Outer Dowsing Offshore Wind

Habitat Regulations Assessment – Report to Inform Appropriate Assessment

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OUTER DOWSING OFFSHORE WIND

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Abbreviations

Acronym	Expanded name
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AEoI	Adverse Effect on Integrity
AIL	Abnormal Indivisible Loads
AOE	Alde Ore Estuary
AOWFL	Aberdeen Offshore Windfarm Limited
AQMP	Air Quality Management Plan
BAEF	Boston Alternative Energy Facility
BDMPS	Biologically Defined Minimum Population Scales
BEIS	Department for Business, Energy & Industrial Strategy (now the Department for Energy Security and Net Zero (DESNZ))
BERR	Business, Enterprise and Regulatory Reform
BLP	Brink Linked Platform
BND	Bottlenose Dolphin
BTO	British Trust for Ornithology
CBRA	Cable Burial Risk Assessment
CCS	Carbon Capture and Storage
CCW	Countryside Council for Wales
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CI	Confidence Interval
CMS	Construction Method Statement
CPS	Counterfactual of Population Size
CRM	Collision Risk Modelling
cSAC	candidate Special Area of Conservation
CSIP	Cetacean Strandings Investigation Programme
DBS	Dogger Bank South
DCO	Development Consent Order
DECC	Department of Energy & Climate Change, now the Department for Energy Security and Net Zero (DESNZ)
Defra	Department for Environment, Food and Rural Affairs (Defra, not DEFRA)
DEP	Dudgeon Extension Project
DESNZ	Department for Energy Security and Net Zero, formerly Department of Business, Energy and Industrial Strategy (BEIS), which was previously Department of Energy & Climate Change (DECC)
DML	Deemed Marine Licence
DP	Decommissioning Programme
EC	European Commission
ECC	Export Cable Corridor
ECJ	European Court of Justice
EDR	Effective Deterrent Radius

Acronym	Expanded name
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Frequency
EMS	Ecological Method Statement
EOWDC	European Offshore Wind Development Centre
EPP	Evidence Plan Process
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
FCS	Favourable Conservation Status
FFC	Flamborough and Filey Coast
GBS	Gravity Base Structure
GS	Grey Seal
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (a wholly owned Green Investment Group portfolio company), Gulf Energy Development and TotalEnergies
HP	Harbour Porpoise
HRA	Habitat Regulations Assessment
HS	Harbour Seal
HVAC	High Voltage Alternating Current
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Committee on the Exploration of the Sea
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
LWT	Lincolnshire Wildlife Trust
MarESA	Marine Evidence based Sensitivity Assessment
MDS	Maximum Design Scenario
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
ML	Marine Licence
MLA	Marine Licence Application
MLWS	Mean Low Water Springs
MMF	Mean-Max Foraging
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Organisation
MPCP	Marine Pollution Contingency Plan
MSL	Mean Seal Level
MU	Management Unit
MWH	Minke Whale
NE	Natural England

Acronym	Expanded name
NPS	Natural Policy Statement
NRMM	Non-Road Mobile Machinery
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind
OFTO	Offshore Transmission Owner
OP	Offshore Platform
ORCP	Offshore Reactive Compensation Platform
ORJIP	Offshore Renewables Joint Industry Programme
OSS	Offshore Substation
OWEZ	Offshore Windpark Egmond aan Zee
OWF	Offshore Windfarm
PCH	Proportion at Collision Height
PCW	Phocid Carnivores in Water
PDV	Phocine distemper virus
PEIR	Preliminary Environmental Impact Report
PEMP	Project Environmental Management Plan
PINS	Planning Inspectorate
PPEIRP	Pollution Prevention and Emergency Incident Response Plan
pSPA	potential Special Protected Area
PTS	Permanent Threshold Shift
PVA	Population Viability Analysis
RBBP	Rare Breeding Birds Panel
RIAA	Report to Inform Appropriate Assessment
RLB	Red Line Boundary
RMS	Root-Mean-Square
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SACO	Supplementary Advice on Conservation Objectives
SCI	Sites of Community Importance
SCOS	Special Community on Seals
SD	Standard Deviation
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SEP	Sheringham Extension Project
SIP	Site Integrity Plan
SMP	Seabird Monitoring Programme
SMRU	Sea Mammal Research Unit
SMRUC	Sea Mammal Research Unit Consulting
SNCB	Statutory Nature Conservation Body
SNS	Southern North Sea
SOSS	Strategic Ornithological Support Service
SOW	Sofia Offshore Wind
SPA	Special Protection Area

Acronym	Expanded name
SPL	Sound Pressure Level
SPMP	Scour Protection Management Plan
SSC	Suspended Sediment Concentration
SSS	Side Scan Sonar
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
TJB	Transition Joint Bay
TTS	Temporary Threshold Shift
UK	United Kingdom
UXO	Unexploded Ordnance
VHF	Very High Frequency
VMP	Vessel Management Plan
WD	White Beaked Dolphin
WTG	Wind Turbine Generator
WWT	Wildfowl and Wetland Trust
ZoI	Zone of Influence

Terminology

Term	Definition
Array area	The area offshore within the PEIR Boundary within which the generating stations (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling are positioned.
Baseline	The status of the environment at the time of assessment without the development in place.
Biodiversity Net Gain	An approach to development that leaves biodiversity in a measurably improved state than it was previously. Where a development has an impact on biodiversity, developers are encouraged to provide an increase in appropriate natural habitat and ecological features over and above that being affected, to ensure that the current loss of biodiversity through development will be halted and ecological networks can be restored.
Compensatory Measures	Stage 3 of the Habitats Regulations Assessments (see Derogation) involves the development of compensation measures for any features which the report to inform appropriate assessment was unable to conclude no adverse effect on integrity on.
Cumulative effects	The combined effect of the Project acting cumulatively with the effects of a number of different projects, on the same single receptor/resource.
Cumulative impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.

Term	Definition
deemed Marine Licence (dML)	A licence administered under the Marine and Coastal Access Act 2009. The licence set out within a Schedule within the Development Consent Order (DCO).
Derogation	Stage 3 of the Habitats Regulations Assessments which is triggered once it is determined that you cannot avoid adversely affecting the integrity of a designated site. Involves assessing if alternative solutions are available to achieve the same goals as the project, if there are imperative reasons of overriding public interest, and if compensatory measures will be required.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Department for Energy Security and Net Zero (DESNZ).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of an impact with the sensitivity of a receptor, in accordance with defined significance criteria.
EIA Directive	European Union 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU)
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment (EIA) Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the Environmental Impact Assessment (EIA).
Habitats Regulations Assessment (HRA)	Habitats Regulations Assessment. A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts 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) and compensatory measures.
Haul Road	The track within the onshore ECC which the construction traffic would use to facilitate construction.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.

Term	Definition
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Indicative Working Width	The indicative working width within the Export Cable Corridor (ECC), required for the construction of the onshore cable route.
Inter-array cables	Cable which connects the wind turbines to each other and to the offshore substation(s).
Intertidal	Area where the ocean meets the land between high and low tides.
Joint bays	A joint bay provides a secure environment for the assembly of cable joints as well as bonding and earthing leads. A joint bay is installed between each length of cable.
Landfall	The location at the land-sea interface where the offshore export cable will come ashore.
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing electrical earthing links.
Maximum Design Scenario	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Mitigation	Mitigation measures, or commitments, are commitments made by the Project to reduce and/or eliminate the potential for significant effects to arise as a result of the Project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects.
National Grid's OnSS	Onshore substation which is owned and operated by National Grid.
National Policy Statement (NPS)	A document setting out national policy against which proposals for Nationally Significant Infrastructure Projects (NSIPs) will be assessed and decided upon.
Non-statutory consultee	Organisations that the Applicant may be required to (under Section 42 of the 2008 Act) or may otherwise choose to engage during the pre-application phases (if, for example, there are planning policy reasons to do so) who are not designated in law but are likely to have an interest in a proposed development.
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the Preliminary Environmental Information Report (PEIR) Boundary within which the export cable running from the array to landfall will be situated.
Offshore Reactive Compensation Station (ORCP)	Platforms located outside the array area which house electrical equipment and control and instrumentation systems. They also provide access facilities for work boats.
Offshore Substation (OSS)	Platforms located within the array area which house electrical equipment and control and instrumentation systems. They also provide access facilities for work boats and helicopters.

Term	Definition
Onshore Export Cable Corridor (ECC)	The Onshore Export Cable Corridor (Onshore ECC) is the area within which the export cable running from the landfall to the onshore substation will be situated.
Onshore Infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection.
Onshore substation (OnSS)	The Project's onshore substation, containing electrical equipment to enable connection to the National Grid
Outer Dowsing Offshore Wind (ODOW)	The Project.
PEIR Boundary	The PEIR Boundary is outlined in Figure 3.1 of Volume 1, Chapter 3: Project Description and comprises the extent of the land and/or seabed for which the PEIR assessments are based upon.
Pre-construction and post-construction	The phases of the Project before and after construction takes place.
Preliminary Environmental Information Report (PEIR)	The PEIR is written in the style of a draft Environmental Statement (ES) and provides information to support and inform the statutory consultation process in the pre-application phase. Following that consultation, the PEIR documentation will be updated to produce the Project's ES that will accompany the application for the Development Consent Order (DCO).
Project Design envelope	A description of the range of possible elements that make up the Project's design options under consideration, as set out in detail in the project description. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Project Design envelope	A description of the range of possible elements that make up the Project's design options under consideration, as set out in detail in the project description. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
Statutory consultee	Organisations that are required to be consulted by the Applicant, the Local Planning Authorities and/or The Inspectorate during the pre-application and/or examination phases, and who also have a statutory responsibility in some form that may be relevant to the

Term	Definition
	Project and the DCO application. This includes those bodies and interests prescribed under Section 42 of the Planning Act 2008.
study area	Area(s) within which environmental impact may occur – to be defined on a receptor-by-receptor basis by the relevant technical specialist.
Subsea	Subsea comprises everything existing or occurring below the surface of the sea.
The Applicant	GT R4 Ltd. The Applicant making the application for a DCO. The Applicant is GT R4 Limited (a joint venture between Corio Generation, TotalEnergies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company), TotalEnergies and GULF.
The Planning Inspectorate	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
The Project	Outer Dowsing Offshore Wind including proposed onshore and offshore infrastructure
Transboundary impacts	Transboundary effects arise when impacts from the development within one European Economic Area (EEA) state affects the environment of another EEA state(s)
Transition Joint Bay (TJBs)	The offshore and onshore cable circuits are jointed on the landward side of the sea defences/beach in a Transition Joint Bay (TJB). The TJB is an underground chamber constructed of reinforced concrete which provides a secure and stable environment for the cable.
Trenched technique	Trenching is a construction excavation technique that involves digging a narrow trench in the ground for the installation, maintenance, or inspection of pipelines, conduits, or cables.
Trenchless technique	Trenchless technology is an underground construction method of installing, repairing and renewing underground pipes, ducts and cables using techniques which minimize or eliminate the need for excavation. Trenchless technologies involve methods of new pipe installation with minimum surface and environmental disruptions. These techniques may include Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.
Wind turbine generator (WTG)	All the components of a wind turbine, including the tower, nacelle, and rotor.

1 Introduction

1.1 Background to the Project

1.1.1 This document comprises the draft Report to Inform Appropriate Assessment (RIAA) for Outer Dowsing Offshore Wind (hereafter 'the Project'). GTR4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop the Project. The Project will be located approximately 54km from the Lincolnshire coastline in the southern North Sea (Figure 1.1). The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, and connection to the electricity transmission network (see Volume 1, Chapter 3: Project Description for full details).

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N
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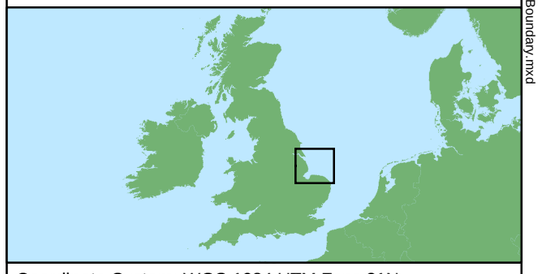
Cottingham
Kingston upon Hull
Hedon
Withernsea
Immingham
Cleethorpes
Market Rasen
Louth
Mablethorpe
Wragby
Horncastle
Woodhall Spa
Spilsby
Skegness
Wainfleet All Saints
Heckington
Boston
The Wash
Hunstanton
Wells-Next-The-Sea
Sheringham
Holt
Fakenham
North Walsham
Aylsham
Reepham
Stalham
Holbeach
Spalding
Long Sutton
King's Lynn
Market Deeping
Crowland
Wisbech
Dereham

Legend

- Onshore and Offshore PEIR Boundary
- Array Boundary
- Offshore Export Cable Corridor
- Onshore ECC Corridor and Substations
- ORCP Search Area
- Artificial Nesting Structure Search Area
- Biogenic Reef Restoration Search Area



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:500,000

Offshore and Onshore PEIR Boundary

Figure 1.1

OUTER DOWSING OFFSHORE WIND

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1.2 Purpose of the RIAA

RIAA Context

1.2.1 The European Commission's guidance on the assessment of plans and projects significantly affecting designated sites, identifies a staged process to the assessment (Section 3.6). Together, these stages are referred to as the Habitats Regulations Assessment (HRA), with this report being of particular relevance to Stage 2 by providing relevant information for the Competent Authority (in this case the SoS for DESNZ) to undertake their 'Appropriate Assessment' (AA).

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

1.2.3 The above Directives were transposed into UK legislation through a series of Regulations. 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. Waters beyond 12nm, to the extent of the British Fishery Limits and UK Continental Shelf Designated Area, are covered under The Conservation of Offshore Marine Habitats and Species Regulations 2017. Collectively, these two sets of regulations are referred to herein 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. For additional context on the legislative context behind this assessment see Section 3.

Purpose of this Document

1.2.4 This document has been produced as part of the overall HRA process for the Project and draws on the Screening Report (Outer Dowsing Offshore Wind, 2022). Screening was originally undertaken in 2022, and issued to consultees in August 2022, to accompany the Project's Scoping Report. A summary of the consultation process to date (including post-screening) with detail on comments received and how/where these are addressed provided in Section 6 of this report.

1.2.5 This document summarises the conclusions on the potential for a Likely Significant Effect (LSE), as drawn in the Screening Report and cognisant of consultee comments, with respect to the conservation objectives of the screened in European and Ramsar sites and applies these where the potential for an LSE cannot be ruled out to determine the potential for an Adverse Effect on Integrity (AEoI) alone and/or in-combination. It is the information on the potential for an AEoI that is required by the competent authority (in this case the Secretary of State (SoS) for Department for Energy Security and Net Zero (DESNZ), although all potential LSE, have been addressed in order to undertake the AA (hence the document title 'Report to Inform Appropriate Assessment', or RIAA, applied here).

1.2.6 The purpose of the RIAA that will ultimately be submitted as part of the DCO application is to provide the information to the Competent Authority (in this case the SoS for DESNZ), in consultation with the relevant SNCBs (including Natural England and JNCC), required to enable them to undertake the AA.

