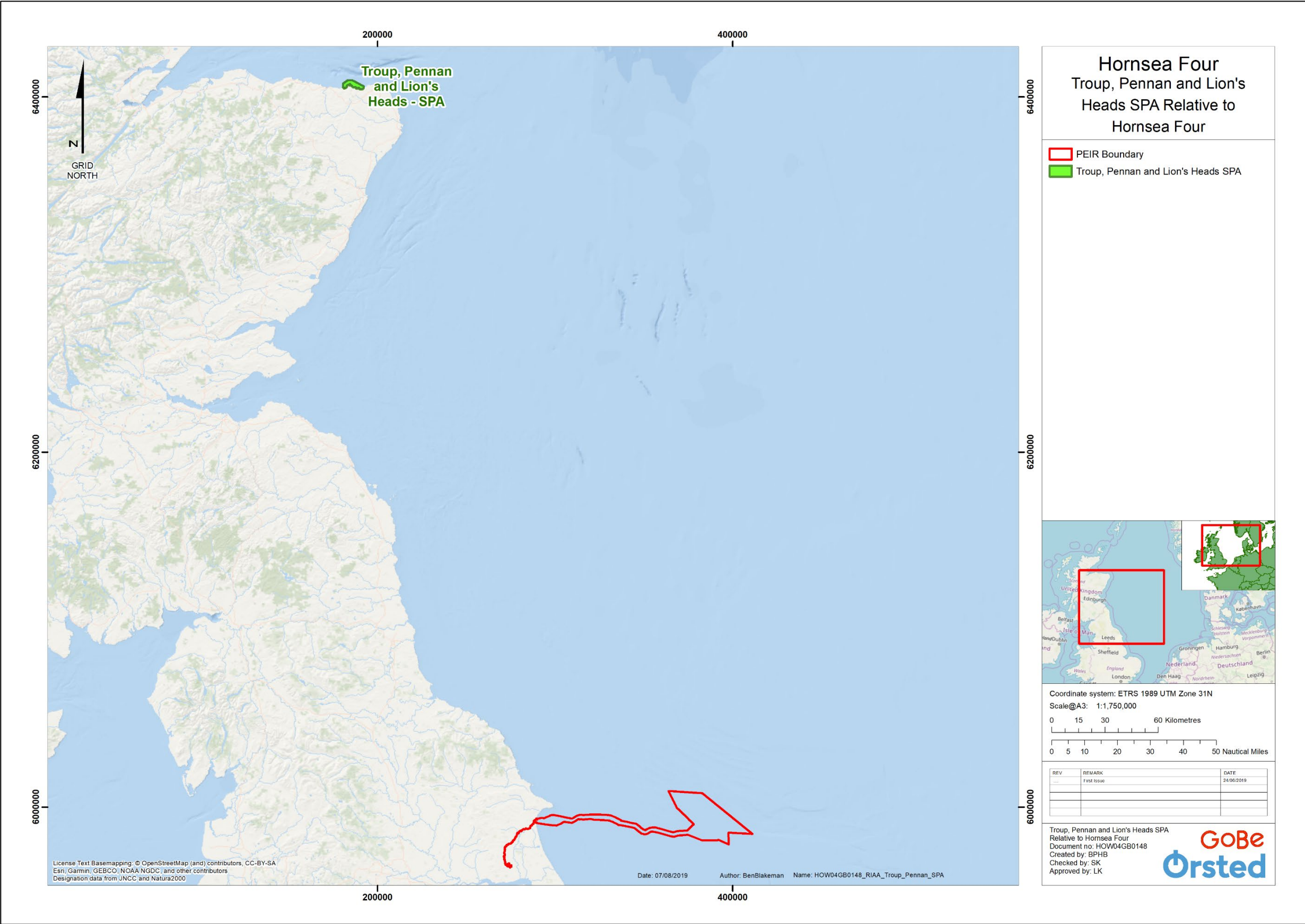


Figure 29: Troup, Pennan and Lion’s Heads SPA in Relation to Hornsea Four (not to scale).

East Caithness Cliffs SPA

East Caithness Cliffs SPA is a 9 km stretch of sea cliffs along the east coast of Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including marine extension) Citation for SPA (SNH, Sept 2009).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification) and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Kittiwake; breeding; 32,500 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Great black-backed gull; breeding; 800 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Guillemot; breeding; 106,700 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill; breeding; 15,800 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Fulmar; breeding; 4,400 pairs;
- Shag; breeding; 2,300 pairs;
- Cormorant; breeding; 230 pairs;
- Peregrine; breeding; 6 pairs; and
- Herring gull; breeding; 9,400 pairs;

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2009 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species

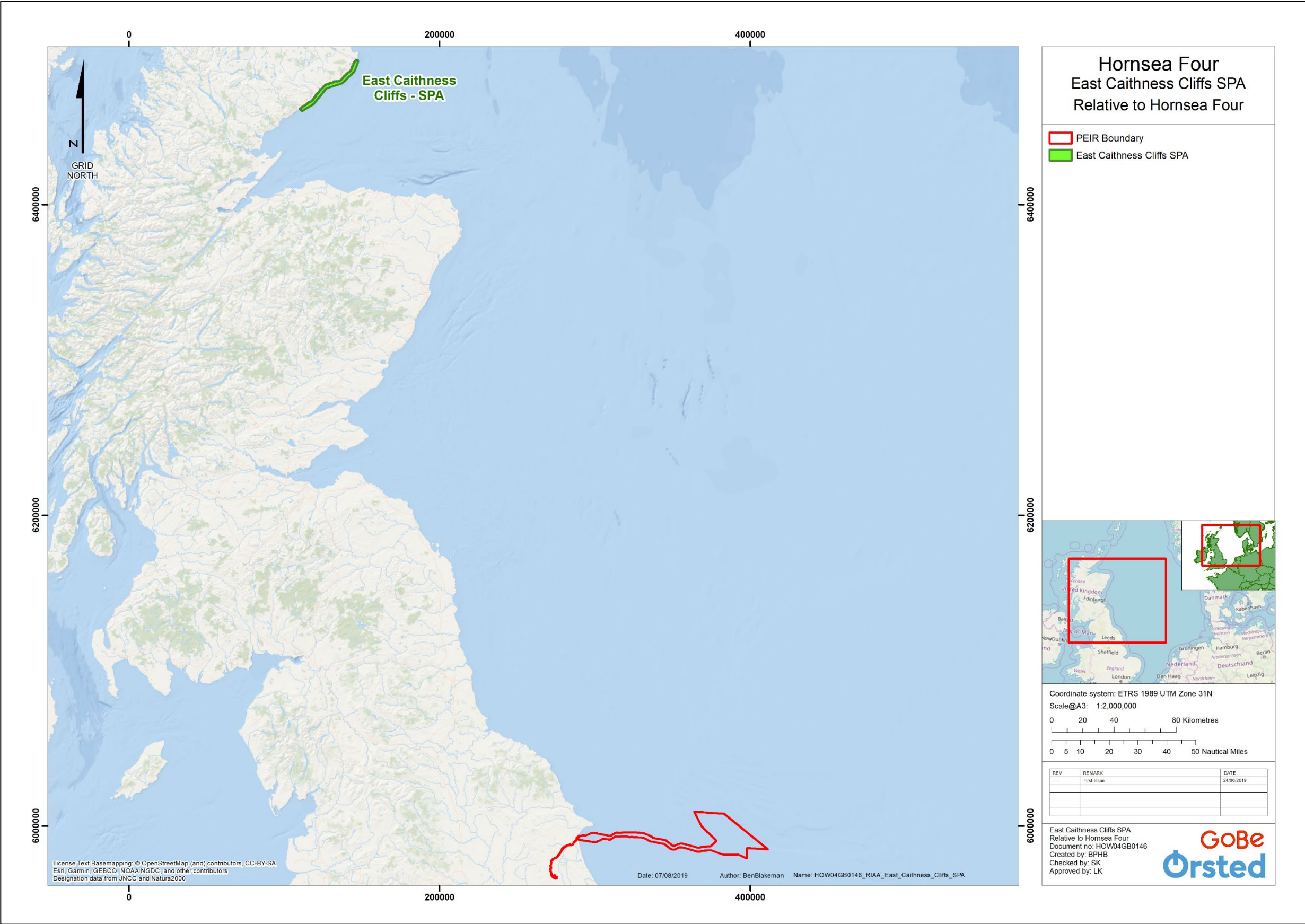


Figure 30: East Caithness Cliffs SPA in Relation to Hornsea Four (not to scale).

North Caithness Cliffs SPA

East Caithness Cliffs SPA is a 9 km stretch of sea cliffs along the east coast of Scotland. Key literature sources, including relevant project literature, are as follows:

- Amended (including marine extension) Citation for SPA (SNH, Sept 2009).

The interest features of this site are listed below along with the population for which the classification was made (all count data relate to the numbers at the time of classification and whether or not that interest feature was screened in or not based on individual effect categories and LSE:

- Kittiwake; breeding; 13,100 pairs;
- Screened in for potential collision mortality at the operational stage alone and in-combination;
- Guillemot; breeding; 38,300 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Razorbill; breeding; 4,000 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Puffin; breeding; 2,080 pairs;
- Screened in for potential disturbance and displacement at the operational stage alone and in-combination.
- Fulmar; breeding; 14,700 pairs;

The Conservation Objectives for the site were provided by Scottish Natural Heritage in 2009 as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

Population of the species as a viable component of the site

Distribution of the species within site

Distribution and extent of habitats supporting the species

Structure, function and supporting processes of habitats supporting the species

No significant disturbance of the species

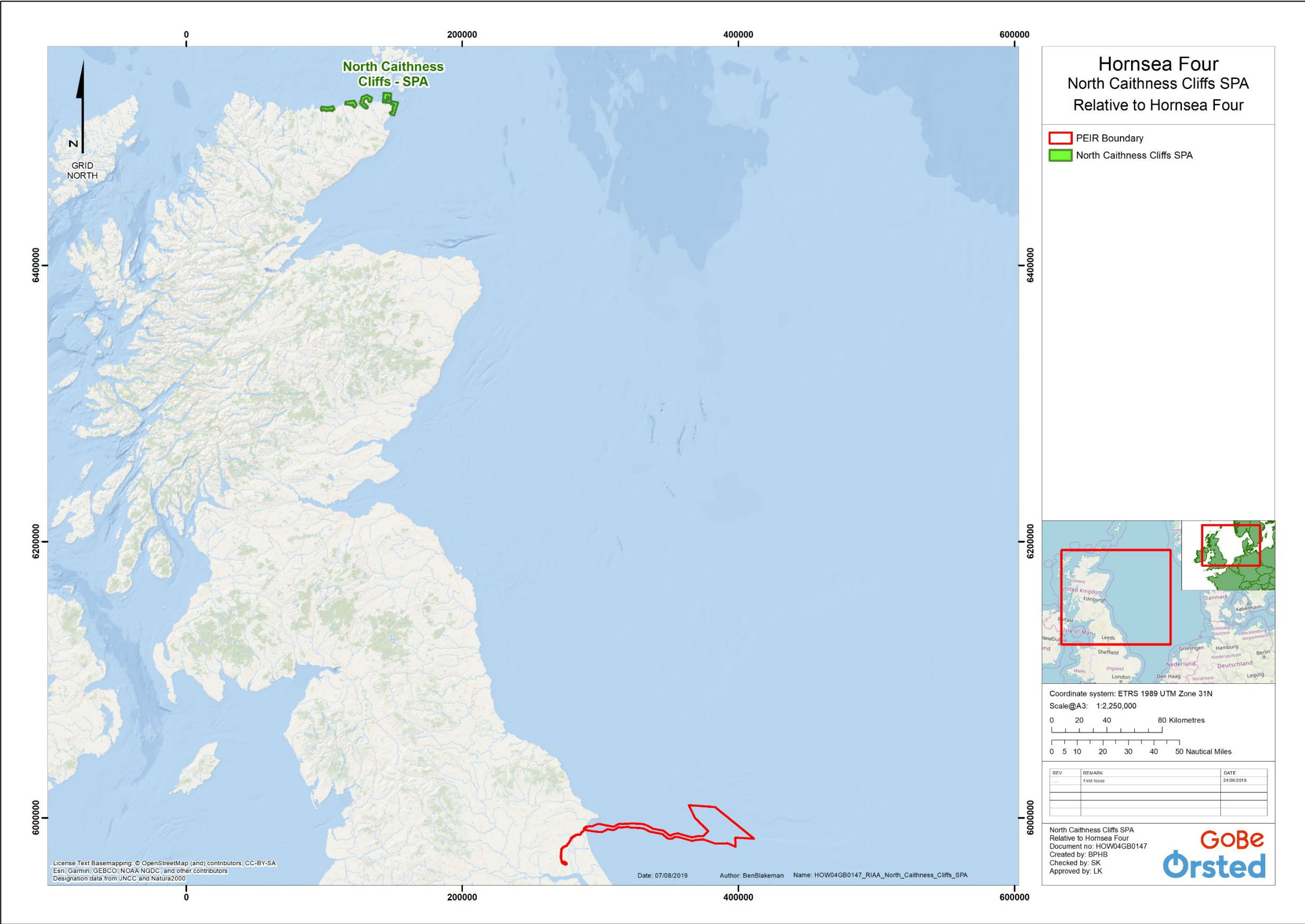


Figure 31: North Caithness Cliffs SPA in Relation to Hornsea Four (not to scale).

Appendix F – Related Guidance Documents

- European Commission (2018): Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC;
- European Commission (2001): Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites;
- European Commission: EU Guidance on wind energy development in accordance with EU nature directives;
- European Commission (2001) Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- Opinion of the Commission (2007) Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC – Clarification of the concepts of: Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures;
- European Commission (2011) Guidance Document on Wind Energy Developments and Natura 2000;
- Department of Communities and Local Government: Guidance on 'Planning for the Protection of European Sites: Appropriate Assessment';
- MHCLG, 2019. Guidance on the use of Habitats Regulations Assessment;
- Planning Inspectorate (PINS) Advice Note 9: Rochdale Envelope;
- PINS Advice Note 10: Habitat Regulations Assessment relevant to nationally significant infrastructure projects;
- PINS Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects;
- Department of Energy and Climate Change: Guidelines on the Assessment of Transboundary Impacts of Energy Developments on Natura 2000 Sites Outside the UK;
- English Nature: Habitats Regulations Guidance Note (HRGN 1): The Appropriate Assessment (Regulation 48) The Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature: Habitats Regulations Guidance Note (HRGN 3): The Determination of LSE under the Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature: Habitats Regulations Guidance Note (HRGN 4): Alone or in combination;
- Natural England and JNCC: Interim advice on HRA screening for seabirds in the non-breeding season;
- Natural England and JNCC: Interim Advice Note – Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation to Offshore Windfarm Developments;
- Literature and discussions held during a series of workshops in 2016 and 2017 in connection with the Southern North Sea cSAC; and
- Guidance on when new marine Natura 2000 sites should be taken into account in offshore renewable energy consents and licences (the Department of Energy and Climate Change (DECC), 2016).

Additional documents of relevance are provided below:

- Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010);
- JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017);
- JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2010);
- Managing underwater noise in European Waters (Tasker *et al.*, 2010);
- The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area, (JNCC, NE and CCW 2010);

- Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers (King *et al.* 2009);
- Assessment methodologies for offshore wind farms (Maclean *et al.*, 2009);
- Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms (RenewableUK 2013);
- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, freshwater and coastal. (CIEEM, 2016);
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Institute of Ecology and Environmental Management (IEEM), Winchester, 2018);
- Assessing the risk of offshore windfarm development to migratory birds designated as features of UK Special Protection Areas (and other Annex I species). British Trust for Ornithology, Thetford (Wright *et al.*, 2012);
- Advice on assessing displacement of birds from offshore wind farms (Statutory Nature Conservation Bodies (SNCBs), 2017);
- Collision risk modelling (CRM) to assess bird collision risks for offshore wind farms (Band, 2012);
- Stochastic Band CRM – GUI User Manual, Draft V1.0, 31/03/2017 (Donovan, 2018);
- A Stochastic Collision Risk Model for Seabirds in Flight. HiDef BioConsult Scientific Report to Marine Scotland, 06/04/2018, Issue I, 59 pp (McGregor *et al.*, 2018).
- CRM incorporating variability and uncertainty to assess bird collision risks for offshore wind farms (Masden, 2015);
- Assessing the risk of offshore wind farm development to migratory birds (Wright *et al.*, 2012);
- Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164 (Furness, 2015);
- Vulnerability of seabirds to offshore wind farms (Furness and Wade 2012; Furness *et al.*, 2013);
- Review of seabird demographic rates and density dependence. JNCC Report No. 552. Joint Nature Conservation Committee, Peterborough (Horswill & Robinson, 2015);
- Seabird sensitivity to offshore wind farms in English Territorial Waters (Bradbury *et al.*, 2014);
- The avoidance rates of collision between birds and offshore turbines (Cook *et al.*, 2014);
- Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review (JNCC *et al.*, 2014);
- Bird Collision Avoidance: Empirical evidence and impact assessments, JNCC Report No. 614, JNCC, Peterborough, ISSN 0963-8091 (Bowgen & Cook, 2018);
- Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61 (Thaxter *et al.*, 2012); and
- Consideration of quantifying impact assessments for selected seabird populations (MacArthur Green, 2016).