1.3 Project Literature

1.3.1 This draft RIAA follows a suite of documents prepared as part of the PEIR and that will be subsequently updated to be issued as part of the DCO Application. Key documents issued as part of the PEIR and in support of the statutory consultation process include technical reports (both for site-specific surveys but also modelling and desk-based studies), with many of these being the key source documents for the information presented herein. 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:

- Part 6, Volume 1 (Chapters):
  - Chapter 1: Introduction;
  - Chapter 2: Need, Policy and Legislative Context;
  - Chapter 3: Project Description;
  - Chapter 4: Site Selection and Consideration of Alternatives;
  - Chapter 7: Marine Processes;
  - Chapter 9: Benthic and Intertidal Ecology;
  - Chapter 10: Fish and Shellfish Ecology;
  - Chapter 11: Marine Mammals;
  - Chapter 12: Offshore and Intertidal Ornithology;
  - Chapter 19: Onshore Air Quality;
  - Chapter 21: Onshore Ecology;
  - Chapter 22: Offshore Ornithology; and
  - Chapter 26: Noise and Vibration.
- Part 6, Volume 2 (Appendices):

- Appendix 3.2: Underwater Noise Assessment;
- Appendix 4.1: Landfall Assessment & Offshore ECC Route Optioneering;
- Appendix 7.1: Physical Processes Technical Baseline;
- Appendix 7.2: Physical Processes Modelling Report;
- Appendix 9.1: Benthic Ecology Technical Report (Array);
- Appendix 9.2: Benthic Ecology Technical Report (Export Cable Corridor);
- Appendix 9.3: Intertidal Technical Report;
- Appendix 10.1: Fish and Shellfish Ecology Technical Baseline;
- Appendix 11.1: Marine Mammals Technical Baseline;
- Appendix 12.1: Ornithology Technical Baseline;
- Appendix 12.2: Collision Risk Modelling Assessment Annex;
- Appendix 12.3: Displacement Assessment Annex;
- Appendix 22.1: Ornithology Desk Study;
- Appendix 22.2: Ornithology Desk Study Confidential Annex;
- Appendix 22.3: Winter 2022-23 Bird Survey Report; and
- Appendix 22.4: Bird Species List.

1.3.2 It is noted in Advice Note 10 (the Inspectorate, 2022) that the EIA and HRA apply differently to decision making, with the ES that will be provided as part of the DCO application informing the decision (its findings must be taken into consideration) whereas the DCO can only be granted if the decision-maker has followed the stages prescribed by the 2017 Habitats Regulations. Therefore, the information contained in the above chapters and documents has been used to inform the assessments undertaken here in the draft RIAA, but with the draft RIAA following the prescribed stages and with the distinct legal and evidentiary requirements of the Habitats Regulations firmly in mind.

1.4 Implications of Previous OWF Decisions

1.4.1 Other OWF projects have previously been consented despite having conclusions of AEoI, when factoring the provision of ecological compensation under the derogation process. The first OWF project in the UK whose HRA required progression beyond 'Stage 2' was Hornsea Three, and it was granted development consent on the 31st December 2020[1]. The AEoI identified from Hornsea Three was on kittiwake at the Flamborough and Filey Coast SPA in-combination with other plans and projects, and sandbanks for the North Norfolk Sandbanks and Saturn Reef SAC and The Wash and North Norfolk Coast SAC both alone and in-combination with other plans and projects. Hornsea Three was consented under the provision that adequate compensation would be provided for the features with a conclusion of AEoI, as stated in paragraph 6.60 of the Hornsea Three SoS decision letter:

'Given the updated compensation measures for kittiwake provided by the Applicant and the sandbank compensation measures outlined above, the Secretary of State is confident that adequate compensation is proposed and will be in place to offset any impacts to features of Natura 2000 sites from the Development.'

1.4.2 Subsequent to the Hornsea Three decision, several other projects have been consented with similar compensation requirements for ornithology (as a result of in-combination collision mortalities) and subtidal sandbank habitats (as a result of Project alone and in-combination permanent loss associated with cable protection), including Norfolk Boreas and Norfolk Vanguard. These projects were given development consent on the 10th December 2021[2] and the 11th February 2022[3] respectively. The AEoI identified for both projects was for lesser black-backed gulls at the Alde-Ore Estuary SPA/Ramsar in-combination, kittiwake at the Flamborough and Filey Coast SPA in-combination, and Annex 1 reef and sandbank features of the Haisborough, Hammond and Winterton SAC from the Development alone and in-combination. As for Hornsea Three, Norfolk Boreas and Norfolk Vanguard were consented under the provision that adequate compensation would be provided for the features with a conclusion of AEoI. This is stated in paragraph 5.56 of the Norfolk Boreas SoS Decision letter:

'Having considered the additional information presented post-examination, the Secretary of State is able to conclude that appropriate compensation measures can be secured and delivered through the DCO as set out in Schedule 19 and that the requirements of the derogation provisions under the Habitats Regulations and Offshore Habitats Regulations have been met.'

1.4.3 This is also stated in paragraph 5.55 of the Norfolk Vanguard SoS Decision letter:

'Having considered the additional information presented to him, the Secretary of State is able to conclude that appropriate compensation measures can be secured and delivered

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003265-EN010080%20Hornsea%20Three%20-%20Secretary%20of%20State%20Decision%20Letter.pdf

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-002917-NORB-Boreas-Decision-Letter.pdf

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-004458-NORV-SoS-decision-letter.pdf

through the DCO as set out in Schedule 17 and that the requirements of the derogation provisions under the Habitats Regulations and Offshore Habitats Regulations have been met.'

1.4.4 The projects were both consented after the SoS was content that there were no alternative solutions and there was an imperative need of overriding public interest (IROPI), with the development of compensatory measures for those features identified above.

1.4.5 Additionally, the Round 4 Plan HRA undertaken by The Crown Estate (TCE) concluded an AEoI for kittiwake for the Flamborough and Filey Coast SPA (specifically for collision risk in-combination with other plans and projects). This therefore informs the need for compensation to be undertaken for the species at a Round 4 Plan level, which is the first instance of this happening within the UK. As part of the derogation for the TCE Round 4 Plan level HRA, a Kittiwake Strategic Compensation Plan Steering Group was established to develop adequate compensation measures for kittiwake predicted to be impacted by Round 4 projects. The Project are currently engaging in the steering group to ensure adequate compensation measures are considered for the Project, as required by the Agreement for Lease.

Application of a "Without Prejudice" Derogation Case

1.4.6 As a consequence of ongoing consultation with a range of statutory nature conservation bodies highlighting the potential for AEoI arising from the Project (see Section 5), a series of documents will be drafted, containing the necessary information (draft case presented "without prejudice") to inform the SoS's derogation process under the Habitat Regulations. This series of documents, to be submitted as part of the DCO application, does not form part of the draft RIAA and instead informs the next stage of the HRA process (i.e., HRA Stage 3: Derogation, should that stage be triggered) as referenced in Section 3.6.

2 Structure of the Draft RIAA

2.1.1 This document is set out in a number of stages that mirror the prescribed HRA process, with the overall structure of the document summarised below:

- 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 draft 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 ES, providing the maximum design scenario (MDS) for each receptor group including temporal and spatial aspects;
- Section 7: Mitigation. To include Project specific mitigation included per receptor group;
- Section 8: HRA Screening. Summarising the conclusions on screening;
- Section 9: Summary of Designated Sites. Summarising site-specific information for all designated sites screened in;
- Section 10: Assessment of Adverse Effect Alone. Determination of whether the Project alone will result in an adverse effect;
- Section 11: 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 12: Transboundary Statement;
- Section 13: Conclusion of the Assessment. Summarising the conclusions on adverse effect, alone and/or in-combination; and
- Section 14: References.

3 Legislation, Policy and Guidance

3.1 Legislative Context and Government Policy

3.1.1 In addition to the Habitats Regulations discussed in Section 1.2, UK Government policy (Office of the Deputy Prime Minister (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 possible SACs (cSACs) and to sites identified, or required, as compensatory measures for adverse effects on any of the above sites, through planning policy such as the National Planning Policy Framework.

3.1.2 Further guidance can be found within the UK National Policy Statements (NPSs). These are statements produced by DESNZ which, amongst other things, set out certain policies relating to the mitigation of, and adaption to, climate change. There are six Energy NSPs in total however those of relevance to the Project are:

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

3.1.3 These NPSs have been reviewed by the UK government and draft versions of the updated documents are available at the time of writing. These are:

- Draft Overarching NPS for Energy (EN-) (DESNZ, 2023a);
- Draft NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023b); and
- Draft NPS Electricity Networks Infrastructure (EN-5) (DESNZ, 2023c).

3.1.4 Of particular note is EN-3 (DESNZ, 2023b), as it relates directly to the development and implementation of renewable energy (including offshore wind developments).

3.2 EU-Exit Regulations

3.2.1 The UK left the European Union (Brexit) on Exit Day, 31st January 2020, followed by Completion Day on 31st December 2020. The EU Exit Regulations (2019) establish any EU Exit-related changes to the Habitats Regulations (2017), with these considered to have no material implications on the requirement or process for a HRA of the Project.

3.2.2 After Brexit, UK sites designated under the Habitats Regulations became part of the National Site Network (as defined in the interpretation sections of the Habitat Regulations (2017)), with a focus on maintaining ecological coherence throughout the UK. As this RIAA assesses both National Site Network sites and European Natura 2000 sites, where appropriate they will be referred to together as designated sites.

3.3 Energy Security Bill Policy Statement

3.3.1 The Energy Security Bill Policy Statement Offshore Wind Environmental Improvement Package Measure (the Policy Statement) includes proposals on possible changes to the HRA process which have been introduced to the Energy Bill through a number of the amendments to the Bill discussed below. The Energy Bill was introduced into Parliament on 6 July 2022, with 8 additional amendments made to the Bill on the 9th of January 2023. The Energy Bill builds on the commitments in the British Energy Security Strategy to invest in homegrown energy and maintain the diversity and resilience of the United Kingdom's energy supply while working towards net zero by 2050. The British Energy Security Strategy, published in April 2022, builds on this success and sets out an increased ambition for up to 50 gigawatts (GW) of offshore wind, including up to 5GW of floating wind, by 2030. The British Energy Security Strategy outlined a series of measures which collectively will accelerate deployment whilst protecting the marine environment. These include:

- Establishing a fast-track consenting route to reduce the offshore wind consent time from up to four years down to one year for priority cases where quality standards are met.
- Strengthening the National Policy Statement for Renewable Energy to reflect the importance of energy security and net zero.
- Developing an Offshore Wind Environmental Improvement Package to address the impacts of offshore wind infrastructure in the marine environment. The package will speed up the consenting process whilst protecting the environment, and will include measures to:
    - deliver Offshore Wind Environmental Standards (previously called nature-based design standards in the British Energy Security Strategy);
    - develop regulations and guidance to streamline the Habitats Regulations Assessment and Marine Conservation Zone assessment process for offshore wind projects;
    - deliver environmental compensatory measures across one or more offshore wind projects to compensate for adverse environmental effects on protected sites that cannot be otherwise avoided, reduced or mitigated;
    - implement a Marine Recovery Fund; and
    - introduce strategic monitoring to improve our understanding of the marine environment and the measures needed to further protect it.

3.3.2 Of the five measures in the Policy Statement, three require primary legislation which were introduced through Government amendments to the Energy Bill at the House of Lords Committee Stage. These are to enable:

- making of regulations about the assessment of the environmental effects on protected sites of offshore wind developments' marine infrastructure, and about compensatory measures for adverse environmental effects;
- strategic compensatory measures to be taken or secured; and

- making regulations to introduce one or more Marine Recovery Funds, and to allow for delegation of the operation and management of the Funds to other bodies.

3.3.3 These powers will enable improved assessment of the environmental effects of offshore wind developments' marine infrastructure on protected sites, and earlier assessment to allow adequate time to resolve discrepancies in evidence and data. Where compensatory measures are required for damage to the national site network or a protected marine area, these amendments will allow compensation to be delivered by developers working together if that is more appropriate through "strategic compensation".

3.4 Case Law and Recent Examples

3.4.1 Specific case law of note includes the following recent rulings by the European Court of Justice (ECJ):

- Case C-323/17 People Over Wind and Peter Sweetman v Coillte Teoranta and Case C-164/17 Edel Grace and Peter Sweetman v An Bord Pleanála; (referred to together hereafter as "People over Wind"); and
- Case C-461/17 Holohan v An Bord Pleanála (referred to hereafter as "Holohan").

3.4.2 The People over Wind rulings relate to how screening for potential 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 of these rulings have been taken into consideration during preparation of the HRA Screening Report and the draft RIAA.

3.4.3 Additionally, recent consents awarded to offshore wind projects have included decisions of relevance to the Project (See Section 1.4).

3.5 Guidance Documents

3.5.1 Several 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 range of HRA guidance has been used in drafting and therefore is considered relevant to the current draft RIAA. This includes documents specific to individual topics (and that may be applied to technical reports and/or PEIR chapters that underpin the draft RIAA) up to and including documents that advise on overall HRA process. Some of the key guidance documents considered are listed below:

- Department of Energy and Climate Change (DECC) (2021). Changes to the Habitats Regulations 2017;
- Department of Communities and Local Government (2006). Guidance on 'Planning for the Protection of European Sites: Appropriate Assessment';

- Department of Energy and Climate Change (DECC) (2015). Guidelines on the Assessment of Transboundary Impacts of Energy Developments on Natura 2000 Sites Outside the UK;
- English Nature (1997). Habitats Regulations Guidance Note (HRGN 1): The Appropriate Assessment (Regulation 48) The Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature (1999): Habitats Regulations Guidance Note (HRGN 3): The Determination of Likely Significant Effect under the Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature (2001): Habitats Regulations Guidance Note (HRGN 4): Alone or in combination;
- European Commission (2001). Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites;
- European Commission (2001). Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- European Commission (2011). Guidance Document on Wind Energy Developments and Natura 2000;
- European Commission (2018). Managing Natura 2000 sites. The Provisions of Article 6 of the 'Habitats' Directive 92/43/EEC;
- European Commission (2020). Guidance Document on Wind Energy Developments and EU Nature Legislation;
- Joint Nature Conservation Committee (JNCC) (2010). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise;
- JNCC (2017). Guidelines for minimising the risk of injury to marine mammals from geophysical surveys;
- JNCC (2010). Guidelines for minimising the risk of injury to marine mammals from using explosives;
- Ministry of Housing, Communities and Local Government (MHCLG) (2019). Guidance on the Use of Habitats Regulations Assessment;
- Natural England and JNCC (2013). Interim Advice on HRA Screening for Seabirds in the Non-Breeding Season;
- Natural England and JNCC (2017). Joint Statutory Nature Conservation Bodies (SNCB) Interim Displacement Advice Note - Advice on How to Present Assessment Information on the Extent and Potential Consequences of Seabird Displacement from Offshore Windfarm Developments;
- 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;

- PINS (2019). Advice Note 17: Cumulative Effects Assessment Relevant to Nationally Significant Infrastructure Projects;
- PINS (2022). Advice Note 10: Habitat Regulations Assessment Relevant to Nationally Significant Infrastructure Projects.