Appendix G – Maximum Design Scenario

Hornsea 4



Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
<i>Construction</i>				
1	Temporary habitat disturbance in the Hornsea Four array area and offshore ECC from construction activities.	Subtidal Benthic and Intertidal Ecology	<p>Temporary habitat disturbance of 41,725,097 m². Breakdown provided below.</p> <p>Array Area:</p> <p><i>Foundation seabed preparation = 680,294 m²</i></p> <ul style="list-style-type: none"> • 180 suction bucket jacket foundations for WTGs = 511,379 m² • Six small OSS on GBS foundations and three large OSS on suction caisson jacket foundations = 156,594 m² • One accommodation platform on a suction bucket jacket foundation (small OSS) = 12,321 m² <p><i>Jack up and anchoring operations = 1,063,200 m²</i></p> <ul style="list-style-type: none"> • WTG installation jack up vessel (JUV) footprint (six legs, 170m² per foot, 4 jack-up operations per turbine) = 734,400 m² • WTG installation vessel anchor footprints (100m² per anchor, 8 anchors per vessel, 2 anchored vessels per turbine) = 288,000m² • OSS and accommodation platform installation JUV footprint (six legs, 170m² per foot, 4 jack-up operations per structure) = 40,800 m² <p><i>Cable seabed preparation and installation = 10,391,400 m²</i></p> <ul style="list-style-type: none"> • Boulder clearance in array area - 30 m corridor = 20,700 m² • Sandwave clearance in array area – 30 m corridor = 20,700 m² • Burial of 600 km of array cables (1.5 m width) = 9,000,000 m² • Burial of 90 km of inter-connector cables (15 m width) = 1,350,000 m² <p>Offshore ECC:</p> <p><i>Foundation seabed preparation = 36,963 m²</i></p> <ul style="list-style-type: none"> • Three small OSS on suction caisson jacket foundations = 36,963 m² <p><i>Jack up operations = 12,240 m²</i></p> <ul style="list-style-type: none"> • OSS installation JUV footprint (six legs, 170m² per foot, 4 jack-up operations per structure) = 12,240 m² <p><i>Cable seabed preparation and installation = 29,541,000 m²</i></p> <ul style="list-style-type: none"> • Boulder clearance in offshore ECC - 30 m corridor = 19620,000 m² • Sandwave clearance in offshore ECC – 30 m corridor = 757,000 m² 	The temporary disturbance relates to seabed preparation and cable installation. The footprint of infrastructure is assessed as a permanent impact in O&M. It should be noted that the seabed preparation area for foundations is less than the footprint of the foundation scour protection.

Hornsea 4



Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Burial of 654 km of export cables (15 m width) = 9,810,000 m² Cable jointing (4 joints per cable, 6 cables, 3,500 m² per joint) = 84,000 m² 	
2	Temporary habitat disturbance in the intertidal area from export cable installation	Subtidal Benthic and Intertidal Ecology	Intertidal open cut trenching: <ul style="list-style-type: none"> 6 cables within a 280 m corridor (40m per circuit (6 × 40) with 20m temporary works area either side (2 × 20) across 200 m long intertidal (MLWS to MHWS) = 56,000 m². Excavation to a depth of 3 m.	The MDS for temporary habitat disturbance in the intertidal area from the installation of cables has considered the installation of all cables via open cut trenching, as the total potential temporary disturbance associated with this method is greater than the potential temporary disturbance associated with either the HDD option.
3	Temporary increase in SSC and sediment deposition in the Hornsea Four array area and offshore ECC.	Subtidal Benthic and Intertidal Ecology	Array Area: <i>WTG Foundations</i> <ul style="list-style-type: none"> 180 turbines on suction caisson jacket foundations requiring seabed preparation, resulting in the suspension of 2,134,440 m³ of sediment; <i>OSS Foundations</i> <ul style="list-style-type: none"> Nine suction caisson foundations requiring seabed preparation, resulting in the suspension of 737,130 m³ of sediment; <i>Offshore Accommodation Platform Foundations</i> <ul style="list-style-type: none"> One suction caisson foundation requiring seabed preparation, resulting in the suspension of 57,245 m³ of sediment; <i>Sandwave Clearance</i> <ul style="list-style-type: none"> Sandwave clearance across 18 km² of seabed with an impact width of 15 m per cable resulting in the suspension of 961,000 m³ of sediment. <i>Cable Trenching</i> <ul style="list-style-type: none"> Cable installation by MFE of array cables, interconnector cables, and part of the export cables within the array resulting in the suspension of 4,140,000 m³ of sediment. Offshore ECC <i>HVAC Booster Station Foundations</i>	<p>The maximum design scenario for foundation installation results from the largest volume suspended from seabed preparation (suction caisson jackets) and the largest volume suspended from potential drilling of foundations (monopiles), both at the maximum number of foundations (180).</p> <p>For cable installation, the maximum design scenario results from the greatest volume from sandwave clearance and installation using energetic means (jetting). This also assumes the largest number of cables and the greatest burial depth.</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> 3 suction caisson foundations requiring seabed preparation, resulting in the suspension of 171,735 m³ of sediment; <p><i>Sandwave Clearance</i></p> <ul style="list-style-type: none"> Sandwave clearance across a 99 km corridor for 6 cables resulting in the suspension of 757,000 m³ of sediment. <p><i>Cable Trenching</i></p> <ul style="list-style-type: none"> Installation of 6 cables by MFE resulting in the suspension of 3,543,000 m³ of sediment (excluding the part of the export cable within the array Cable Jointing Up to 17,500 m³ of sediment from up to four cable joints per export cable. <p>Total: In the case of seabed preparation for suction caisson foundations, a maximum volume of 12,879,050 m³.</p>	
4	Temporary increase in SSC and sediment deposition in the intertidal area.	Subtidal Benthic and Intertidal Ecology	<ul style="list-style-type: none"> Excavated volume of material for HDD exit pits is 2,500 m³. Material would either be taken away to a temporary stockpile or stored adjacent to the exit pit prior to backfilling. Open cut trenching of 6 cables within a 280 m corridor (40m per circuit; i.e. 20 m either side 6 × 40 + 2 × 20 = 280 m) across the intertidal (200 m) to a depth of 3m. <p>All installation techniques described for export cable installation (except dredging) may be applied to installation within the intertidal. For MFE, an equivalent volume of 7,162 m³ of sediment may be dredged across a 200 m stretch of beach for six export cables.</p>	This scenario represents the maximum footprint from the greatest number of cables and the largest excavation volume from cofferdams.
5	Direct and indirect seabed disturbances leading to the release of sediment contaminants.	Subtidal Benthic and Intertidal Ecology	The MDS for seabed disturbance are presented in the rows above. The risk of release of contaminants will be assessed further within the PEIR.	This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during construction activities.
6	PTS and TTS from piling noise	Marine Mammals	<p>Array Area (spatial MDS):</p> <ul style="list-style-type: none"> 180 WTGs on monopile foundations 	The piling scenario with the largest PTS impact ranges represent the maximum