3.6 The HRA Process

3.6.1 The Habitats Regulations require that whenever a project that is not directly connected to, or necessary for the management of a site within the National Site Network, is likely to have a significant effect on the site (directly, indirectly, alone and/or in-combination with other plans or projects), then an AA must be undertaken by the Competent Authority (Regulation 63 of the Habitats Regulations and Regulation 28 of the Offshore Habitats Regulations). The AA must be carried out before consent or authorisation can be given for the Project.

3.6.2 The Inspectorate Advice Note 10 (the Inspectorate, 2022) 'Habitats Regulations Assessment relevant to nationally significant infrastructure projects' (Version 9, August 2022), defines HRA as a step-by-step process which determines potential LSE and (where appropriate) assesses adverse impacts on the integrity of a designated site, examines alternative solutions, and provides justification of IROPI. Once IROPI is established, then compensatory measures can be developed. HRA includes a three-stage process, as summarised below and illustrated in:

- **HRA Stage 1 – Screening:** Screening for potential LSE (alone and/or in-combination with other projects or plans);
- **HRA Stage 2 – Appropriate Assessment:** Assessment of implications of identified potential LSEs on the conservation objectives[4] of a designated site to ascertain if the proposal will adversely affect the integrity of a designated site; and
- **HRA Stage 3 - Derogation:** Where it cannot be ascertained that the proposal will not adversely affect the integrity of a designated site, alternative solutions must be considered to see if the Project qualifies for consent. Subsequently, where it can be demonstrated that there are no alternative solutions to the Project, the Project may still be carried out if the competent authority is satisfied that the scheme must be carried out for imperative reasons of overriding public interest. The final part of Stage 3 is the consideration of whether adequate compensatory measures can be secured.

[4] Conservations objectives are targets set to help public bodies comply with the law and to protect designated wildlife sites. They set out the broad ecological aims for the site and provides detail and site-specific information for each feature within the site, including which of the attributes need to be conserved/maintained, and which ones need to be recovered/restored.

3.6.3 All three 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 (and summarised in Section 9), has been completed for the Project alone and a summary of the conclusions are available in Table 8.1 (summarising the conclusions of the full Screening Report). Where the Screening process concludes the potential for a LSE, then there is a requirement for an AA (Stage 2). Stage 1 Screening for the Project has identified the possibility of LSE for certain sites, features and effects. The required Stage 2 AA will be conducted by the SoS, with the information necessary to inform that assessment provided in the RIAA.

3.6.4 The integrity of a site has been defined in guidance as relating to the sites conservation objectives, which are based on the ecological requirements of the species and habitats present and should define the desired conservation condition of these species and habitat types on the site (EC, 2018). 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.

3.6.5 The Inspectorate Advice Note 10 includes a number of points to be considered under Stage 2 and as such they have been considered in this draft 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 10);
- A description of any commitments/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 Section 10);
- 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 10;
- Cross references to the relevant draft 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 designated sites either alone and/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 and/or in-combination is provided in Sections 10 and 11); 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 is described in Section 5).

3.6.6 Stage 3 of the HRA process is required where a conclusion of adverse effect on integrity is drawn following Stage 2. Stage 3. provides a derogation which would allow a plan or project to be approved in limited circumstances even though it would or may have an AEoI on a European site. The derogation process applies to sites protected under the Habitats Regulations.

3.6.7 Through the derogation process, a plan or project can only proceed provided three sequential tests are met:

- There must be no feasible alternative solutions to the plan or project which are less damaging to the affected European site(s);
- There must be IROPI for the plan or project to proceed; and
- All necessary compensatory measures must be secured to ensure that the overall coherence of the network of European sites is protected.

4 Roles and Responsibilities

4.1.1 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 may result, for example, in Statements of Common Ground (SoCG) that identify areas of agreement and disagreement between Applicant and SNCBs (and other relevant bodies). Wider consultation (including the role of the Evidence Plan Process) is discussed below in Section 5.

4.1.2 This draft RIAA submitted alongside the PEIR to support the statutory pre-application consultation process (together with the range of supporting documentation, notably the attached appendices) for the Project is intended to provide the information required to support the statutory consultation, and to seek the views of stakeholders including Natural England as the relevant SNCB, on the draft findings. These will be taken into account following consultation and in drafting the final RIAA to accompany the DCO application.

5 Consultation

5.1.1 Full details on the consultation process undertaken for the Project is detailed within Part 6, Volume 1, Chapter 6: Consultation, however a brief summary relevant to the RIAA is described within this section. The primary method of consultation on HRA matters for the Project, to date, has been through the evidence plan process, as detailed below in Section 5.3. The stakeholders who were consulted through the Expert Topic Group (ETG) meetings include (in alphabetical order):

- Cefas;
- County Council;
- Drainage Board;
- Environment Agency;
- Lincolnshire Wildlife Trust;
- Local Planning Authority;
- Marine Management Organisation;
- Natural England;
- Royal Society for the Protection of Birds;
- The Planning Inspectorate (the Inspectorate, observer role); and
- The Wildlife Trusts.

5.1.2 A summary of consultation from the ETGs to date is provided in Table 5.1. Note – there will be additional consultation with stakeholders pre-DCO submission, including derogation (compensation) specific consultation. Natural England were consulted on the HRA Screening Report in August 2022. Natural England concluded in their response that, while there are some concerns regarding offshore and intertidal ornithology and subtidal and intertidal ecology, the considered impact pathways to designated sites were considered appropriate. The key issues raised are presented in Table 5.1 and have been considered when drafting this draft RIAA and addressed in the relevant section.

Table 5.1: Consultation comments from Natural England responding to the Project's HRA Screening Report

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Offshore and Intertidal Ornithology		
Scoping Opinion (Natural England, 9 September 2022)	The project states that the designated sites assessed within the study are all those likely to be impacted. Natural England note that breeding sandwich tern are a feature of the NNC SPA, therefore NE advises that the Applicant includes North Norfolk Coast SPA in the list of key designated sites for ornithology.	Sandwich tern from NNC SPA have been included in the assessment in Section 10.4.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England note a lack of clarity in the report as regards screening criteria for ornithological features and as regards which ornithological features are being screened in from which SPAs and for which impacts. Natural England request greater detail and clarity before we can comment fully.	A full list of features and impacts screened into the HRA assessment is provided in Section 8.1.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England note that distant SPAs screened in should not be limited to those determined solely by the breeding season/foraging ranges of their ornithological features, but also account for the potential for the project to interact with birds from much more distant SPAs during the migration and non-breeding seasons.	This has been addressed within Sections 8.1, 8.2 and 10.40.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening	Natural England note that all migratory waterbird features appear to be screened out of the assessment and recommend a more precautionary approach.	Migratory waterbird features at SPAs within 100km of the Project array area will be considered for migratory collision risk post-PEIR.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Report (Natural England, 23 September 2022)		
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England note that some ornithological features have been screened out despite being within mean-max foraging range +1SD. Natural England recommend that these features be screened into the assessment due to potential breeding connectivity: sandwich tern as North Norfolk Coast SPA and lesser black-backed gull at the Alde-Ore Estuary SPA.	Sandwich tern at the North Norfolk Coast SPA assessed for collision risk in Sections 10.4 and 11.40, Lesser black-backed gull assessed for collision risk in Section 10.4.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England note a lack of detail provided in this report as regards survey methodology, methods for estimating abundance and densities, methods of assessment for impacts and approach to in-combination assessment. Natural England is unable to comment on these matters at this time but will welcome further engagement.	A full list of features and impacts screened into the HRA assessment is provided in Section 8.1. The approach to in-combination assessment can be found in Section 11.4.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England note that common scoter is also a potentially sensitive feature of the Greater Wash SPA and would like to see it included for consideration as a key species for the ECC AoS.	Common scoter at the Greater Wash SPA assessed for displacement impacts in the ECC in Section 10.4.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Table 7.6.6 - Disturbance & Displacement: Intertidal ECC during the Operation and Maintenance phase has been scoped out due to the fact that it is "highly localised and episodic (i.e., limited to any maintenance or repair of the export cables)". Natural England is not only concerned about the additional displacement from turbines on the distribution of red-throated divers within the Greater Wash SPA, but also from associated activities, and welcomes the following embedded mitigation for RTD: "Construction and operational maintenance vessels will follow a route from their home port that avoids high concentrations of red-throated diver (a species known to be sensitive to disturbance by boat traffic)." Natural England highlights our increasing concerns in relation to disturbance and/or displacement of red-throated divers features from the more persistent presence of offshore windfarm and oil and gas related vessel activity which could make a meaningful contribution to in-combination effects to the Greater Wash SPA and indeed the adjacent Outer Thames Estuary SPA depending on the transit route. As such, we advise appropriate consideration of both seasonal timing of construction and O&M works and vessel transit route is included within the application. Natural England recommends that where possible, any construction and O&M activities avoid the months of November to March inclusive. Vessel transit routes outside of existing navigation routes through the Greater Wash SPA and Outer Thames Estuary, depending on the port of origin, should also be avoided during these winter months. Natural England advises as minimum use of best practice measures between 1st November and 31st March to mitigate and therefore minimise disturbance to red-throated diver namely: ▪ Selecting routes (when transiting to site) that avoid aggregations of red-throated diver and common scoter, where practicable.	Red-throated diver at the Greater Wash SPA have been assessed for displacement impacts in the ECC in Section 10.4.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
	▪ Restricting (to the extent possible) vessel movements when transiting to the site to existing navigation routes (where the densities of divers are typically relatively low). ▪ Avoidance of over-revving of engines (to minimise noise disturbance); and ▪ Briefing of vessel crew on the purpose and implications of these vessel management practices (through, for example, tool-box talks).	
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	NE hold the opinion that whilst the landfall area of search still includes waterbird SPAs like the Humber, it is premature to scope out intertidal cable operations and maintenance at this stage.	Please find the Projects updated position on intertidal birds and migratory collision risk species in section 8.1.
Subtidal and Intertidal Benthic Ecology		
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England notes that Likely Significant Effect (LSE) can't be excluded for Inner Dowsing Race Bank and North Ridge SAC. We have been reviewing the Offshore Wind leasing Round 4 Plan Level HRA (and associated docs) and note that for IDRBNR SAC there is a mitigation requirement to avoid all irreparable damage to this site. Due to the proposed overlap between the Project transmission assets with IDRBNR SAC; the identified impact pathway from cable protection and the Secretary of States Adverse Effect on Integrity decision for Hornsea Project 3, Norfolk Boreas and Norfolk Vanguard from the placement of cable protection on Annex I sandbanks; Natural England urges the Project to have further consultation with The Crown Estate on this matter, before the export cable route is finalised.	The applicant notes NE's comment. Further consultation has been undertaken through the Evidence Plan Process (EPP) and is presented below in Table 5.2Table 5.2.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England notes that the ECC includes several designated sites in the marine and coastal environment and depending on installation methodology impact pathways to sites features can't be excluded. Thorough assessment is required and continuation of progress on identifying mitigation and where required compensation measures.	The applicant notes NE's comment regarding sites within the ECC. A reflection of those sites considered to have an impact pathway is presented within Section 8, with mitigation presented in Section 7.
Onshore Ecology		
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	"As per above our previous comments (29th July 2022): The concern would be the PEIR being submitted in Q1 before the full suite of surveys have been completed. The full impacts cannot be assessed, and therefore correctly mitigated for, without the full survey results".	A full season of winter bird surveys has been completed and results are presented in Vol 2, Appendix 22.2. Breeding bird surveys are on-going and therefore where there are data gaps relating to breeding birds they are clearly stated within this report.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Screening Distances Applied for Receptors. "Natural England welcomes the consideration of extending the survey area if potential additional pathways are identified at a later stage. It should be noted that the scoping area should be based on the potential for species to be present within the area, the Impact Risk Zone (IRZ) for designated sites as available on Magic, the ecology, i.e., foraging areas of designated species of sites in proximity to the proposed development area. Fragmentation and disruption to habitats should also be considered and assessed. As previously commented (29th July 2022), if it cannot be determined that areas are not functionally linked to a designated sites for passage and over wintering Annex I birds then surveys should be carried out".	Winter bird surveys have been completed covering land within 400m of the 300m-wide PEIR boundary corridor, along the full length of the route, inclusive of the landfall and OnSS options. Screening for designated sites was based on a 15 km search area around the Project boundary at the time of screening, which covered a greater area than the PEIR boundary. The

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
		screening area has been extended where there is evidence of connectivity, for example to include the North Norfolk SPA in relation to non-breeding pink-footed goose.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	"Until finalised project parameters and pollution contingency plans are provided Natural England advise that the potential risk of pollution to affect habitat quality is considered for LSE. For Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC".	This pathway has been included in the RIAA in Section 10.6.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	"Natural England advises that the 'loss of or decline in populations of scarce invertebrates and plants' is added to Table 5.6.1, and is considered for LSE during construction regarding Gibraltar Point Ramsar".	The PEIR boundary is now 2.3km away from Gibraltar Point Ramsar at the closest point. The potential impact pathway of construction phase pollution has been screened in in relation to this designated site, refer to Table 8.1 Screening.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural	"We advise that consideration is given to the loss or damage to habitats during the construction and decommissioning stages for Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC".	The PEIR boundary is now 2.3km away from Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC at the closest point. The potential impact pathway of loss or changes to habitat quality in relation to this designated site have

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
England, 23 September 2022)		been screened in, refer to Table 8.1 Screening.
Discretionary Advice Service response to the Habitats Regulations Assessment Screening Report (Natural England, 23 September 2022)	Natural England advise that consideration is given to the pollution from site run-off affecting habitat quality for Saltfleetby Theddlethorpe Dunes & Gibraltar Point SAC.	The PEIR boundary is now 2.3km away from Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC at the closest point. The potential impact pathway of construction phase pollution has been screened in in relation to this designated site, refer to Table 8.1 Screening.

5.2 Transboundary Consultation

5.2.1 The Inspectorate Advice Note 10 (the Inspectorate, 2022) notes that where an application is 'likely to have a significant effect (either alone and/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 stated by DECC in their 2015 guidance on transboundary impacts on Natura 2000. DECC (2015) also add that 'the format and extent of transboundary consultation is for the applicant to agree with the Planning Inspectorate'.

5.2.2 This draft RIAA is intended to provide 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 (and, for example, drawing on evidence provided as part of recent DCO Examination stages for similar offshore wind projects in the same region and the transboundary projects identified during that process) and the determination of adverse effect alone and/or in-combination made here within the draft RIAA. This draft transboundary assessment will subsequently be updated following the statutory pre-application consultation process as necessary and in light of any changes made to the Project, with the final transboundary part of the RIAA provided as part of the DCO application to inform the AA, to be undertaken by the SoS.