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> 3 offshore converter substations on monopile foundations 6 offshore transformer substations on monopile foundations 1 offshore accommodation platform on a monopile foundation Maximum design (~30% of WTG): 5,000 kJ hammer energy, 4 hours piling duration, 30 min ramp up Most likely (~70% of WTG): 4,000 kJ hammer energy, 127.5 min piling duration, 52.5 min ramp up Total WTG piling days: 216 assuming 1.2 days per monopile (151 days at most likely energy and 65 days at maximum design) over a 12 month piling period <p>Array Area (temporal MDS):</p> <ul style="list-style-type: none"> 180 WTGs on pin-piled jacket foundations, 3 piles per jacket (540 total) 3 offshore converter substations on pin-piled jacket foundations (16 piles per structure (48 total), hammer energy: 2,500 kJ) 6 offshore transformer substations on pin-piled jacket foundations (24 piles per structure (144 total), hammer energy: 2,500 kJ) 1 offshore accommodation platform on a pin-piled jacket foundation (24 piles, hammer energy: 2,500 kJ) Maximum design (~30% of WTG): 2,500 kJ hammer energy, 4 hours piling duration, 30 min ramp up Most likely (~70% of WTG): 1,750 kJ hammer energy, 127.5 min piling duration, 52.5 min ramp up Total WTG piling days: 270 assuming 1.5 days per jacket foundation (189 days at most likely energy and 81 days at maximum design) over a 12 month piling period <p>HVAC Area of Search (spatial MDS):</p> <ul style="list-style-type: none"> 3 HVAC booster stations on monopile foundations 	<p>design scenario. This differs between species depending on the frequency characteristics emitted during installation of each pile type and the hearing of the species (e.g. for high frequency cetaceans such as harbour porpoise, pin piles have a larger PTS impact range whereas for low frequency cetaceans, monopiles have a larger PTS impact range).</p> <p>The maximum number of piled foundations would represent the temporal maximum design scenario for disturbance. The maximum predicted impact range for underwater noise for piled foundations would represent the spatial maximum design scenario for disturbance.</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Maximum design: 5,000 kJ hammer energy, 4 hours piling duration, 30 min ramp up Most likely: 4,000 kJ hammer energy, 127.5 min piling duration, 52.5 min ramp up Total piling days: 3.6 assuming 1.2 days per monopile over a 12-month piling period <p>HVAC Area of Search (temporal MDS):</p> <ul style="list-style-type: none"> 3 HVAC booster stations on pin-piled jacket foundations (24 piles per structure (72 total), hammer energy: 2,500 kJ) Maximum design: 2,500 kJ hammer energy, 4 hours piling duration, 30 min ramp up Most likely: 1,750 kJ hammer energy, 127.5 min piling duration, 52.5 min ramp up <p>Total piling days: 4.5 assuming 1.5 days per jacket foundation over a 12-month piling period</p>	
7	Behavioural Disturbance from piling noise	Marine Mammals	As per PTS from piling noise.	<p>The maximum number of piled foundations would represent the temporal maximum design scenario (MDS).</p> <p>The maximum predicted impact range for underwater noise for piled foundations would represent the spatial MDS.</p>
8	Vessel collision risk	Marine Mammals	<p>Wind Turbine Foundation Installation:</p> <ul style="list-style-type: none"> 4 installation vessels (90 return trips) 16 support vessels (360 return trips) 40 Transport / Feeder vessels (incl. Tugs) (360 return trips) Duration: 12 months <p>Wind Turbine Installation:</p>	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> 2 installation vessels (90 return trips) 12 Support vessels (270 return trips) 24 transport (540 return trips) Duration: 24 months <p>Substation Foundation Installation (all offshore substations and accommodation platform):</p> <ul style="list-style-type: none"> 2 installation vessels (24 return trips) 12 Support vessels (108 return trips) 4 transport (48 return trips) Duration: 12 months <p>Substation Installation (all offshore substations and accommodation platform):</p> <ul style="list-style-type: none"> 2 installation vessels (36 return trips) 12 Support vessels (162 return trips) 4 transport (72 return trips) Duration: 24 months <p>Inter-Array and Offshore Interconnector Cables Installation:</p> <ul style="list-style-type: none"> 3 main laying vessels (204 return trips) 3 main burying vessels (204 return trips) 12 support vessels (1,080 return trips) Duration: 24 months 	
9	Disturbance from vessels	Marine Mammals	As per collision risk	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision.
10	Non-piling noise (e.g. cable laying, dredging)	Marine Mammals	<p>Offshore Cables Installation:</p> <ul style="list-style-type: none"> Methods: Trenching, dredging, jetting, ploughing, mass flow excavation, vertical injection, rock cutting 	Maximum potential for underwater noise impacts.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Total length of array cables: 600 km Total length of interconnector cables/circuits: 90 km Where possible, the export cables will be buried below the seabed through to landfall. Total length of export cables: 654 km (6 cables x 109 km cable length) Total duration of cable installation: 36 months	
11	PTS from UXO clearance	Marine Mammals	UXO Clearance: <ul style="list-style-type: none"> Estimated 2,263 targets 86 UXOs may require clearance. One UXO will be cleared every 24 hours 86 detonations in 86 days	Estimated maximum design based on data from other projects in the Hornsea Zone. A detailed UXO survey would be completed prior to construction. The type, size (net explosive quantities (NEQ)) and number of possible detonations and duration of UXO clearance operations is therefore not known at this stage.
12	Disturbance from UXO clearance	Marine Mammals	As per PTS from UXO clearance.	
13	Reduction in prey availability	Marine Mammals	Assessment is based on the MDS presented in Volume 2, Chapter 3: Fish and Shellfish Ecology .	
14	Reduction in foraging ability	Marine Mammals	Maximum amount of suspended sediment released during construction activities and associated duration - see Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes .	
15	Disturbance and displacement from increased vessel activity and helicopters within the array area	Offshore and Intertidal Ornithology	<u>Construction vessels / helicopters within Array Area:</u> - 8 construction vessels within 3 to 4 blocks of 5km ² at one time. <u>WTG Installation:</u> - 2 installation vessels (JUV) (90 return trips) - 12 support vessels (270 return trips) - 24 transport vessels (540 return trips) - 135 helicopter return trips <u>WTG Foundation Installation:</u>	The maximum estimated number of blocks with vessels operating concurrently would cause the greatest disturbance to birds on site.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> - 4 installation vessels (2 JUV and 2 anchored) (90 return trips); - 16 support vessels (360 return trips) - 40 transport/feeder vessels (including tugs) (360 return trips) - 180 helicopter return trips <p><u>Offshore Substation Installation (including substations and accommodation platform):</u></p> <ul style="list-style-type: none"> - 2 installation vessels (36 return trips); - 12 support vessels (162 return trips) - 4 transport/feeder vessels (72 return trips) - 63 helicopter return trips <p><u>Offshore Substation Foundation Installation (including substations and accommodation platform):</u></p> <ul style="list-style-type: none"> - 2 installation vessels (24 return trips); - 12 support vessels (108 return trips) - 4 transport/feeder vessels (48 return trips) - 42 helicopter return trips <p><u>Inter-array and Interconnector cable installation:</u></p> <ul style="list-style-type: none"> - 3 main cable laying vessels (204 return trips) - 3 main cable burial vessels (204 return trips) - 12 support vessels (1,080 return trips) - 396 helicopter return trips 	
16	Indirect impacts during the construction phase within the array area through effects on habitats and prey species	Offshore and Intertidal Ornithology	See MDS for Fish and Shellfish Ecology assessment (Volume 2, Chapter 3: Fish and Shellfish Ecology).	As per justification in Volume 2, Chapter 3: Fish and Shellfish Ecology .

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
17	Disturbance and displacement from vessel activity within the ECC area	Offshore and Intertidal Ornithology	<u>Construction vessels within ECC:</u> <ul style="list-style-type: none"> - 3 cable laying vessels (96 return trips) - 3 cable jointing vessels (72 return trips) - 3 cable burial vessels (96 return trips) - 15 support vessels (144 return trips) - 800 helicopter return trips 	The assumption is that vessels would be in situ from start to finish, so any disturbance events would be throughout entire period.
18	Disturbance and displacement from presence and operation of construction machinery/vehicles within the cable landfall area	Offshore and Intertidal Ornithology	<u>Open Cut Installation:</u> <ul style="list-style-type: none"> - 1 to 3 m burial depth - Peak two-way daily Heavy Goods Vehicle (HGV) movements in one month: 1,097 - Peak two-way daily Large Goods Vehicle (LGV) movements: 368 <u>Cable Laying:</u> <ul style="list-style-type: none"> - Cable laying rate of 100 m per day 	The assumption is that the trenching, cable laying and burial of the export cable would be throughout 32 consecutive months from the start to finish, so any disturbance events would be throughout the entire period.
19	Direct impacts on designated sites: Temporary construction areas could occupy areas leading to loss and/or degradation of designated sites	Ecology and Nature Conservation	Onshore Export Cable Corridor: <ul style="list-style-type: none"> • Construction duration: 30 months • Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months • ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² • Haul Road: Number: 1, Width: 6m (with 7 m passing places), Length: 40km, Depth: 1m • Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km, Depth: average of 0.5m • Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds • Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box • HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds 	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance.