5.3 The Evidence Plan Process (EPP)

5.3.1 The EPP has been followed during the drafting of this draft RIAA and has involved a number of relevant authorities and stakeholders, although not all have provided comment directly on the HRA process completed to date. The stakeholders that have been involved in the Evidence Plan Process (as relevant to the draft RIAA) are listed above in paragraph 5.1.1.

5.3.2 The EPP has been managed through a series of ETG meetings, with meetings to be held until DCO Application and with comment on the draft RIAA summarised in Table 5.2 below. Comments relevant to the wider PEIR have been incorporated into the relevant documents, on which the draft RIAA draws, and have been taken into account indirectly during the preparation of the draft RIAA where relevant (this includes any comments received in the Scoping Opinion that are of relevance to designated sites and therefore the RIAA). Such comments 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 9.2 of Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology;
- Comments made in relation to marine mammals are summarised in Table 11.2 of Part 6, Volume 1, Chapter 11: Marine Mammals
- Comments made in relation to offshore ornithology are summarised in Table 12.2 of Part 6, Volume 1, Chapter 12: Offshore and Intertidal Ornithology;
- Comments made in relation to onshore ecology are summarised in Table 21.4 of Part 6, Volume 1, Chapter 21: Onshore Ecology; and

- Comments made in relation to migratory fish are summarised in Table 10.1 of Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology.

Table 5.2: Consultation comments relevant to the PEIR which have been incorporated into the draft RIAA

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Offshore and Intertidal Ornithology		
Scoping Opinion – Impact assessment Methodology (The inspectorate, 9 September 2022)	The Project states that designated sites assessed within the study are all those likely to be impacted. The inspectorate notes that the ES should also assess any likely significant effects to the North Norfolk Coast SPA based on the proximity of the Proposed Development and the presence of breeding sandwich tern at the SPA.	The North Norfolk Coast SPA is screened into the assessments. This is assessed in Section 10.4.
Scoping Opinion (Natural England, 30 August 2022)	Natural England advise that designated sites including Flamborough and Filey Coast and the Greater Wash SPAs should be scoped in and the impacts on prey availability referred to/signposted in the Designated Sites section of the report.	Flamborough and Filey Coast and the Greater Wash have been screened into the assessments. This is assessed in Section 10.4.
Scoping Opinion – Impact assessment Methodology (The inspectorate, 9 September 2022)	The Project states that the designated sites assessed within the study are all those likely to be impacted. Natural England note that breeding sandwich tern are a feature of the NNC SPA, therefore NE advises that the Applicant includes North Norfolk Coast SPA in the list of key designated sites for ornithology.	The North Norfolk Coast SPA is screened into the assessments. This is assessed in Section 10.4.
Scoping Opinion (Natural England, 9 September 2022)	Natural England note that common scoter is also a potentially sensitive feature of the Greater Wash SPA and advise that it is included for consideration as a key species for the ECC AoS.	Common scoter has been included for consideration as a key species within the ECC AoS. This has been addressed in Section 10.4.
Offshore Ornithology Expert Topic Group (Natural England, 29 September 2022)	For apportioning, the Project proposes to use the best practice interim guidance from NatureScot (2018). Natural England advises that the apportioning assessment should also draw on and reflect the findings of any colony-specific tracking data.	The Project has used the NatureScot methodology and colony-specific tracking data to inform apportioning. This has been included within Appendix 4.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Offshore Ornithology Expert Topic Group (Natural England, 29 September 2022)	The Project do not intend to include population viability analysis (PVA) as part of the analysis at PEIR. Natural England advise that it might be useful for the PEIR to take an initial view on which species are likely to be subject to PVA, so stakeholders can consider this.	This has been included for relevant species conclusions within the assessments in Sections 10.4 & 11.4.
Offshore Ornithology and Derogation and Compensation ETG (Natural England, 28 November 2022)	The Project proposes it will retrospectively apply the new avoidance rates to previous projects for the cumulative impact assessment in the future, though at this stage new avoidance rates have only been applied for the Project alone impacts. Natural England now support the use of the stochastic CRM (sCRM, McGregor et al 2018) as per the draft updated Collision Risk Modelling parameters. With regards to applying variance within the flight height distributions, Natural England advise the project to use the default option within the application, which uses the Johnston (2014) bootstrap samples to draw from in the simulation.	This advice has been noted and taken into consideration for the assessment. Information can be found in Section 11.4.
Offshore Ornithology and Derogation and Compensation ETG (Natural England, 28 November 2022)	The Project is not considering gannet as a species at risk of needing compensation. Natural England agreed the revised avoidance rates are likely to reduce the need to provide compensation. However, Natural England are unable to confirm at this stage due to data from round 4 projects not yet available.	Gannet assessment can be found in Section 10.4. Consultation with NE will continue as data becomes available.
Offshore Ornithology and Derogation and Compensation ETG (Natural England, 28 November 2022)	Regarding apportioning, Natural England is of the opinion that even for FFC, some kittiwake could be attributed to non-SPA colonies. Natural England confirmed to have impact from compensated project be considered as zero.	Kittiwake assessment can be found in Section and the Apportioning Annex (Appendix 7.1.4).
Offshore Ornithology and Derogation and Compensation	Use Biologically Defined Maximum Population Scale (BDMPS) from Furness (2015) for non-breeding season apportioning.	Full apportioning methodology can be found in Appendix 4.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
ETG (Natural England, 28 November 2022)		
Offshore Ornithology and Derogation and Compensation ETG (Natural England, 28 November 2022)	The Project proposes that Sandwich tern are screened in for collision but not for displacement. Natural England agree with the project that Sandwich tern are screened in for collision but not for displacement	This methodology has been agreed and is assessed in Sections 10.4.
Subtidal and Intertidal Benthic Ecology		
Scoping Opinion (MMO, 26 August 2022)	The MMO advises that the ECC is routed to avoid designated sites that protect benthic features. If this is not feasible, then impacts on the protected benthic features within these sites should be minimised.	The Applicant notes the MMOs comment. Information on the site selection process (including ECC routing) is summarised within Section 6.3 of the draft RIAA and within Volume 1, Chapter 4: Site Selection and Consideration of Alternatives. Descriptions of the impacts and mitigation applied to minimise effects can be found within Section 8 and Section 7 respectively.
Evidence Plan Meeting ETG 12 October 2022	Cefas accepted the measures in place to prevent the introduction of marine INNS. However, Cefas confirmed the installation of infrastructure would create hard habitats and requested the Project consider the potential for infrastructure to be colonised by INNS and consider connection between structures.	The Applicant notes Cefas' comment. The assessment of INNS and hard substrates is considered within Section 10.2 and 11.2.
Marine Mammals		
Scoping opinion (The Inspectorate, 9 September 2022)	Mitigation measures The ES should include consideration of measures to manage potential cumulative disturbance in the event that there is multiple piling or other noisy activities taking place simultaneously in the	The Applicant notes The Inspectorate's comment. The mitigation considered for this assessment is presented within Section 7. Discussion around the use of

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
	Southern North Sea Special Area of Conservation (SAC). It is also recommended an outline Site Integrity Plan (SIP) be provided with the Application.	a SIP is within Section 10.3 and 11.3. An Outline SIP will be prepared for the RIAA which will accompany the application.
Scoping Opinion (Natural England, 30 August 2022)	Natural England agrees that the listed embedded mitigation protocols are relevant to the marine mammal assessment, however we advise that more measures may be required to manage disturbance in the SNS SAC in the event that construction takes place simultaneously with other OWF construction or noisy activities in the SAC. These plans and contingencies will need to be outlined in detail as part of the ES. Furthermore, a Site Integrity Plan (SIP) will need to be produced which will specify exactly how these plans will be implemented as part of marine licence. We reserve the right to comment on the suitability of these documents in mitigating impacts when they are submitted as part of the consultation process.	The Applicant notes NE's comment. The mitigation considered for this assessment is presented within Section 7. Discussion around the use of a SIP is within Section 10.3 and 11.3. An Outline SIP will be prepared for the RIAA which will accompany the application.
Onshore Ecology		
Scoping opinion (The Inspectorate, 9 September 2022)	Confidential Annexes. "Public bodies have a responsibility to avoid releasing environmental information that could bring about harm to sensitive or vulnerable ecological features. Specific survey and assessment data relating to the presence and locations of species such as badgers, rare birds and plants that could be subject to disturbance, damage, persecution, or commercial exploitation resulting from publication of the information, should be provided in the ES as a confidential annex. All other assessment information should be included in an ES chapter, as normal, with a placeholder explaining that a confidential annex has been submitted to the Inspectorate and may be made available subject to request".	A confidential annex has been produced for the ornithology desk study (PEIR Vol 2, Appendix 22.2). Where within this RIAA there are references to sensitive information, then those references will be redacted prior to publication, with an unredacted version provided to the Inspectorate.

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
Scoping Opinion (Natural England, 30 August 2022)	"More generally, Natural England advises that 24 months of survey effort is the minimum expected evidence standard for bird and marine mammal data, to have any certainty to draw conclusions from and inform requirements for mitigation measures".	A second season of winter bird surveys will be undertaken across winter 2023-24.
Scoping Opinion (Natural England, 30 August 2022)	"Natural England flags potential impacts on SPA functionally land as a likely risk i.e., geese, golden plover etc. for the cable route".	Potential impacts to functionally linked land for SPA and Ramsar qualifying species have been assessed in Sections 10.6 and 11.6.
Scoping Opinion (Natural England, 30 August 2022)	"Natural England advises that air quality impacts to designated sites should be considered".	Potential air quality impacts to onshore designated sites have been assessed in Sections 10.6 and 11.6.
Scoping Opinion (Natural England, 30 August 2022)	"Natural England advises that it is the Applicant's responsibility to determine whether there is sufficient information/evidence to exclude areas from surveys. As previously commented to the applicant (29th July 2022), if it cannot be determined that areas are not functionally linked to a designated sites for passage and over wintering Annex I birds then surveys should be carried out. Our standard advice would be two years of survey data to be obtained to inform possible mitigation measures. Given the proposed submission dates of Autumn 2023 this will be difficult. If less than two years of data is collected, then consideration should be given to extending the 400m buffer area either side of the cable corridor in order to obtain further data to help demonstrate the relative importance of the cable corridor with the surrounding habitats".	Winter bird surveys have been completed covering land within 400m of the 300m-wide PEIR boundary corridor, along the full length of the route, inclusive of the landfall and OnSS options. A second season of non-breeding bird surveys will be undertaken in 2023-24. Survey effort was increased in winter 2022-23, to twice per month visits, in order to collect more information on the populations and distribution of waterbirds within the study area. Given that the working area will be refined down to an 80 m wide corridor, the actual survey buffer will vary from a

Date and consultation phase/type	Consultation and key issues raised	Section where comment addressed
		minimum of 400 m to a maximum of 620 m.

6 Project Overview

6.1 Introduction

6.1.1 The draft RIAA draws on Volume 1, Chapter 3: Project Description which includes a 'Project design envelope' developed to include necessary flexibility to accommodate further project refinement and optimisation during detailed design, post consent. The proposed windfarm array area is 500km^2 , located approximately 54km east from the Lincolnshire coastline at its closest point. It is noted that prior to DCO submission it is anticipated that the proposed array area will be reduced to 300km^2. The Project consists of an array area, an offshore export cable corridor (Offshore ECC) including an area of search for two Offshore Reactive Compensation Platforms (ORCP), landfall location at Wolla Bank and onshore export cable corridor options (Onshore ECCs), including the possible onshore substation area (OnSS). Additionally, the Project includes areas of search for potential compensation measures, namely an artificial nesting structure(s) (Figure 1.1). Due to the current broad nature of the compensation area, they are not considered within this draft RIAA. However, they will be assessed within the final RIAA following the refinement of the proposed areas and once details of the works to be undertaken have been finalised.

6.1.2 Full details on the Project description are presented within the PEIR in Volume 1, Chapter 3: Project Description. For a number of aspects of the Project, a range of options are being considered, particularly during the construction phase. To manage the potential for impact, and in line with both the PEIR and the Inspectorate Advice Note 9: Rochdale Envelope, the Project elements that represent the MDS for each topic (the 'Rochdale Envelope') have been identified and taken forward. The key project design parameters considered within this draft RIAA are described below in Section 6.2 and 6.4 below.

6.1.3 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified a number of receptor groups; for the PEIR, the topic-specific MDS for each group is presented within the relevant PEIR chapter. The receptor groups identified are: benthic and intertidal ecology; marine mammals; offshore and intertidal ornithology; migratory fish, and onshore ecology. The relevant MDS' applied here are described within Section 6.4.

6.2 Project Description

6.2.1 A proposed maximum of 93 Wind Turbine Generators (WTGs) will be installed within the array area. Electricity generated will be transported to the coastline via offshore export cables which will make landfall within the cable corridor on the Lincolnshire coast, to either connect to the National Grid at the Lincolnshire Node or Weston Marsh grid connection locations.

6.2.2 The foundation type used for the main offshore structures (e.g. Offshore Substations (OSSs), WTGs, ORCP's and accommodation platform) depends on the final detailed site investigations, engineering design studies and the procurement process. Given the uncertainty regarding these conditions and the final project design, four types of foundation are currently being considered: monopiles, gravity base structure foundations, pin piled jacket foundations, and suction bucket jacket foundations.

6.2.3 Scour protection will be put in place around the foundations (where required for engineering purposes), with several methods considered including rock placement, concrete mattresses, frond mattresses, rock bags, seabed spacers, and rock berms. The level and type of scour protection will vary depending on the foundation type selected with the MDS described within Section 10.

6.2.4 Several cable installation methodologies are being considered for the installation of offshore cables, including jet-trenching, pre-cut and post-lay trenching, mechanical trenching, dredging (Trailing Hopper Suction Dredging, and backhoe dredging or water injection dredging), mass flow excavation/controlled flow excavation, rock cutting, burial sledge, jet sledding (hybrid of jet trencher and cable plough), and vertical injector burial. The cables will either be directly buried using the above techniques or pulled into a duct/pipe that will be installed using the above techniques.

6.2.5 As far as practicable, all offshore cables will be buried to a sufficient depth below the seabed, with target burial depth informed by the findings of a Cable Burial Risk Assessment (CBRA) as part of the final project design process. A preliminary CBRA has been undertaken by the Project for the section of the cable route which passes through the Inner Dowsing, Race Bank and North Ridge SAC. This is helping to further define the approach to cable installation as well as informing the requirement or otherwise for cable protection material over the designated sandbank features within the SAC site and the type, design and installation process for any such protection.

6.2.6 The Project intends to discuss the outcomes of the CBRA with stakeholders throughout the remaining pre-application period, principally through the EPP, in determining the Project design including (where a need is identified) such options for alternative, feasible cable installation and protection techniques that would demonstrably avoid any adverse effects on the integrity of the sandbank features. Future phases of the Project design will subsequently inform the RIAA that will accompany the DCO Application, and which will set out in full the assessment of the potential AEoI on the SAC sandbank features.

6.2.7 However, where it is not possible to bury cables (array, interlink and export) to an adequate depth it may be necessary to install cable protection to prevent scour forming around cables and to minimise the risk of cable exposure, to protect the cable asset from damage to the cables from forces and movement damaging the cables over time resulting in additional works, and to ensure cables are not snagged by other sea users. An analysis of the requirement for the cables to cross existing infrastructure (such as cables and pipelines) is provided within the PEIR.

6.2.8 The onshore elements of the Project will comprise the landfall, the onshore ECC and the OnSS (collectively, the “onshore infrastructure”). The landfall is where the offshore electrical cables will come ashore to meet the onshore electrical cables. These will be joined at a transition joint bay compound which will be onshore (further details of onshore cable installation can be found in Volume 3, Chapter 1: Project Description). The OnSS will be used to make the power generated by the windfarm suitable for transfer to the National Grid. The onshore export cables will link the landfall to the OnSS where the power will be transferred to the National Grid via a National Grid Substation. The onshore sections of the export cables will be buried underground. The onshore red line boundary (RLB) has a maximum length of approximately 80 km for the Weston Marsh OnSS options.

6.2.9 The assessments presented here assume the project is completed as detailed and described in the paragraphs above. As the project design is further refined, the conclusions of assessments made here will be revisited to confirm they remain valid; any changes will be discussed through the EPP and clearly documented in future iterations of the draft RIAA.

6.3 Consideration of Alternatives

6.3.1 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 4: Site Selection and Consideration of Alternatives.

6.3.2 The approach taken to site selection and alternatives has involved early engagement with stakeholders, together with a range of electrical, engineering, ecological and socioeconomic considerations.

6.3.3 The site selection process began early in the Project lifetime and involved the following stages:

- Stage 1 – Identification of the Array Area;
- Stage 2 - Identification of the Landfall Zones;
- Stage 3 - Identification of the Offshore ECC Route Options;
- Stage 4 - Identification of the Proposed Onshore Substation (OnSS) Study Areas;
- Stage 5 - Identification of the Onshore Export Cable Corridor (ECC);
- Stage 6 – Offshore Refinement of Project from Scoping to PEIR; and
- Stage 7 – Onshore Refinement of Project from Scoping to PEIR.

Consultation on site selection

6.3.4 Consideration has been given to a range of alternatives in developing the Project. This has informed key decisions within the Project, including technical and engineering options and environmental issues when considering, for example, micro-siting and route changes when developing the export cable routes.

6.3.5 Consultation has been a key part of this process in developing the Project to this point and has helped to define the Project with options and alternatives discussed with key stakeholders, both through Evidence Plan meetings, workshops and through the feedback received through public events.

6.3.6 Following receipt of the Scoping Opinion, the Project consulted with a range of interested parties on the potential for Project boundary refinements through the ETGs (see Table 5.2. This process was iterative, taking account of refinements to the offshore and onshore ECC search areas and the latest site-specific data. Consideration was given to technical, commercial and environmental issues informed by data analysis and constraints mapping prior to presentation and consultation with key stakeholders (see full details within Volume 1, Chapter 4: Site Selection and Consideration of Alternatives).

6.3.7 Full details of the Project consultation process and mechanisms are presented within Volume 1, Chapter 6: Consultation, and in relation to individual technical topics, within each of the technical chapters of the PEIR.

6.4 Maximum Design Scenario (MDS)

6.4.1 The MDS is referred to throughout the PEIR and here in the draft 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; this provides confidence that any other (lesser) scenarios will have an impact that gives rise to a significance of effects that is less than or no greater than that assessed for the MDS.

6.4.2 The Screening Report identified a number of receptor groups, with the topic specific MDS for each group presented within the relevant chapter from the PEIR. Where a receptor group is screened in for potential LSE, these chapters are drawn on here. The receptor groups are outlined below, together with the relevant MDS table within each of the corresponding PEIR chapter:

- Table 5.12 from Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology;
- Table 4.7 from Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology;
- Table 1.7 from Part 6, Volume 1, Chapter 11: Marine Mammals;
- Table 12.8 from Part 6, Volume 1, Chapter 12: Offshore and Intertidal Ornithology; and
- Table 1.11 from Part 6, Volume 1, Chapter 21: Onshore Ecology
- Table 22.11 from Part 6, Volume 1, Chapter 22: Onshore Ornithology.

6.4.3 The MDS, as it applies to each receptor group, is listed at the beginning of each assessment 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 It is anticipated, that if granted consent, the windfarm will be operational by 2030, with construction commencing as early as 2025. A more detailed programme is provided in the PEIR to inform the detailed assessments (including in-combination and cumulative assessments).

6.6 Operations and Maintenance, and Decommissioning Programme

6.6.1 The full project description is provided in Part 6, Volume 1, Chapter 3: Project Description, with Operation and Maintenance (O&M) addressed in Section 9 of that chapter.

6.6.2 The overall O&M strategy will be finalised once the O&M base location and technical specification of the Project are known, including WTG type, electrical export option and final project layout. Maintenance operations will be undertaken throughout the operational life of the Project (anticipated approximately 35 years) and will be both preventive (scheduled) and corrective (unexpected repairs).

6.6.3 The onshore O&M 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. O&M requirements for the OnSS will be both preventative and corrective.

6.6.4 At the end of the operational lifetime of the Project, it is anticipated that all structures above the seabed or ground level will be completely removed, with detail on removal for aspects such as scour protection, cables and cable protection as follows:

- Any scour protection left in situ;
- Expected that most cables will be left in situ, exposed cables to be removed; and
- Rock protection to be left in situ as it is deemed more harmful to remove it. If removed, would be done by a dredger or grab but only if it is determined at the time that it is not more harmful than leaving in situ.

6.6.5 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 the Project'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 Mitigation

7.1.1 The information on the mitigation being proposed for each receptor and in relation to individual potential impacts arising from the Project is set out in the individual topic chapters of the PEIR. The mitigation relevant to the draft RIAA is summarised below in Table 7.1 including the route for securing each measure. Mitigation is not taken into account during the consideration of potential LSE; however it is a consideration during the determination of the potential for adverse effect within the design scenario assessed. The approach ensures the draft RIAA is compliant with the People over Wind ruling referenced in Section 3.

Table 7.1: Mitigation proposed for the Project

Mitigation	Details of Measure Relevant to the draft RIAA
Benthic Subtidal and Intertidal Ecology	
Project Design	▪ Wind farm infrastructure will be micro-sited around Annex I habitat as far as practicable, to avoid where possible direct significant impacts on these conservation features; ▪ Development of a Scour Protection Management Plan (SPMP) and Cable Specification and Installation Plan (CSIP) which will consider the need for scour protection; and ▪ The installation of scour protection where required for engineering purposes. Scour protection may take the form of Rock/gravel placement, concrete mattresses, flow energy dissipation devices, protective aprons or coverings, ecological based solutions and bagged solutions
Cable Burial Risk Assessment (CBRA)	A cable burial risk assessment (CBRA) will be undertaken to inform front end engineering works. Cable burial will be the preferred option for cable protection, and this will minimise any impacts associated with habitat loss.
Pollution prevention	A Project Environmental Management Plan (PEMP) (for the construction and operation phases) and Decommissioning Plan (for the decommissioning phase) will be produced and followed. This will include a Marine Pollution Contingency Plan (MPCP) which will safeguard the marine environment in the event of accidental pollution occurring as a result of ODOW operations. Plans will also highlight key organisations and contact details in the event of a spill (e.g. Environment Agency, Marine Management Organisation, Natural England and the Maritime and Coastguard Agency (MCA)).
Marine Invasive Non-Native Species (INNS) control	A Biodiversity and Invasive Non-Native Species Method Statement will be prepared.
Pre-construction Annex I habitat survey	Windfarm infrastructure will be micro-sited around Annex I habitat as far as practicable, to avoid where possible direct significant impacts on these conservation features.
EMF and cable protection	Where possible, cables will be buried to reduce the impacts of EMF on sensitive receptors and minimise the requirement for additional cable protection.
Decommissioning Programme	Development of, and adherence to, a Decommissioning Programme.
Marine Mammals	

Mitigation	Details of Measure Relevant to the draft RIAA
Project design	Identification of maximum hammer energy to be used during pile driving (6,600 kJ for monopile, 3,500 kJ for pin-pile). Inclusion of soft-start and ramp up procedures for pile driving. Maximum of 2 simultaneous piling events.
PEMP	A Project Environmental Management Plan (PEMP) (for the construction and operation phases) and Decommissioning Plan (for the decommissioning phase) will be produced and followed. This will include a Marine Pollution Contingency Plan (MPCP) which will safeguard the marine environment in the event of accidental pollution occurring as a result of ODOW operations. Plans will also highlight key organisations and contact details in the event of a spill (e.g. Environment Agency, Marine Management Organisation, Natural England and the Maritime and Coastguard Agency (MCA)).
Marine Mammal Mitigation Protocol (MMMP) for piling	Implementation of a piling Marine Mammal Mitigation Protocol (MMMP) (to minimize the risk of auditory injury to negligible levels).
MMMP for UXO	Implementation of a UXO MMMP (to minimize the risk of auditory injury to negligible levels).
MMMP for geophysical surveys	A Implementation of a geophysical survey MMMP (to minimize the risk of auditory injury to negligible levels).
Vessel Management Plan (VMP)	Development of, and adherence to, a Vessel Management Plan (VMP) (including defined vessel navigational routes, a vessel code of conduct to reduce collision risk and minimize disturbance and identification and avoidance of sensitive areas where practicable);
Decommissioning Plan	Development of, and adherence to, a Decommissioning Plan.
Decommissioning MMMP	Implementation of a decommissioning MMMP (to minimize the risk of auditory injury to negligible levels);
Offshore and Intertidal Ornithology	
Site selection	The Project currently covers a potential area of 500km^2, which will be reduced to 300km^2 post PEIR. A site-selection process will involve investigating the distribution of key seabird species across the Project array to determine areas where impacts can be reduced.
Minimum tip height	The design of the Project includes an air gap of 30m at Mean Seal Level (MSL). This provides a greater air gap than the minimum required of 22m Mean High Water Springs (MHWS) and is included in the design to reduce the potential collision risk to offshore ornithological receptors.

Mitigation	Details of Measure Relevant to the draft RIAA
Best practice protocol	Best practice protocol will be utilised during works to minimise disturbance of offshore ornithological receptors, especially red-throated divers and common scoter, through the following: ▪ Where possible, minimising vessel traffic during the most sensitive time in October to March; ▪ Where possible, restricting vessel movement to existing navigation routes; ▪ Where possible, maintaining direct transit routes, minimising transit distances through areas used by key species; ▪ Where possible, avoidance of rafting birds when necessary to go outside of navigational routes, and where possible avoid disturbance to areas with consistently high diver density; ▪ Avoidance of over-revving engines to minimise noise disturbance; and ▪ Briefing of vessel crew on the purpose and implications of these vessel management practices.
Cable Burial Risk Assessment (CBRA)	A cable burial risk assessment (CBRA) will be undertaken to inform front end engineering works. Cable burial will be the preferred option for cable protection, and this will minimise any impacts associated with habitat loss.
Pollution Prevention	A Project Environmental Management Plan (PEMP) will be developed post-consent and adopted, which will cover the construction and O&M phases of the Project. This will be secured through a Condition in the deemed Marine Licence. This PEMMP will include a Marine Pollution Contingency Plan (MPCP), which provides protocols to cover accidental spills and potential contaminant release, and provide key emergency contact details. Typical measures will include: ▪ Storage of all chemicals in secure designated areas with impermeable bunding (generally 100% of the volume); and ▪ Double skinning of pipes and tanks containing hazardous materials.
Marine INNS control	Relevant best practice guidelines, policy and legislation will be followed to minimise marine INNS introduction/spread. Any vessels used for the delivery of materials to site will adhere to industry legislation, codes of conduct and/or best practice to reduce the risk of introduction or spread of invasive non-native species.
Decommissioning Programme	Development of, and adherence to, a Decommissioning Programme (DP).
Onshore Ecology	
Project Design	Careful routing of the landfall and onshore ECC and design of key crossing points and avoidance of direct impacts to designated sites, including SSSIs, LWSs and LWT reserves. Where the route crosses these designations, trenchless techniques will be used.

Mitigation	Details of Measure Relevant to the draft RIAA
Vegetation Clearance and Other Construction Works	A Construction Method Statement (CMS) which will confirm construction methods and the roles and responsibilities of parties engaged in construction. It will detail any construction-related mitigation measures. A (CMS) which will include: o A commitment to best practice oPre-construction surveys o Micro-siting of project elements to avoid IEFs o Measures to reduce disturbance to birds and other wildlife o Site preparation and construction work to be overseen by an ECoW
Landscape and Ecology Design Principles Plan (LEDPP)	Outline planting mitigation principles have been developed for the three indicative OnSS locations and are set out in the LEDPP. These mitigation principles include areas of proposed woodland, areas identified for ecological mitigation and an area identified for SuDS. In locations where it is possible to undertake planting that will not interfere with construction works and where practical to do so, mitigation woodland could be planted during the early phases of the OnSS construction to ensure robust screening as quickly as possible. If implemented at the start of the construction phase, this woodland planting will give these areas additional growth prior to completion of construction and commencement of operation of the OnSS. Depending on the final design and size of the OnSS, earthworks used to create the OnSS platform may result in surplus soil and excavation material. If available, this could potentially be used in the creation of landscape bunding in areas of proposed woodland within the sites. This will further limit views of the OnSS and provide further landscape and visual mitigation.
Pollution Prevention and Emergency Incident Response Plan	Compliance with the final Pollution Prevention and Emergency Incident Response Plan to be drafted in line with the Outline Pollution Prevention and Emergency Incident Response Plan.
Best Practice	All construction work will be undertaken in accordance with the CMS and relevant good practice guidance including, but not limited to: ▪ Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors CIRIA (C532) (CIRIA, 2001); ▪ CIRIA – SuDS Manual (C753) (CIRIA, 2015);

Mitigation	Details of Measure Relevant to the draft RIAA
	▪ No discharge to main river watercourses will occur without permission from the Environment Agency (SuDS Manual); ▪ Wheel washers and dust suppression measures to be used as appropriate to prevent the migration of pollutants (SuDS Manual); and, ▪ Regular cleaning of roads of any construction waste and dirt to be carried out (SuDS Manual).
Air quality	The construction dust mitigation measures recommended as part of the construction dust assessment will form inclusion within the CoCP, in agreement with the relevant Authority. This will be undertaken in accordance with best practice measures that are proportional to the likely impacts, including those relating to dust and Non-Road Mobile Machinery (NRMM). Dust mitigation measures are identified by the applied IAQM methodology. This would apply to all onshore construction activities.
Operational activities	Operational practices will incorporate measure to prevent pollution and increased flood risk, including emergency spill response procedures, clean up and control of any potentially contaminated surface water runoff. These measures will be included within an Environmental Management System (EMS). The EMS would also include specific measures to avoid potential impacts to protected species or sensitive habitats. Where unplanned operational or maintenance works are required, appropriate mitigation measures would be developed and agreed with relevant consultees prior to works taking place. This would include surveys for Schedule 1 nesting birds and use of fencing to provide a visual and acoustic barrier. Temporary screening would be employed for corrective maintenance works within 400m of sensitive areas for non-breeding waterbirds, in order to provide a degree of visual and acoustic screening.
Decommissioning activities	Provision of a decommissioning plan in advance of decommissioning works will be a requirement of the DCO, to include protection of ecological features, based on up-to-date survey information and relevant guidance in place at the time of decommissioning.
Otter	Reasonable avoidance measures would be used to reduce the risk of committing an offence under the protecting legislation. These may include micro-siting certain elements and/or installing protective fencing to minimise