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
20	Impacts on non-designated sites: Construction compounds, access roads and other infrastructure will temporarily occupy areas leading to loss and/or degradation of non-designated habitat	Ecology and Nature Conservation	<p>Landfall:</p> <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m <p>Onshore Export Cable Corridor:</p> <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Cable trench: Depth: 1.5 m, Width at base: 1.5m, Width at surface: 5m Haul Road: Number: 1, Width: 6m (with 7 m passing places), Length: 40km, Depth: 1m Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) <p>Onshore Substation and Energy Balancing Infrastructure:</p> <ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² 	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			400 kV ECC: <ul style="list-style-type: none"> Cable circuits: Number: 4 Cable trench depth: 1.5m Length: 2,100m, Width: 60 m 	
21	Impacts on bat species: Construction activities will temporarily occupy areas leading to loss and/or degradation of habitat and loss of habitat connectivity used by bats for roosting, commuting and/or foraging	Ecology and Nature Conservation	Landfall: <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m Onshore Export Cable Corridor: <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) Crossings affecting potential bat commuting/ foraging or roosting habitats: Number: 324 Onshore Substation and Energy Balancing Infrastructure:	<p>These parameters represent the maximum numbers of crossing, construction duration and building design parameters that could potentially disrupt bat commuting/foraging habitat and/or bat roosts.</p> <p>For further detail, see Volume 4, Annex 4.2: Onshore Crossing Schedule.</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² <p>400 kV ECC:</p> <ul style="list-style-type: none"> Length: 2,100m, Width: 60 m 	
22	Impacts on breeding and/or wintering bird species: Construction activities will temporarily occupy areas leading to loss and/or degradation of habitat used by breeding and/or wintering birds	Ecology and Nature Conservation	<p>Landfall:</p> <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m <p>Onshore Export Cable Corridor:</p> <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) Crossings: Number: 324 	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance, alongside

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			Onshore Substation and Energy Balancing Infrastructure: <ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² 400 kV ECC: <ul style="list-style-type: none"> Length: 2,100m, Width: 60 m 	
23	Impacts on otter and / or water vole: Open cut trenching and HDD used to cross watercourses with otter and / or water vole potential could lead to loss of habitat, disturbance and / or connectivity severance	Ecology and Nature Conservation	Landfall: <ul style="list-style-type: none"> Construction duration: 32 months Trench width per circuit: 15 m Potential disturbance corridor from plant movements, excavation, etc.: 60 m per circuit Onshore Export Cable Corridor: <ul style="list-style-type: none"> Construction duration: 30 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Cable trench: Depth: 1.5 m, Width at base: 1.5m, Width at surface: 5m Temporary access bridges: Number: 24, Width: 6 m Crossings: Number: 324 Onshore Substation and Energy Balancing Infrastructure: <ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) 	These parameters represent the maximum numbers of crossings that could potentially affect water vole and/or otter habitat.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² <p>400 kV ECC:</p> <ul style="list-style-type: none"> Length: 2,100m, Width: 60 m 	
24	Impacts on great crested newt populations: Works in or within 250 m of water bodies with great crested newt potential could cause habitat loss, degradation, habitat severance and harm or kill individual animals	Ecology and Nature Conservation	<p>Landfall:</p> <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m <p>Onshore Export Cable Corridor:</p> <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) <p>Onshore Substation and Energy Balancing Infrastructure:</p> <ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m 	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			road, 7m soil storage) <ul style="list-style-type: none"> Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² 400 kV ECC: <ul style="list-style-type: none"> Length: 2,100m, Width: 60 m 	
25	Impacts on reptiles: Construction activities will temporarily occupy areas leading to loss and / or degradation of habitat, loss of habitat connectivity and harm or mortality of individual reptiles.	Ecology and Nature Conservation	Landfall: <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m Onshore Export Cable Corridor: <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) Onshore Substation and Energy Balancing Infrastructure: <ul style="list-style-type: none"> Construction duration: 36 months 	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² <p>400 kV ECC:</p> <ul style="list-style-type: none"> Length: 2,100m, Width: 60 m 	
26	Impacts on badgers: Construction activities could disturb badger setts and / or lead to temporary severance of territories.	Ecology and Nature Conservation	<p>Landfall:</p> <ul style="list-style-type: none"> Construction duration: 32 months Landfall compound: Number: 1, Total Area: 40,000 m², Duration: 32 months Transition Joint Bays (located within Landfall compound area): Number: 6, Depth: 6m <p>Onshore Export Cable Corridor:</p> <ul style="list-style-type: none"> Construction duration: 30 months Logistics compounds: Number: 8, Size: 140x140 m, Duration: 36 months ECC: Length: 40 km (approximate), Width: 80m, Area: 3,200,000 m² Cable circuits (HVAC system): Number: 6 Temporary access roads: Number: 24, Width: 6 m (with 7 m passing places), Total combined length (excluding existing paved sections): 10km. Joint Bays: Number: 240, Depth 2.5m, Area: 225m² per Joint Bay, Joint Bay compounds: 240 40x40m compounds Link Boxes: Number: 240, Depth: 2m, Area: 9m² per Link Box HDDs: Number: 112, HDD compounds (entry and exit): 56 70x70m compounds; HDD Compound Duration: 1 month (per compound) <p>Onshore Substation and Energy Balancing Infrastructure:</p>	These parameters represent maximum ground disturbance conditions both in terms of potential size of area affected and in terms of duration of expected disturbance.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Construction duration: 36 months Temporary access road: Number: 1, Length: 1,600 m, Width: 15m (8m road, 7m soil storage) Permanent infrastructure area: 155,000 m² Temporary works area: 130,000 m² <p>400 kV ECC: Length: 2,100m, Width: 60 m</p>	
27	Temporary localised increases in SSC and smothering.	Fish and Shellfish Ecology	<p>Wind Turbine Foundations:</p> <ul style="list-style-type: none"> 180 turbines on suction caisson jacket foundations requiring seabed preparation, resulting in the suspension of 2,134,440 m³ of sediment; <p>Or</p> <ul style="list-style-type: none"> 180 turbines on piled foundations with 10% of locations requiring drilling to the full length of the pile, resulting in a drill arising volume of 127,235 m³. <p>OSS Foundations:</p> <ul style="list-style-type: none"> Nine suction caisson foundations requiring seabed preparation, resulting in the suspension of 737,130 m³ of sediment; <p>Or</p> <ul style="list-style-type: none"> Nine piled foundations drilled to 10% of pile depth, resulting in a drill arising volume of 13,854 m³. <p>Offshore Accommodation Platform Foundations:</p> <ul style="list-style-type: none"> One suction caisson foundation requiring seabed preparation, resulting in the suspension of 57,245 m³ of sediment; <p>Or</p> <ul style="list-style-type: none"> One piled foundation drilled to 10% of pile depth, resulting in a drill arising volume of 1,540 m³. 	<p>The maximum adverse scenario for foundation installation results from the largest volume suspended from seabed preparation (suction caisson jackets) or the largest volume suspended from potential drilling of foundations (monopiles) as these are mutually exclusive, both with the maximum number of foundations (180).</p> <p>For cable installation, the maximum adverse scenario results from the greatest volume from sandwave clearance and installation using energetic means (MFE). This also assumes the largest number of cables and the greatest burial depth.</p>

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<p>Array Cable Sandwave Clearance:</p> <ul style="list-style-type: none"> Sandwave clearance across 18 km² of seabed with an impact width of 15 m per cable resulting in the suspension of 961,000 m³ of sediment. <p>Array Cable Trenching:</p> <ul style="list-style-type: none"> Cable installation by MFE of array cables, interconnector cables, and part of the export cables within the array resulting in the suspension of 4,140,000 m³ of sediment. <p>HVAC Booster Station Foundations:</p> <ul style="list-style-type: none"> 3 suction caisson foundations requiring seabed preparation, resulting in the suspension of 171,735 m³ of sediment; <p>Or</p> <ul style="list-style-type: none"> 3 piled foundations drilled to 10% of pile depth, resulting in a drilling volume of 4,618 m³. <p>Sandwave Clearance:</p> <ul style="list-style-type: none"> Sandwave clearance across a 99 km corridor for 6 cables resulting in the suspension of 757,000 m³ of sediment. <p>Cable Trenching:</p> <ul style="list-style-type: none"> Installation of 6 cables by MFE resulting in the suspension of 3,543,000 m³ of sediment (excluding the part of the export cable within the array). <p>Cable Jointing:</p> <ul style="list-style-type: none"> Up to 17,500 m³ of sediment from up to four cable joints per export cable. 	

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			Total: <ul style="list-style-type: none"> 12,879,050 m³ (seabed preparation for suction caisson foundations). Or 9,925,747 m ³ (drilling for piled foundations).	
28	Direct and indirect seabed disturbances leading to the release of sediment contaminants.	Fish and Shellfish Ecology	The MDS for seabed disturbance are presented in the rows above. The risk of release of contaminants will be assessed further within the PEIR.	As above.
29	Mortality, injury, behavioural changes and auditory masking arising from noise and vibration.	Fish and Shellfish Ecology	Array Area (spatial MDS): <ul style="list-style-type: none"> Monopile wind turbine foundations 180 wind turbine foundations Six offshore transformer substations Three offshore converter substations One offshore accommodation platform Maximum hammer energy 5,000 kJ 4-hour piling duration 1.2 days per monopile 216 piling days (single vessel) 106 piling days (2 vessels) Array Area (temporal MDS): <ul style="list-style-type: none"> 180 wind turbines on piled jacket foundations (3 piles per jacket) – 540 pin piles Six offshore transformer substations on piled jacket foundations (6 legs per jacket and 4 piles per leg – 144 pin piles) Three offshore converter substations on piled jacket foundations (8 legs per jacket and 2 piles per leg – 48 pin piles) One offshore accommodation platform on a piled jacket foundation (6 legs and 4 piles per leg – 24 pin piles) <i>Total of 756 pin piles in the array</i> 	<p>Piling: The spatial worst case results from the installation of monopile foundations for 180 WTCs, 9 offshore substations and an offshore accommodation platform using 5,000 kJ hammer energy. This would result in the largest spatial noise impact at any given time.</p> <p>The temporal worst case would be associated with the installation of the maximum number of piles; the worst-case scenario would be the installation of 180 WTCs using piled jacket foundations, resulting in the piling of 540 piles. The worst case for OSS installation is the greatest number of piles, based on the installation of six medium OSSs on six leg jacket foundations, requiring 4 piles per leg requiring 144 piles and three large OSSs on 8 leg jackets requiring 24 pin piles. In addition, on accommodation platform could be installed on a 6 leg jacket with 4 piles per leg requiring 24 pin piles.</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Maximum hammer energy 2,500 kJ 1.5 days per jacket foundation 270 piling days (single vessel) 135 days (2 vessels) <p>HVAC Booster Area of Search (spatial MDS):</p> <ul style="list-style-type: none"> Three HVAC booster stations on monopile foundations Maximum hammer energy 5,000 kJ 4-hour piling duration 1.2 days per monopile <p>HVAC Booster Area of Search (temporal MDS):</p> <ul style="list-style-type: none"> Three HVAC booster stations on piled jackets (6 legs per jacket and 4 piles per leg – 72 pin piles) <p>Interconnector Cable Installation:</p> <ul style="list-style-type: none"> 6 circuits/cables Total length of interconnector cables: 90 km Total duration of cable installation: 24 months <p>Export Cable Installation:</p> <ul style="list-style-type: none"> Where possible, the export cables will be buried below the seabed through to landfall. Total length of export cables: 654 km Total duration of cable installation: 24 months <p>Vessel Disturbance During Wind Turbine Foundation Installation:</p> <ul style="list-style-type: none"> 4 installation vessels (90 return trips) 16 support vessels (360 return trips) 40 Transport / Feeder vessels (incl. Tugs) (360 return trips) 	<p>For HVAC booster stations, the spatial MDS is based on 3 stations on monopiles, and the temporal MDS is based on 3 stations on piled jacket foundations.</p> <p>Cable Installation: The MDS for cable installation would result in the greatest noise impacts from construction activities.</p> <p>Vessel Activity: The instalment of WTC foundations is predicted to have the greatest noise impacts from vessel activity.</p> <p>UXO clearance: The MDS for UXO clearance would result in 86 detonations, across 86 days. UXO clearance will be carried out ~one to two years prior to the start of offshore construction works.</p> <p>The MDS assumes UXO will be identified and it will not be possible to be avoided or removed from the seabed and disposed of in a designated area</p>

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<p>Wind Turbine Installation:</p> <ul style="list-style-type: none"> • 2 installation vessels (90 return trips) • 12 Support vessels (270 return trips) • 24 transport (540 return trips) <p>Substation Foundation Installation (including Accommodation and HVAC Booster Station Foundations):</p> <ul style="list-style-type: none"> • 2 installation vessels (24 return trips) • 12 support vessels (108 return trips) • 4 transport vessels (48 return trips) <p>Substation Platform Installation (including Accommodation and HVAC Booster Station Platforms):</p> <ul style="list-style-type: none"> • 2 installation vessels (36 return trips) • 12 support vessels (162 return trips) • 4 transport vessels (72 return trips) <p>Inter-Array and Interconnector Cable Installation:</p> <ul style="list-style-type: none"> • 3 Main cable laying vessels (204 return trips) • 3 Main burial vessels (204 return trips) • 12 support vessels (1,080 return trips) <p>Offshore Export Cable Installation:</p> <ul style="list-style-type: none"> • 3 main cable laying vessels (96 return trips) • 3 main cable jointing vessels (72 return trips) • 3 main cable burial vessels (96 return trips) • 15 support vessels (144 return trips). <p>Unexploded Ordnance (UXO) Clearance:</p>	

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Estimated 2,263 targets 86 UXOs may require clearance. One UXO will be cleared every 24 hours 86 detonations in 86 days	
<i>Operation and Maintenance</i>				
30	Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection	Subtidal and Intertidal Benthic Ecology	Habitat change of 3,707,730 m ² . Breakdown provided below. Array Area: <ul style="list-style-type: none"> Turbine footprint with scour protection, based on 180 suction bucket jackets for WTG = 795,216 m² Offshore transformer substation foundation footprint and scour protection, based on 6 small and 3 large OSS (HVDC: GBS (Box-type) & GBS (Large OSS)) = 371,250 m² Offshore HVAC booster substations and associated scour , based on three subsea structures (GBS (Box-type)) = 91,875 m² Offshore accommodation platform and associated scour protection (GBS (Box-type)) = 30,625 m² Maximum rock protection area for array cable = 624,000 m² Maximum rock protection area for interconnector cable = 94,000 m² Pre- and post-lay rock berm area, based on 40 cable crossings within the array area = 255,000 m² Offshore ECC: <ul style="list-style-type: none"> Maximum rock protection area for the export cable = 792,000 m² Pre- and post-lay rock berm area, based on 10 cable crossings within the export ECC area = 268,000 m ²	The maximum design scenario is defined by the maximum area of seabed lost by structures, scour protection, cable protection and cable crossings.
31	Colonisation of the WTGs and scour/ cable protection may affect benthic ecology and biodiversity.	Subtidal and Intertidal Benthic Ecology	Total area of introduced hard substrate = 3,707,730 m ² (calculated from total of cell above)	The maximum design scenario is defined by the maximum area of structures, scour protection, cable protection and cable crossings introduced to the water column, including surface area of vertical structures.
32	Increased risk of introduction or spread of Marine Invasive Non-	Subtidal and Intertidal	Total area of introduced hard substrate = 3,707,730 m ² (calculated from total of cell above).	Defined by the maximum surface area introduced as described above.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
	Native Species (MINNS) due to presence of subsea infrastructure and vessel movements (e.g. ballast water) may affect benthic ecology and biodiversity.	Benthic Ecology		
33	Direct disturbance to seabed from jack-up vessels and cable maintenance activities.	Subtidal and Intertidal Benthic Ecology	<p>Direct disturbance to seabed from jack-up vessels and cable maintenance activities = 3,252,500 m². Breakdown provided below.</p> <p>WTG O&M activities:</p> <ul style="list-style-type: none"> • Component replacement = 378,000 m² • Access ladder replacement = 378,000 m² • Foundation anode replacement = 378,000 m² • J-Tube repair/ replacement = 108,000 m² <p>Array cable activities:</p> <ul style="list-style-type: none"> • Remedial burial of array cables = 200,000 m² • Array cable repairs = 200,000 m² • Cable protection replacement = 156,000 m² <p>Offshore substations and accommodation platform activities:</p> <ul style="list-style-type: none"> • Offshore substation component replacement = 6,000 m² • Foundation anode replacement = 21,000 m² • J-Tube repair/ replacement = 6,000 m² <p>ECC activities:</p> <ul style="list-style-type: none"> • Cable remedial burial = 200,000 m² (per event) • Cable protection replacement = 198,000 m² • Array cable repairs = 700,000 m² <p>Interconnector cable activities:</p> <ul style="list-style-type: none"> • Cable remedial burial = 200,000 m² (per event) • Cable protection replacement = 23,500 m² • Array cable repairs = 100,000 m² <p>Vessel return trips per year:</p>	Defined by the maximum number of jack-up vessel operations and maintenance activities that could have an interaction with the seabed anticipated during operation.