Mitigation	Details of Measure Relevant to the draft RIAA
	disturbance to retained holts, ensuring excavations remain closed overnight or contain ramps such that otters cannot become trapped. A licence from Natural England may be required depending on the nature of any impact.
Piling activities	No impact piling will occur, other than for the foundations of the OnSS. The OnSS search areas are located away from statutory ornithological sites. Disturbance minimisation measures outlined within this table will be employed at the OnSS.
Minimising potential disturbance to breeding and wintering birds	HDD pits, OnSS and other working areas at sensitive areas such as watercourse crossings would be fenced to provide visual and acoustic screening of active working areas. Details of proposed fencing are still being developed and further details will be provided in a subsequent version of the RIAA. As a broader measure, to reduce disturbance to important populations of non-breeding birds along the onshore ECC, during the winter period (October-March inclusive), temporary screening would be used during potentially disturbing construction works within and adjacent to areas used by significant numbers of waterbirds. Further details will be provided in a later version of the RIAA, following the provision of more detailed information regarding construction.
Project Design and Micro-siting	Entry and exit pits, and associated working areas, will be set back from sensitive areas such as Anderby Marsh and The Haven as far as possible, in order to avoid disturbance impacts to European site bird features utilising those areas. There will be a minimum of 300m stand off distance at Anderby Marsh (where there are existing landscape features which provide a degree of screening) and 400m (from The Wash SPA and Ramsar) at The Haven crossing.
Minimising potential disturbance to wintering birds	If necessary, works (construction, decommissioning and corrective maintenance) at sensitive areas would be suspended during periods of very cold weather. Disturbance to non-breeding waterbirds is likely to be most critical during periods of prolonged cold weather, when they may be unable to feed in their usual foraging areas and may face reduced prospects for survival. A scheme has been in place since 1983 to minimize the level of disturbance from wildfowl shooting in frozen conditions (JNCC, 2019). Similar measures would be imposed here, with the works suspended after seven consecutive days on which the ground was frozen (as measured at a nearby weather station). Any suspension of works would last for a minimum of seven days thereafter and any lifting of the suspension will take into consideration the need for a period of recovery for waterbirds after the end of the severe weather itself.
Protection of breeding Schedule 1 birds	Species listed on Schedule 1 of the Wildlife and Countryside Act (1981) as amended are afforded legal protection from disturbance at the nest site, as well as protection of dependent young. Surveys would take place during each

Mitigation	Details of Measure Relevant to the draft RIAA
	breeding season in which construction occurs in order to identify the approximate locations of nesting Schedule 1 birds and to review the mitigation measures to ensure they are sufficient to avoid disturbance.

8 Stage 1: HRA Screening

8.1 Screening Undertaken for the Project Alone

8.1.1 As noted in Section 3.6 above, the first stage of the HRA process is Screening, this being the process followed to identify the potential for LSE from the Project, alone and or in-combination, on designated sites of nature conservation importance. Screening for the Project alone was initially undertaken alongside the EIA Scoping process, with the draft Screening Report issued in August 2022 for consultation.

8.1.2 The Screening Report (Outer Dowsing Offshore Wind, 2022) included detail on all consultation carried out during the Screening process. The Screening Matrix incorporated all final decisions on HRA Screening and is appended as Appendix 2, following the structure provided in the Inspectorates Advice Note 10.

8.1.3 The Screening information for the Project alone is summarised in Table 8.1, as adapted from the Screening Matrix (Appendix 2). Table 8.1 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 Screening Matrix (Appendix 2) but is not reproduced in full here in the interests of brevity. The Screening Report (Outer Dowsing Offshore Wind, 2022) also included screening for potential LSE for onshore ecology and migratory fish, which confirmed that no potential for LSE alone had been identified.

8.1.4 It is noted that the screening exercise undertaken to inform this draft RIAA was based on a broader cable corridor than the finalised cable route established at PEIR, which has resulted in an increased number of SACs and effects being considered here on a precautionary basis. An updated screening exercise will be undertaken before the final RIAA for application, factoring in the adjusted cable route and the reduction in array area, leading to a less precautionary but more proportionate assessment.

Table 8.1: Sites and features screened in for the assessment of the Project

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
Benthic and Intertidal Ecology							
North Norfolk Sandbanks and Saturn Reef SAC	5.8	17.7	86.1	▪ Reefs; and ▪ Sandbanks which are slightly covered by sea water all of the time	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.	▪ Indirect pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
Inner Dowsing, Race Bank, and North Ridge SAC	16.7	0.0	3.9	▪ Reefs; and ▪ Sandbanks which are slightly covered by sea water all of the time	▪ Physical habitat loss/disturbance; ▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Physical habitat loss/disturbance; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; ▪ Changes to physical processes; and ▪ EMF	▪ Physical habitat loss/disturbance; ▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
The Wash and North Norfolk Coast SAC	47.8	13.4	0.1	▪ Sandbanks which are slightly covered by sea water all of the time; ▪ Mudflats and sandflats not covered by seawater at low tide; ▪ Large shallow inlets and bays; ▪ Reefs; ▪ Salicornia and other annuals colonizing mud and sand; and ▪ Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; ▪ Changes to physical processes; and ▪ EMF	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
Humber Estuary Ramsar	52.7	12.1	10.7	▪ Dune systems with humid dune slacks, ▪ Estuarine waters; ▪ Intertidal mud and sand flats; ▪ Saltmarshes; and ▪ Coastal brackish/saline lagoons	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; ▪ Changes to physical processes; and ▪ EMF	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
Humber Estuary SAC	53.1	18.5	17.1	▪ Estuaries; ▪ Mudflats and sandflats not covered by seawater at low tide; ▪ Sandbanks which are slightly covered by sea water all the time; ▪ Salicornia and other annuals colonizing mud and sand; and	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; ▪ Changes to physical processes; and ▪ EMF	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Atlantic salt meadows.			
Gibraltar Point Ramsar	62.1	13.3	2.3	▪ Estuarine mudflats; ▪ Sandbanks; ▪ Saltmarsh; and ▪ Dunes	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; ▪ Changes to physical processes; and ▪ EMF	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
The Wash Ramsar	65.5	16.4	0.1	▪ Saltmarshes; ▪ Estuaries; ▪ Major intertidal banks of sand and mud; ▪ Shallow water; and ▪ Deep channels	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.
Marine Mammals							
Southern North Sea SAC	0.0	1.1	50.8	▪ Harbour Porpoise (*Phocoena phocoena*)	▪ Underwater noise; ▪ Vessel disturbance; ▪ Collision risk; ▪ Indirect pollution; ▪ Accidental pollution; and ▪ Changes to prey.	▪ Underwater noise; ▪ Vessel disturbance; ▪ Collision risk; ▪ Indirect Pollution; ▪ Accidental pollution; and ▪ Changes to prey.	▪ Underwater noise; ▪ Vessel disturbance; ▪ Collision risk; ▪ Indirect Pollution; ▪ Accidental pollution; and ▪ Changes to prey.
Humber Estuary SAC	53.1	18.5	17.1	▪ Grey Seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	▪ Vessel disturbance; and ▪ Collision risk.	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk
Humber Estuary Ramsar	53.1	18.5	17.1	▪ Grey Seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	▪ Vessel disturbance; and ▪ Collision risk.	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk
The Wash and North Norfolk Coast SAC	47.8	13.4	0.1	▪ Harbour Seal (*Phoca vitulina*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	▪ Vessel disturbance; and ▪ Collision risk.	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk
Transboundary sites for seals; ▪ Bancs des Flandres SAC; ▪ Doggersbank (Netherlands) SAC	Various	Various	Various	▪ Harbour seal (*Phoca vitulina*); and ▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	▪ Vessel disturbance; and ▪ Collision risk.	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
▪ Klaverbak SCI; ▪ Noordzeekustone SCI; ▪ SBZ 1 SCI; ▪ SBZ 2 SCI; ▪ SBZ 3 SCI; ▪ Vlaamse Banked SCI; ▪ Vlakte van de Raan SCI; ▪ Voordelta SCI; ▪ Waddenzee SCI; and ▪ Westerschelde & Saeftinghe SCI.							
Offshore and Intertidal Ornithology							
Greater Wash SPA	23.4	0.0	0.0	▪ Common scoter; ▪ Little gull; ▪ Red-throated diver; ▪ Little tern; ▪ Common tern; and ▪ Sandwich tern	▪ N/A	▪ Collision risk on migration due to the presence of turbines	▪ N/A
				▪ Common scoter; and ▪ Red-throated diver	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.	▪ Direct disturbance and displacement in the array area plus 4km buffer due to the presence of turbines (**red-throated diver only**).	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.
Humber Estuary SPA and Ramsar	52.7	12.1	10.7	▪ Avocet; ▪ Bar-tailed godwit; ▪ Bittern; ▪ Black-tailed godwit; ▪ Dunlin; ▪ Golden plover; ▪ Hen harrier; ▪ Knot; ▪ Little tern; ▪ Marsh harrier; ▪ Redshank; ▪ Ruff; ▪ Shelduck;	▪ N/A	▪ Collision risk on migration due to the presence of turbines	▪ N/A

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Pink-footed goose; ▪ Wigeon; ▪ Ringed plover; ▪ Curlew; ▪ Sanderling; ▪ Oystercatcher; ▪ Dark-bellied brent goose; ▪ Mallard; ▪ Pochard; ▪ Goldeneye; and ▪ Scaup.			
North Norfolk Coast SPA	56.4	29.9	29.9	▪ Sandwich tern	N/A	▪ Collision risk due to the presence of turbines	▪ N/A
				▪ Great bittern; ▪ Pink-footed goose; ▪ Dark-bellied brent goose; ▪ Eurasian wigeon; ▪ Eurasian marsh harrier; ▪ Pied avocet; ▪ Red knot; ▪ Common tern; and ▪ Little tern.	N/A	▪ Collision risk on migration due to the presence of turbines	▪ N/A
Flamborough and Filey Coast SPA	92.9	92.0	94.0	▪ Kittiwake; ▪ Gannet; and ▪ Herring gull*	N/A	▪ Collision risk due to the presence of turbines	▪ N/A
				▪ Guillemot; ▪ Razorbill; ▪ Gannet; and ▪ Puffin.	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.	▪ Direct disturbance and displacement in the array area plus 2km buffer due to the presence of turbines.	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.
Alde-Ore Estuary SPA	147.3	130.3	130.3	▪ Lesser black-backed gull	N/A	▪ Collision risk due to the presence of turbines	▪ N/A
Coquet Island SPA	257.0	258.8	258.1	▪ Sandwich tern (non-breeding)	N/A	▪ Collision risk due to the presence of turbines	▪ N/A
				▪ Common tern	N/A	▪ Collision risk on migration due to the presence of turbines	▪ N/A

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Puffin	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.	▪ Direct disturbance and displacement in the array area plus 2km buffer due to the presence of turbines.	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.
Farne Islands SPA	284.2	289.1	289.1	▪ Kittiwake ▪ Sandwich tern (non-breeding)	▪ N/A	▪ Collision risk due to the presence of turbines.	▪ N/A
				▪ Guillemot ▪ Puffin	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.	▪ Direct disturbance and displacement in the array area plus 2km buffer due to the presence of turbines.	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.
Scottish SPAs	Various	Various	Various	▪ Gannet ▪ Guillemot ▪ Razorbill ▪ Puffin	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones	▪ Direct disturbance and displacement in the array area plus 2km buffer due to the presence of turbines.	▪ Direct disturbance and displacement due to work activity and vessel movements in both the offshore and intertidal zones.
				▪ Gannet ▪ Kittiwake	▪ N/A	▪ Collision risk due to the presence of turbines	▪ N/A
Migratory Fish							
Humber Estuary SAC	53.1	18.5	17.1	▪ Sea lamprey *Petromyzon marinus*; and ▪ River lamprey *Lampetra fluviatilis*	▪ Underwater noise	▪ Underwater noise	▪ Underwater noise
River Derwent SAC	129.8	100.3	95.8	▪ River lamprey Lampetra fluviatilis	▪ Underwater noise	▪ N/A	▪ Underwater noise
Onshore Ecology							
Humber Estuary SPA	52.7	12.1	10.7	▪ Bittern (non-breeding and breeding); ▪ Shelduck (non-breeding); ▪ Marsh harrier (breeding); ▪ Hen harrier (non-breeding); ▪ Avocet (non-breeding and breeding); ▪ Golden plover (non-breeding); ▪ Knot (non-breeding); ▪ Dunlin (non-breeding); ▪ Ruff (non-breeding); ▪ Black-tailed godwit (non-breeding); ▪ Bar-tailed godwit (non-breeding);	▪ Loss of foraging, roosting and nesting habitat inside and outside the SPA for birds; ▪ Disturbance/ displacement of birds inside and outside the SPA; and ▪ Pollution from site run-off affecting habitat quality and resources.	▪ Disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds inside and outside SPA; and ▪ Pollution from site run-off affecting habitat quality.

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Redshank (non-breeding); ▪ Little tern (breeding); and ▪ Waterbird assemblage			
Humber Estuary Ramsar	52.7	12.1	10.7	Onshore Ramsar Features: ▪ Criterion 1- dune systems and humid dune slacks; ▪ Criterion 5 – assemblages of international importance (waterfowl, non-breeding season); ▪ Criterion 6 – species/populations occurring at levels of international importance: ▪ Shelduck; ▪ Golden plover; ▪ Knot; ▪ Dunlin; ▪ Black-tailed godwit; ▪ Bar-tailed godwit; and ▪ Redshank.	▪ Loss of estuary habitats such as dune systems and dune slacks; ▪ Loss of foraging, roosting and nesting habitat within the site and surrounding area; ▪ Disturbance of birds within and outside the site; ▪ Possible loss of estuary habitats; and ▪ Pollution from site run-off affecting habitat quality and resources.	▪ Damage to habitats and disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds within and outside the site; and ▪ Pollution from site run-off affecting habitat quality.
Humber Estuary SAC	53.1	18.5	17.1	▪ H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks; ▪ H1130. Estuaries; ▪ H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats; ▪ H1150. Coastal lagoons; ▪ H1310. Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand; ▪ H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); ▪ H2110. Embryonic shifting dunes ▪ H2120. Shifting dunes along the shoreline with Ammophila arenaria (white dunes); ▪ Shifting dunes with marram ▪ H2130. Fixed dunes with herbaceous vegetation (grey dunes); Dune grassland; and ▪ H2160. Dunes with *Hippophae rhamnoides*; Dunes with sea-buckthorn.	Pollution from site run-off affecting habitat quality (in-combination only).	N/A	Pollution from site run-off affecting habitat quality (in-combination only).
Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC	53.2	11.9	2.3	▪ Annex I habitats: ▪ 2110 Embryonic shifting dunes; ▪ 2120 "Shifting dunes along the shoreline with *Ammophila arenaria* (""white dunes"")";	▪ Disturbance and loss of Annex I habitats present within the SAC; and ▪ Reduction of habitat quality.	▪ Damage to habitats from operations and maintenance activities.	▪ Disturbance and loss of Annex I habitats present within the SAC; and ▪ Reduction of habitat quality.