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> • 2,580 for wind turbine visits • 780 for wind turbine foundation visits • 65 for platform visits - Structural Scope • 100 for platform visits - Electrical Scope • 260 crew shift transfer • 124 jack-up visits • 1,205 crew vessel wind turbine visits <p>104 supply vessel visits to accommodation platform</p>	
34	Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities.	Subtidal and Intertidal Benthic Ecology	<p>Array Area:</p> <p><i>WTG Foundations</i></p> <ul style="list-style-type: none"> • Mono suction bucket has a 40 m diameter base which is also proud of the seabed by 10 m before tapering into the main support column (unspecified width), however, the suction bucket jacket has 4 * 20 m buckets which reach 5 m about the seabed. The total structure footprint of these two foundation types is actually the same, however, group scour is probable around all suction buckets as well as local scour around any single bucket, making this option the MDS for scouring prior to placement of scour protection. The total width of the suction bucket foundation is also wider at 65 m when face on to flows and wider at 45° to flows when the equivalent width is 92 m. <p><i>OSS foundations</i></p> <ul style="list-style-type: none"> • The (3) large box-type GBS of 150 m width (150 * 150) has a greater seabed footprint than the Pontoon GBS (2 * 179 * 35). The MDS option for the 6 small/medium foundations is the 75 m GBS box-type. <p><i>Offshore accommodation</i></p> <ul style="list-style-type: none"> • The 6-legged suction bucket Jacket (Medium) has the largest total width at the seabed, although the total area of structures is less than the 75 m GBS (box-type) structure. The 6-legged suction bucket is likely to have local scour around each leg and group scour around all legs, making scouring of the unprotected seabed larger than the 75 m GBS (box-type) which is likely to have edge scour at corners. • Rock berms at cable crossings: 34 potential crossings over new pipelines (TQ), potential for scouring dependent on rock size and grading to perimeter. Some alignments may inhibit bedload transport. 	This impact is defined by any anticipated changes to physical processes as defined in the Marine Geology, Oceanography and Physical Processes assessment.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			Offshore ECC <ul style="list-style-type: none"> HVAC booster area – pre-scour protection period around a 75 m GBS (box-type) <p>Rock berms at cable crossings – 10 crossings over existing assets, potential for scouring dependent on rock size and grading to perimeter with heights of 1.5 m.</p>	
35	Operational noise	Marine Mammals	Number of Wind Turbines: 180 (maximum rotor diameter 305 m)	The largest turbine will result in the highest levels of operational noise transmission
36	Vessel collision risk	Marine Mammals	Vessel return trips per year: <ul style="list-style-type: none"> 2,580 for wind turbine visits 780 for wind turbine foundation visits 65 for platform visits - Structural Scope 100 for platform visits - Electrical Scope 260 crew shift transfer 124 jack-up visits 1,205 crew vessel wind turbine visits 104 supply vessel visits to accommodation platform	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.
37	Disturbance from vessels	Marine Mammals	As per vessel collision risk.	The maximum numbers of vessels and associated vessel movements represents the maximum potential for disturbance.
38	Reduction in prey availability	Marine Mammals	Maximum effect on fish prey species as detailed in the assessment in Volume 2, Chapter 3: Fish and Shellfish Ecology .	
39	Reduction in foraging ability	Marine Mammals	Maximum amount of suspended sediment released during construction activities and associated duration - see Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes .	
40	Disturbance and displacement from Operational activities associated with moving turbines and	Offshore Ornithology	<u>Array Area:</u> - 600 km ² <u>Wind Turbine Generators:</u> - 180 WTGs - Minimum height of lowest blade tip above MSL (m): 35m	Displacement would be assumed from the entire Array Area that contains WTGs and other associated structures, which maximises the potential for disturbance and displacement.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
	maintenance vessels. may lead to disturbance and displacement of species within the array area and different degrees of buffers surrounding it.		<ul style="list-style-type: none"> - Maximum rotor blade radius: 152.5m <u>Vessels during Maintenance:</u> <ul style="list-style-type: none"> - 3,525 return vessel visits per year - 2,580 return visits to wind turbines per year - 780 return visits to wind turbine foundations per year - 65 return visits to offshore platforms (structural scope) per year - 100 return visits to offshore platforms (electrical scope) per year - Vessels include: CTVs, SOVs, supply vessels, cable and remedial protection vessels and JUVs 	Assessment of extent / varying displacement from Array Area and a buffer is species specific due to their sensitivity levels.
41	Collision risk to seabirds	Offshore Ornithology	<u>Array Area:</u> <ul style="list-style-type: none"> - 600 km² area <u>Wind Turbines:</u> <ul style="list-style-type: none"> - 180 WTGs - Minimum height of lowest blade tip above MSL (m): 35m - Maximum rotor blade radius: 152.5m 	This represents the maximum number of the largest WTGs, which represents the greatest total swept area to be considered for collision risk.
42	Collision risk to migrant non-seabirds	Offshore Ornithology	<u>Array Area:</u> <ul style="list-style-type: none"> - 600 km² area <u>Wind Turbines:</u> <ul style="list-style-type: none"> - 180 WTGs - Minimum height of lowest blade tip above MSL (m): 35m - Maximum rotor blade radius: 152.5m 	This represents the maximum number of the largest WTGs, which represents the greatest total swept area to be considered for collision risk.
43	Indirect impacts within the array area during the operational phase through effects on habitats and prey species	Offshore Ornithology	See MDS for Fish and Shellfish Ecology assessment (Volume 2, Chapter 3: Fish and Shellfish Ecology).	As per justification in Volume 2, Chapter 3: Fish and Shellfish Ecology .

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
44	Barrier effect to the migratory or regular foraging movements of seabirds	Offshore Ornithology	<u>Array Area:</u> - 600 km ² area - 30 km north-south extent between the northernmost point of the array area and the southernmost point <u>Wind Turbines:</u> - 180 WTGs	The measurement would be North to South to define the additional effort required for birds to fly around the Array Area to the North or South from FFC colony during the breeding if assumed to be commuting to foraging areas beyond Array Area to the East.
45	Potential for ad-hoc maintenance of export cable through the intertidal zone during the operational phase may lead to disturbance and displacement of waterbird species in close proximity to the works.	Offshore Ornithology	N/A as scoped out	N/A
46	Impacts on habitats or species: Operation of the onshore substation will cause long-term	Ecology and Nature Conservation	Onshore Substation and Energy Balancing Infrastructure: <ul style="list-style-type: none"> Permanent infrastructure area: 155,000 m² Noise output (Variable Shunt Reactor): 97 dB per unit Number of variable shunt reactors: 12	These parameters represent maximum land take and operational activities relevant to the OnSS.
47	Impacts on protected species: Operation and maintenance activities of the onshore substation could cause disturbance to protected species	Ecology and Nature Conservation	Onshore Substation and Energy Balancing Infrastructure: <ul style="list-style-type: none"> Permanent infrastructure area: 155,000 m² Noise output (Variable Shunt Reactor): 97 dB per unit Number of variable shunt reactors: 12 	These parameters represent maximum land take and operational activities relevant to the OnSS.

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
48	Long-term loss of habitat due to the presence of turbine foundations, scour protection and cable protection.	Fish and Shellfish Ecology	<p>WTG foundations, including scour protection</p> <p>180 WTGs</p> <p>suction bucket jacket foundations = 795,216 m²</p> <p>Offshore transformer substation foundations including scour protection</p> <p>6 small and 3 large OSS</p> <p>HVDC: GBS (Box-type) & GBS (Large OSS) foundations = 371,250 m²</p> <p>Offshore HVAC booster substations, including scour protection</p> <p>GBS (Box-type) foundations = 91,875 m²</p> <p>Offshore accommodation platform, including scour protection</p> <p>GBS (Box-type) foundations = 30,625 m²</p> <p>Cable protection</p> <p>Array cables = 624,000 m² (scour protection from construction phase) + 156,000m² (25% replenishment of scour protection during O&M phase) = 780,000 m²</p> <p>Offshore interconnector cables = 94,000 m² + 23,500m² (25% cable replenishment) = 117,500 m²</p> <p>Offshore export cables = 792,000 m² + 198,000 m² (25% cable replenishment) = 990,000 m²</p> <p>Total footprint = 1,887,500 m²</p> <p>Cable crossings</p> <p>Cable crossings within the array area (Pre- and post-lay rock berm area) = 255,000 m² (40 crossings)</p> <p>Cable crossings in the ECC area (Pre- and post-lay rock berm area) = 268,000m² (10 crossings)</p> <p>Total footprint = 523,000 m²</p> <p>Maximum design scenario total habitat loss/ change = 3,699,466m²</p>	<p>Cable protection (based on maximum design scenario of rock berm) may be required in the unlikely event that cables cannot be buried (based on 10% of the length), in addition to this, cable replenishment may also be required (based on 25% of the cable protection area) resulting in a footprint of 1,887,500 m² (based on a post lay protection width of 10.4 m). The maximum area of cable protection deployed will result in the greatest area of habitat loss.</p>
49	Temporary localised increases in SSC and smothering	Fish and Shellfish Ecology	<p>Array and Interconnector Remedial Cable Burial:</p> <ul style="list-style-type: none"> • 2000 m per replacement • 10 m wide corridor • 49 km total lifetime replacement 	<p>The worst case impacts from remedial cable burial and cable repairs of array, interconnector and export cables result from the use of MFE. This assumes the</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
			<ul style="list-style-type: none"> Maximum volume of sediment from cable reburial over lifetime: 294,000 m³ <p>Array and Interconnector Cables Repairs:</p> <ul style="list-style-type: none"> 20,000 m² per repair event 15 repair events over lifetime 3 m burial depth Maximum volume of sediment from cable repairs over lifetime: 900,000 m³ <p>Export Cables Remedial Cable Reburial:</p> <ul style="list-style-type: none"> 2000 m per replacement 10 m corridor 14 km replacement over lifetime Maximum volume of sediment from cable reburial over lifetime: 88,624 m³ <p>Export Cable Repairs:</p> <ul style="list-style-type: none"> 20,000 m² per event 35 repair events over lifetime 3 m burial depth Maximum volume of sediment from cable repairs over lifetime: 2,100,000 m³ <p>Total: 3,382,624 m³ (volume of sediment from cable replacement and reburial in the array and offshore area)</p>	largest number of cables, repair events, the greatest burial depth and greatest length/area of maintenance. This results in the worst case sediment volume disturbance of 3,382,624 m ³ .
50	Increased hard substrate and structural complexity as a result of	Fish and Shellfish Ecology	<p>Total Introduced Hard Substrate: 3,699,466 m²</p>	Cable protection (based on worst case scenario of rock berm) may be required in the unlikely event that cables cannot be