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ 2130 "Fixed coastal dunes with herbaceous vegetation (""grey dunes"")" Priority feature; ▪ 2160 Dunes with *Hippophae rhamnoides*; and ▪ 2190 Humid dune slacks.			
The Wash SPA	65.5	16.4	0.1	▪ Bewick's swan (non-breeding); ▪ Pink-footed goose (non-breeding); ▪ Dark-bellied brent goose (non-breeding); ▪ Shelduck (non-breeding) ▪ Wigeon (non-breeding); ▪ Gadwall (non-breeding); ▪ Pintail (non-breeding); ▪ Common scoter (non-breeding); ▪ Goldeneye (non-breeding); ▪ Oystercatcher (non-breeding); ▪ Grey plover (non-breeding); ▪ Knot (non-breeding); ▪ Sanderling (non-breeding); ▪ Dunlin (non-breeding); ▪ Black-tailed godwit (non-breeding); ▪ Bar-tailed godwit (Non-breeding); ▪ Curlew (Non-breeding); ▪ Redshank (Non-breeding); ▪ Turnstone (Non-breeding); ▪ Common tern (Breeding); ▪ Little tern (Breeding); and ▪ Waterbird assemblage	▪ Loss of foraging, roosting, and nesting habitat within the site and surrounding area; ▪ Disturbance of birds within and outside the SPA; and ▪ Pollution from site run-off affecting habitat quality.	▪ Disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds outside SPA; and ▪ Pollution from site run-off affecting habitat quality.
The Wash Ramsar	65.5	16.4	0.1	▪ Criterion 1 – Saltmarshes, major intertidal banks of sand and mud, shallow water, and deep channels; ▪ Criterion 3 – inter-relationship between saltmarshes, intertidal sand, mudflats, and estuarine waters; ▪ Criterion 5 – Bird assemblages of international importance; ▪ Criterion 6 – Bird species/ populations occurring at levels of international importance: ▪ Species with peak counts in spring/autumn: ▪ Redshank; ▪ Curlew (breeding); ▪ Oystercatcher (wintering);	▪ Possible loss of or damage to estuary habitats; ▪ Loss of foraging and roosting habitat within the site and surrounding area; ▪ Disturbance of birds within and outside the site; and ▪ Pollution from site run-off affecting habitat quality.	▪ Damage to habitats and disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds outside the site; and ▪ Pollution from site run-off affecting habitat quality.

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Grey plover (wintering); ▪ Knot (wintering); and ▪ Sanderling. ▪ Species with peak counts in winter: ▪ Black-headed gull; ▪ Eider; ▪ Bar-tailed godwit; ▪ Shelduck; ▪ Dark-bellied brent goose; ▪ Dunlin; ▪ Pink-footed goose; ▪ Golden plover; and ▪ Lapwing. ▪ Species with peak counts in spring/autumn: ▪ Black-tailed godwit; and ▪ Ringed plover.			
The Wash & North Norfolk Coast SAC	47.8	13.4	0.1	▪ 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); ▪ 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*); ▪ 1150 Coastal lagoons *Priority feature; and ▪ Otter.	▪ Disturbance and loss of Annex I habitats present within the SAC; and ▪ Displacement of otter and reduction of otter habitat.	▪ Damage to habitats from operations and maintenance activities.	▪ Disturbance and loss of Annex I habitats present within the SAC; ▪ Reduction of habitat quality; and ▪ Displacement of otter.
Greater Wash SPA	23.4	0.0	0.0	▪ Breeding bird species: ▪ Sandwich tern; ▪ Common tern; and ▪ Little tern.	▪ Loss of foraging habitat outside the SPA for birds; ▪ Possible impact on migratory bird species using the site; ▪ Disturbance of birds within the SPA; and ▪ Pollution from site run-off affecting habitat quality and foraging resources.	▪ Disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds within SPA; and ▪ Pollution from site run-off affecting habitat quality and foraging resources.
Gibraltar Point SPA	62.1	13.3	2.3	▪ Grey plover (Non-breeding); ▪ Sanderling (Non-breeding); ▪ Bar-tailed godwit (Non-breeding); and ▪ Little tern (Breeding).	▪ Loss of foraging, roosting and nesting habitat outside the SPA; ▪ Disturbance of birds outside the SPA; and ▪ Pollution from site run-off affecting habitat quality.	▪ Disturbance/ displacement of birds arising from vehicles and workers accessing onshore structures for maintenance.	▪ Disturbance/ displacement of birds outside SPA; and ▪ Pollution from site run-off affecting habitat quality.
Gibraltar Point Ramsar site	62.1	13.3	2.3	▪ Onshore Ramsar Features: ▪ Ramsar Criterion 1: Coastal habitats – estuarine mudflats, sandbanks, and saltmarsh;	▪ Loss of foraging and roosting habitat for birds outside the Ramsar; ▪ Disturbance of birds outside the site;	▪ Damage to habitats and disturbance/ displacement of birds	▪ Disturbance/ displacement of birds outside the site; and

Designated Site	Distance to the Project (km)			Features screened in	Potential for Likely Significant Effect Identified		
	Array	Offshore ECC	Onshore ECC		Construction	O&M	Decommissioning
				▪ Ramsar Criterion 2: Red Data book invertebrates – including: ▪ *Haliplus mucronatus* (a water beetle, aquatic) ▪ *Brachytron pratense* (hairy dragonfly, aquatic) ▪ Ramsar criterion 5: Waterfowl. ▪ Ramsar criterion 6: Grey plover, sanderling, bar-tailed godwit, dark-bellied brent goose.	▪ Pollution from site run-off affecting habitat quality.	arising from vehicles and workers accessing onshore structures for maintenance.	▪ Pollution from site run-off affecting habitat quality.

8.2 Screening Undertaken for the Project In-Combination

8.2.1 The Habitats Regulations include a requirement for the Competent Authority to carry out an AA in respect of the likely significant effects of a plan or project alone and 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 based on the broader cable corridor is summarised above in 8.1, with screening for the Project in-combination undertaken within the Screening Report and the conclusions confirmed here. An updated screening exercise for projects to be considered will be undertaken before the final RIAA for application, factoring in the adjusted cable route and the reduction in array area, leading to a less precautionary but more proportionate assessment of projects.

8.2.2 The following list has been applied to the Project when identifying plans and projects for consideration in-combination (taking account of relevant advice, such as the Inspectorates Advice Note 10, which addresses which plans and projects to include, with the addition of relevant projects in operation):

- Projects in operation (that do not form part of the baseline or have an ongoing impact);
- Projects that are under construction;
- Permitted application(s) not yet implemented;
- Submitted application(s) not yet determined;
- All refusals subject to appeal procedures not yet determined;
- Projects on the National Infrastructure Planning's programme of projects; and
- Projects 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 and the degree of uncertainty which may be present.

8.2.3 A review of such plans and projects has been conducted for the Project, 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 for the corresponding cumulative effects assessment. The relevant cumulative plan/project screening tables to the receptor groups within the draft RIAA are presented within the PEIR chapters as follows:

- Table 9.19 from Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology;
- Table 10.17 from Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology;
- Table 11.35 from Part 6, Volume 1, Chapter 11: Marine mammals;
- Table 12.45 from Part 6, Volume 1, Chapter 12: Offshore and intertidal ornithology; and
- Table 21.16 from Part 6, Volume 1, Chapter 21: Onshore Ecology.

8.2.4 With respect to in-combination effects within the HRA process, the Screening Report (Outer Dowsing Offshore Wind, 2022) identified the broad categories of plans and projects to be considered within this draft RIAA. Further details are provided in Section 11, Assessment of Adverse Effects In-Combination. The specific plans and projects relevant to individual receptors draw on those identified within the individual PEIR chapters, as highlighted above, together with any additional plans or projects relevant to the designated site(s) under consideration. The intention of in-combination screening 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.

8.2.5 Further, it is acknowledged that the potential contribution to an in-combination AEoI by the Project could stem not only from those effects where potential LSE exists in relation to the Project alone (as highlighted in Table 8.1 above), but also potentially from an aspect of the Project that is not significant when considered alone, but that may become more relevant in-combination. As such, where the potential exists for the Project to contribute to potential LSE in-combination this has been considered, immaterial of whether a potential LSE alone applies or not.

8.2.6 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.

8.2.7 The approach applied to screening in-combination is outlined below.

8.2.8 A tiered approach has been applied to the in-combination assessment to reflect the different levels of uncertainty associated with the Project design and timeframes for the Projects screened into assessment. The allocated 'Tiers' reflect the current stage of the relevant projects 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 the Project.

8.2.9 The tiering structure applied is in common with that within relevant PEIR chapters, with the benthic ecology and migratory fish approach provided below in Table 8.2. For both offshore ornithology and marine mammals, a more detailed tiering structure has been applied to allow for the specific concerns for those receptors to be fully addressed and to ensure that there is a clear understanding of the level of confidence in the in-combination assessment within the draft RIAA. The tiering structure applied for offshore ornithology and marine mammals is defined in Table 8.3 and Table 8.4 respectively. In particular, it is noted that within Tier 1 there is significant variability in project certainty between a project in planning but not yet submitted to the Inspectorate, a project under construction and a project in operation, specifically as regards the 'final' scheme design and construction programme (noting that the assessment made here draws on the 'consented' and not 'as built' Project design envelope). 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 subject to change and is generally much greater in terms of impact/timeframe than the final project as defined at the point of construction - e.g. fewer turbines, more clearly defined (and often shorter) construction window, etc.

Table 8.2: Tiers applied for Benthic and Intertidal Ecology, and migratory fish

Tier	Description
Tier 1	Projects under construction; Consented projects (not yet under construction); and Projects with consent applications but not yet determined.
Tier 2	Projects on the Inspectorate's Programme of Projects where a Scoping Report has been submitted.
Tier 3	Projects on the Inspectorate's Programme of Projects where a Scoping Report has not been submitted; Projects identified in the relevant Development Plan; and Projects identified in other plans and programmes which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.

Table 8.3: Description of tiers of other developments considered within the marine mammal cumulative effect assessment (Natural England, 2022).

Tier	Consenting or Construction Stage
1	Built and operational projects should be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/or any residual impact may not have yet fed through to and been captured in estimates of "baseline" conditions.
2	Tier 1 + projects under construction.
3	Tier 2 + projects that have been consented (but construction has not yet commenced).
4	Tier 3 + projects that have an application submitted to the appropriate regulatory body that have not yet been determined.

Tier	Consenting or Construction Stage
5	Tier 4 + projects that have produced a PEIR and have characterisation data within the public domain.
6	Tier 5 + projects that the regulatory body are expecting an application to be submitted for determination (e.g. projects listed under the Inspectorate programme of projects).
7	Tier 6 + projects that have been identified in relevant strategic plans or programmes.

Table 8.4: Tiers applied for offshore and intertidal birds.

Tier	Sub-Tier	Description of stage of development of project
Tier 1	Tier 1a	Project under operation
	Tier 1b	Project under construction
	Tier 1c	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented
	Tier 1d	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined
Tier 2	N/A	Projects on the Inspectorate's Programme of Projects where a Scoping Report has been submitted
Tier 3	Tier 3a	Projects on the Inspectorate's Programme of Projects where a Scoping Report has not been submitted
	Tier 3b	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
	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

Benthic and Intertidal Ecology

8.2.10 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified the designated sites and relevant plans and projects to include for in-combination assessment. On a highly precautionary basis, the screening range used to identify projects was 20km from the designated sites screened in for the project alone, based on the tidal ellipse identified at screening (which has now been evidenced to be larger than the sediment modelling ranges). For Benthic and Intertidal Ecology, the plans and projects screened into the in-combination assessment i are provided in Table 8.5.

Table 8.5: Plans and projects identified for the Benthic and Intertidal ecology in-combination assessment

Development type	Project	Status	Tier
Offshore Windfarm	Sheringham Shoal Extension	In Examination	Tier 1[5]
	Dudgeon Extension	In Examination	Tier 1
	Inner Dowsing	Active/In Operation	Tier 1[6]
	Lincs	Active/In Operation	Tier 1
	Triton Knoll	Active/In Operation	Tier 1
	Dudgeon	Active/In Operation	Tier 1
	Race Bank	Active/In Operation	Tier 1
	Lynn	Active/In Operation	Tier 1
OWF Cables	Hornsea 3 Transmission Asset	Consented	Tier 1
Aggregate Production Area	Outer Dowsing Westminster Gravels Ltd (515/2)	Operation 01/01/2015 - 31/12/2029	Tier 1
	Outer Dowsing Westminster Gravels Ltd (515/1)	Operation 01/01/2015 - 31/12/2029	Tier 1
	Hanson Aggregates Marine Ltd (106/2)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (106/3)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (106/1)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (400)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (1805)	Operation	Tier 1
	Tarmac Marine Ltd (197)	Operation	Tier 1
	Tarmac Marine Ltd (493)	Operation	Tier 1
	Tarmac Marine Ltd (481/1)	Operation	Tier 1
	Van Oord Ltd (481/2)	Operation	Tier 1
	Aggregate area 2103	Operation	Tier 1

[5] Tier 2 criteria include projects on the Planning Inspectorate's Programme of Projects where a scoping report has been submitted (Planning Inspectorate, 2019).

[6] Tier 1 criteria include development under construction; permitted or submitted applications, whether under the PA2008 or other regimes, but not yet implemented (Planning Inspectorate, 2019).