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
	the introduction of turbine foundations, scour protection and cable protection.			buried (based on 10% of the length) in addition to this, cable replenishment may also be required (based on 25% of the cable protection area) resulting in a footprint of 1,887,500 m ² (based on a post lay protection width of 10.4 m). The maximum area of cable protection deployed will result in the greatest area of habitat loss.
51	Underwater noise as a result of operational turbines.	Fish and Shellfish Ecology	180 operational wind turbines.	This results in the maximum potential for noise disturbance on fish and shellfish receptors during the operation and maintenance phase.
52	Potentially reduced fishing pressure within the Hornsea Four array area and increases fishing pressure outside the array area due to displacement	Fish and Shellfish Ecology	<p>Project Design Life:</p> <ul style="list-style-type: none"> 35 years <p>Safety Zones:</p> <ul style="list-style-type: none"> 500 m safety zone around infrastructure (construction and decommissioning) 50 m safety zone around incomplete structures (construction and decommissioning) 500 m safety zone around manned infrastructures (operation and maintenance) 500 m safety zone around infrastructure undergoing major maintenance (operation and maintenance). <p>Total Reduced Area: 662,240 m²</p>	Assessment assumes that fisheries will not be excluded from the Hornsea Four proposed development area, however, due to logistical constraints, fishing pressure may be reduced.

Decommissioning

Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
53	Temporary habitat disturbance from decommissioning of foundation substructures and cables	Benthic Subtidal and Intertidal Ecology	Foundations: <ul style="list-style-type: none"> Total disturbance from removal of all foundations = 1.93 km² Cables: <ul style="list-style-type: none"> Total disturbance from removal of all cables = 102.6 km² <p>Although it is expected that most array and export cables will be left in situ, it has been assumed that all cables will be removed during decommissioning, though any cable protection installed will be left in situ.</p>	<p>Maximum design scenario is assumed to be as per the construction phase, with all infrastructure removed in reverse-construction order.</p> <p>The removal of cables is considered a worst-case, however the necessity to remove cables will be reviewed at the time of decommissioning.</p>
54	Increased SSC and sediment deposition from removal of foundations and cables.	Benthic Subtidal and Intertidal Ecology	This impact is a subset of MP-C-2 for structures that are removed from the seabed. The impacts are expected to be equivalent to MP-C-2 apart from the structures that may remain. E.G. cables to be removed but not cable protection measures.	As above
55	Loss of introduced habitat from the removal of foundations.	Benthic Subtidal and Intertidal Ecology	MDS based on the removal of all foundations = 1.67 km ²	Defined by the maximum surface area introduced as above. Some materials may be left in situ and this will be reviewed closer to the time of decommissioning.
56	PTS and TTS from underwater noise	Marine Mammals	Maximum levels of underwater noise during decommissioning would be from underwater cutting required to remove structures. This is much less than pile driving and therefore impacts would be less than as assessed during the construction phase/ Piled foundations would likely be cut approximately 1 m below the seabed.	
57	Disturbance from underwater noise	Marine Mammals	As per PTS from underwater noise.	
58	Vessel collision risk	Marine Mammals	Assumed to be similar vessel types, numbers and movements to construction phase (or less).	
59	Disturbance from vessels	Marine Mammals	As per vessel collision risk.	
60	Reduction in prey availability	Marine Mammals	Dependant on results of Volume 2, Chapter 3: Fish and Shellfish Ecology .	
61	Reduction in foraging ability	Marine Mammals	Maximum amount of suspended sediment released during decommissioning activities and associated duration - see Volume 2, Chapter 1: Marine Geology, Oceanography and Physical Processes .	

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
62	Demolition activities associated with foundations and WTGs may lead to disturbance and displacement of species within the array area and different degrees of buffers surrounding it.	Offshore and Intertidal Ornithology	<u>Impacts assumed as per construction (or less):</u> - 3,525 return vessel visits per year - 2,580 return visits to wind turbines per year - 780 return visits to wind turbine foundations per year - 65 return visits to offshore platforms (structural scope) per year - 100 return visits to offshore platforms (electrical scope) per year - Vessels include: CTVs, SOVs, supply vessels, cable and remedial protection vessels and JUVs	Maximum estimated number of vessel movements would cause greatest displacement to birds on site.
63	Indirect impacts during the decommissioning phase within the offshore export cable corridor and landfall through effects on habitats and prey species.	Offshore and Intertidal Ornithology	See MDS for Fish and Shellfish Ecology assessment (Volume 2, Chapter 3: Fish and Shellfish Ecology).	As per justification in Volume 2, Chapter 3: Fish and Shellfish Ecology .
64	Impacts on protected species: Decommissioning of the onshore substation could lead to temporary disturbance or displacement of protected species	Ecology and Nature Conservation	The OnSS above ground electrical equipment and infrastructure will be removed, along with building foundations and security fencing. The site will be returned to its previous condition.	The parameters selected set out the worst case spatial and temporal envelope for ground disturbance during decommissioning of the OnSS.
65	Impacts on habitats or species: Decommissioning of the onshore substation could lead to damage	Ecology and Nature Conservation	The OnSS above ground electrical equipment and infrastructure will be removed, along with building foundations and security fencing. The site will be returned to its previous condition.	The parameters selected set out the worst case spatial and temporal envelope for ground disturbance during decommissioning of the OnSS.

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
	to habitats or species from accidental release of pollutants			
66	Impacts on protected species: Decommissioning of the onshore substation could lead to temporary disturbance or displacement of protected species	Ecology and Nature Conservation	The OnSS above ground electrical equipment and infrastructure will be removed, along with building foundations and security fencing. The site will be returned to its previous condition.	The parameters selected set out the worst case spatial and temporal envelope for ground disturbance during decommissioning of the OnSS.
67	Temporary localised increases in SSC and smothering.	Fish and Shellfish Ecology	MDS is identical (or less) to that of the construction phase.	<p>WTGs will be removed by reversing the methods used to install them. Pile foundations will likely be cut approximately 1m below the seabed. The area of seabed impacted during the removal of the WTGs would be the same as the area impacted during installation. The OSSs will likely be a reverse installation. The area of the seabed disturbed by decommissioning activities will be the same as the area impacted during installation. If piled foundations are used, they will likely be cut approximately 1 m below the seabed.</p> <p>It is likely that equipment similar to that which is used to install the cables could be used to reverse the burial process and expose them. Therefore, the area of seabed impacted during the removal of the</p>

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Reference	Project Parameter	Receptor Group	Maximum design scenario assessed	Justification
				cables could be the same as the area impacted during the installation of the cables. Any scour protection will be left in situ.
68	Direct and indirect seabed disturbances leading to the release of sediment contaminants	Fish and Shellfish Ecology	Maximum design scenario is identical (or less) to that of the construction phase.	See row above.
69	Mortality, injury, behavioural changes and auditory masking arising from noise and vibration.	Fish and Shellfish Ecology	Maximum levels of underwater noise during decommissioning would be from underwater cutting required to remove structures. This is much less than pile driving and therefore impacts would be less than as assessed during the construction phase/ piled foundations would likely be cut approximately 1 m below the seabed.	This would result in the maximum potential disturbance associated with noise associated with decommissioning activities including foundation decommissioning.