Development type	Project	Status	Tier
	Race Bank Disposal Site	Active	Tier 1
	Hornsea Disposal Area 1	Active	Tier 1
Sea Disposal Site	Race Bank OWF	Open	Tier 1
Subsea Sables and Pipelines	Gas Shearwater to Bacton Seal Line (Shell)	Active/In Operation	Tier 1
	Viking CCS Pipeline	Proposed	Tier 1
	Hornsea 1 OFTO	Active	Tier 1
	Hornsea 2 OFTO	Active	Tier 1
	Triton Knoll	Under Construction	Tier 1
	Dudgeon OFTO	Active	Tier 1
	Race Bank OFTO	Active	Tier 1
	Lincs	Active	Tier 1
	Inner Dowsing	Active	Tier 1
	Lynn	Active	Tier 1
Oil and Gas Pipelines	Elgood to Blythe Gas Export	In-planning	Tier 1
	Elgood to Blythe Umbilical	In-planning	Tier 1
	Gas Shearwater to Bacton Seal Line (Shell)	Active	Tier 1
Oil and Gas Subsurface	Durango 48/21A-4	Precommissioned	Tier 1
	Pipeline PL370 Cut End Point 1	Precommissioned	Tier 1
	Pipeline PL370 Cut End Point 2	Precommissioned	Tier 1
Oil and Gas Surface	48/9A Mimas	Precommissioned	Tier 1
Carbon Capture and Storage (CCS)	SNS Area 1	In-planning	Tier 6
	SNS Area 2	In-planning	Tier 6
	SNS Area 3	In-planning	Tier 6
	SNS Area 4	In-planning	Tier 6
	SNS Area 5	In-planning	Tier 6
	SNS Area 6	In-planning	Tier 6
	SNS Area 7	In-planning	Tier 6
	SNS Area 8	In-planning	Tier 6
	NNS Area 1	In-planning	Tier 6
	NNS Area 2	In-planning	Tier 6
	EIA Area 1	In-planning	Tier 6
	CNS Area 1	In-planning	Tier 6
	CNS Area 2	In-planning	Tier 6

8.2.11 It is worth noting here that at the time of writing this draft RIAA, the Aggregate Area 2103, Viking CCS pipelines, and CCS Areas have not been assessed in-combination due to a lack of information on the projects including estimated timescales. The list of projects considered in-combination will be revisited for the final RIAA and these two projects will be considered further within the revised assessment.

Marine mammals

8.2.12 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified the designated sites and relevant plans and projects to include for in-combination assessment. On a highly precautionary basis, the screening range used to identify projects was based on the species specific MUs. For Marine Mammals, the plans and projects screened into the in-combination assessment are provided in Table 8.6.

Table 8.6 Marine mammal in-combination short list. HP = harbour porpoise, HS = harbour seal and GS = grey seal. 'Y' indicates that the Project is within the species-specific MU, , 'N' indicates that the Project is not within the species-specific MU (and is thus screened out for that specific species)

Development Type	Project	Status	Tier	HP	HS	GS
Offshore windfarm	The Project	-	-	y	y	y
	Berwick Bank	In-planning	1	y	n	n
	Blyth Demonstration Phases 2&3	Consented	3	y	n	y
	Borkum Riffgrund 3	Planned	3	y	n	n
	Campion	Pre-planning Application	6	y	n	n
	Cluaran Deas Ear DEME E3	Pre-planning Application	6	y	n	n
	Courseulles-sur-mer	Consented	3	y	n	n
	Dogger Bank A	Under Construction	1	y	n	n
	Dogger Bank B	Under Construction	1	y	n	N
	Dogger Bank C	Under Construction	2	y	y	y
	Dogger Bank South (East)	Pre-planning	6	y	n	n
	Dogger Bank South (West)	Pre-planning	6	y	n	n
	Dieppe - Le Treport	Consented	3	y	n	n
	Dudgeon Extension	In-planning	4	y	y	y
	East Anglia 1N	Consented	3	y	y	y
	East Anglia 2	Consented	3	y	y	y
	East Anglia 3	Consented	3	y	y	y
	EnBW He Dreiht	Consented	3	y	n	n
	Endurance	Concept/Early Plan	6	y	y	y
	Fecamp	Consented	3	y	n	n
	Five Estuaries	Pre-planning Application	5	y	y	y
	Forthwind Ltd	Planned	6	y	n	n
	Gode Wind 3	Consented	3	y	n	n

Development Type	Project	Status	Tier	HP	HS	GS
	Hollandse Kust Nord	Construction	2	y	n	n
	Hollandse Kust (West)	Planned	6	y	n	y
	Hollandse Kust (Zuid)	Construction	2	y	n	n
	Hornsea 3	Consented	3	y	y	y
	Hornsea 4	In Planning	4	y	y	y
	Inch cape	Construction	2	y	n	n
	Moray west	Consented	3	y	n	n
	Morven BP E1	Pre- planning Application	6	y	n	n
	Muir Mhor	Pre-planning application	6	y	n	n
	N-10.1 (DE3C)	Planned	6	y	n	n
	N-10.2 (DE3I)	Planned	6	y	n	n
	North Sea Cluster – Nordsee Three (N-3.5)	Concept/Early Planning	6	y	n	n
	North Sea Cluster – Delta Nordsee 1&2 (N-3.6)	Concept/Early Planning	6	y	n	n
	North Sea Cluster – Gode Wind (N-3.7)	Concept/Early Planning	6	y	n	n
	North Sea Cluster – Nordsee Two (N-3.8)	Concept/Early Planning	6	y	n	n
	Atlantis 1 (N-6.6)	Planned	6	y	n	n
	N-6.7	Planned	6	y	n	n
	Global Tech II (N-7.2)	Concept/Early Planning	6	y	n	n
	N-9.1	Planned	6	y	n	n
	N-9.2	Planned	6	y	n	n
	N-9.3	Planned	6	y	n	n
	Nordsoen II vest	Planned	6	y	n	n
	Nordsoen III vest	Planned	6	y	n	n
	Norfolk Boreas	Consented	3	y	y	y
	Norfolk Vanguard East	Consented	3	y	y	y
	Norfolk Vanguard West	Consented	3	y	y	y

Development Type	Project	Status	Tier	HP	HS	GS
	North Falls	Pre-planning Application	6	y	y	y
	Parc eolien pose au large de la Normadie (AO4)	Planned	6	y	n	n
	Pentland floating demonstrator	Application submitted	4	y	n	n
	Perpetuus Tidal Energy	Approved	3	y	n	n
	Rampion 2	Pre-planning Application	5	y	y	y
	SeaGreen Offshore Windfarm	Under Construction	2	y	n	n
	Sheringham Shoal Extension	Application submitted	4	y	y	y
	Sofia	Under Construction	2	y	y	y
	Thor	Concept/Early plan	6	y	n	n
	Vesterhav Nord	Consented	3	y	n	n
	Vesterhav Syd	Consented	3	y	n	n
	West of Orkney	Pre-planning Application	6	y	n	n
CCS	SNS Area 1	In-planning	6	Y	n	n
	SNS Area 2	In-planning	6	Y	n	n
	SNS Area 3	In-planning	6	Y	n	Y
	SNS Area 4	In-planning	6	Y	Y	Y
	SNS Area 5	In-planning	6	Y	n	n
	SNS Area 6	In-planning	6	Y	Y	Y
	SNS Area 7	In-planning	6	Y	n	n
	SNS Area 8	In-planning	6	Y	n	Y
	NNS Area 1	In-planning	6	Y	n	n
	NNS Area 2	In-planning	6	Y	n	n
	EIA Area 1	In-planning	6	Y	n	n
	CNS Area 1	In-planning	6	Y	n	n
	CNS Area 2	In-planning	6	y	n	n

8.2.13 It is worth noting here that at the time of writing this draft RIAA, the CCS projects have not been assessed in-combination due to a lack of information on the projects including estimated timescales. The list of projects considered in-combination will be revisited for the final RIAA and these two projects will be considered further within the revised assessment.

Offshore and Intertidal Ornithology

8.2.14 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified the designated sites and relevant plans and projects to include for in-combination assessment.

8.2.15 In terms of plans and projects to be considered, the conclusions of the screening for other plans and projects considered relevant for offshore and intertidal ornithology are provided in Table 8.7.

Table 8.7: Projects considered relevant to the in-combination assessment for offshore and intertidal ornithology.

Project	Status	Tier
Beatrice	Active	1a
Blyth Demonstration Site	Active	1a
Dudgeon	Active	1a
East Anglia One	Active	1a
EOWDC	Active	1a
Galloper	Active	1a
Greater Gabbard	Active	1a
Gunfleet Sands	Active	1a
Hornsea Project One	Active	1a
Hornsea Project Two	Active	1a
Humber Gateway	Active	1a
Hywind	Active	1a
Kentish Flats	Active	1a
Kentish Flats Extension	Active	1a
Kincardine	Active	1a
Lincs, Lynn & Inner Dowsing	Active	1a
London Array	Active	1a
Methil	Active	1a
Race Bank	Active	1a
Rampion	Active	1a
Scroby Sands	Active	1a
Sheringham Shoal	Active	1a
Teesside	Active	1a
Thanet	Active	1a
Westermost Rough	Active	1a
Triton Knoll	Active	1a
Moray East	Under Construction	1b
Neart na Gaoithe	Under Construction	1b

Project	Status	Tier
Seagreen Alpha	Under Construction	1b
Seagreen Bravo	Under Construction	1b
Dogger Bank A	Under Construction	1b
Dogger Bank B	Under Construction	1b
Sofia	Under Construction	1b
Firth of Forth Alpha	Under Construction	1b
Firth of Forth Bravo	Consented	1c
East Anglia Three	Consented	1c
Dogger Bank C	Consented	1c
Hornsea Three	Consented	1c
Inch Cape	Consented	1c
Moray West	Consented	1c
Norfolk Boreas	Consented	1c
Norfolk Vanguard	Consented	1c
East Anglia ONE North	Consented	1c
East Anglia TWO	Consented	1c
Hornsea Four	In Planning	1d
Dudgeon Extension Project	In Planning	1d
Sheringham Shoal Extension Project	In Planning	1d
Rampion 2	In Planning	2
Berwick Bank	In Planning	2
Five Estuaries	In Planning	2
Dogger Bank South (East and West)	In Planning	2
Dogger Bank D	In Planning	2
Ayre	Pre-planning	3a
Beech North	Pre-planning	3a
Beech South	Pre-planning	3a
Bellrock	Pre-planning	3a
Bowdun	Pre-planning	3a
Buchan Offshore Wind	Pre-planning	3a
Caledonia	Pre-planning	3a
CampionWind	Pre-planning	3a
Cenos	Pre-planning	3a
Green Volt	Pre-planning	3a
MarramWind	Pre-planning	3a
Morven	Pre-planning	3a
Muir Mhor	Pre-planning	3a
Ossian	Pre-planning	3a
Salamander	Pre-planning	3a
Scaraben	Pre-planning	3a
Sinclair	Pre-planning	3a

Project	Status	Tier
Stromar	Pre-planning	3a

8.2.16

Migratory fish

8.2.17 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified the designated sites and relevant plans and projects to include for in-combination assessment (plans or projects which are located within 100 km of the designated site). For migratory fish, the sites identified are the Humber Estuary SAC and the River Derwent SAC.

8.2.18 In terms of plans and projects to be considered, the conclusions of the screening for other plans and projects considered relevant for migratory fish are provided in Table 8.8.

Table 8.8: Projects considered within the fish and shellfish ecology cumulative impact assessment

Development type	Project	Status	Tier
Offshore Windfarm	Norfolk Boreas	Consented	Tier 1
	Sheringham Shoal Extension	Examination	Tier 1
	Dudgeon Extension	Examination	Tier 1
	Dudgeon	Active/In Operation	Tier 1
	Lincs	Active/In Operation	Tier 1
	Race Bank	Active/In Operation	Tier 1
	Inner Dowsing	Active/In Operation	Tier 1
	Triton Knoll	Active/In Operation	Tier 1
	Hornsea Project Three	Consented	Tier 1
	Hornsea Project Four	In Planning	Tier 1
Aggregate Production Area	Westminster Gravels Ltd (515/2)	Operation	Tier 1
	Westminster Gravels Ltd (515/1)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (106/2)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (106/3)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (106/1)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (400)	Operation	Tier 1
	Hanson Aggregates Marine Ltd (1805)	Operation	Tier 1
	Tarmac Marine Ltd (197)	Operation	Tier 1

Development type	Project	Status	Tier
	Tarmac Marine Ltd (493)	Operation	Tier 1
	Tarmac Marine Ltd (481/1)	Operation	Tier 1
	Van Oord Ltd (481/2)	Operation	Tier 1
	Aggregate area 2103	Operation	Tier 1
Oil an5d Gas Platforms	49/11B TETHYS	Operation	Tier 1
	48/9A MIMAS	Operation	Tier 1
Cables and Pipelines	Eastern Link Cable (National Grid).	Proposed	Tier 3
Carbon Capture and Storage	Endurance	In-planning	Tier 1
	SNS Area 2	In-planning	Tier 6
	SNS Area 3	In-planning	Tier 6
	SNS Area 4	In-planning	Tier 6
	SNS Area 6	In-planning	Tier 6
	SNS Area 7	In-planning	Tier 6
	SNS Area 8	In-planning	Tier 6

8.2.19 It is worth noting here that at the time of writing this draft RIAA, the Eastern Link Cable (National Grid), and the CCS projects have not been assessed in-combination due to a lack of information on the projects including estimated timescales. The list of projects considered in-combination will be revisited for the final RIAA and these eight projects will be considered further within the revised assessment.

Onshore Ecology

8.2.20 The Screening Report (Outer Dowsing Offshore Wind, 2022) identified the designated sites and relevant plans and projects to include for in-combination assessment. In terms of plans and projects to be considered, the conclusions of the screening for other plans and projects considered relevant for onshore ecology are provided in Table 8.9:

8.2.21 Table 8-9: Projects identified at Screening to be considered within the onshore ecology cumulative impact assessment

Development type	Project	Status and details	Tier
Energy	Boston Alternative Energy Facility (BAEF)	South of Boston, by The Haven. DCO application submitted 2021, to be decided July 2023.	1
Solar	Heckington Fen Solar Park	DCO application submitted in 2023. Located 17km NW of the Project, to the west of Boston.	1
Gas	Transition to Integrated Gas and	Located entirely offshore, more than 12	2

Development type	Project	Status and details	Tier
	Renewable Energy (TIGRE) Project 1	nm. Gas fired power station connecting in to offshore substation. Pre-application.	
Onshore cable	Triton Knoll Electrical System	The works, which commenced in September 2018, involved laying 57 km of 220kV underground cable from the project's landfall location near Anderby Creek to the newly constructed Triton Knoll Onshore Substation near Bicker Fen. Completed October 2021.	1
Offshore wind	Triton Knoll Offshore Windfarm (TKOWF)	Offshore construction commenced in January 2020, 20 miles off the coast of Lincolnshire. Turbine commissioning was successfully completed in January 2022	1
Offshore wind	Hornsea Project Four	Decision phase of the DCO process following the close of Examination in August 2022. Onshore cable route in East Yorks.	1
Offshore wind	Hornsea Project Three	Offshore windfarm. Has received DCO.	1
Offshore wind	Hornsea Project Two	Operational offshore windfarm.	1
Offshore wind	Hornsea Project One	Operational offshore windfarm.	1
Quays and industrial facility	Able Marine Energy Park	320 ha of developable land and 1300m of new deep water quays, specifically designed for the offshore wind sector. on the south bank of the Humber Estuary.	1

Development type	Project	Status and details	Tier
		DCO issued in 2013 and site operational.	
Quays and industrial facility	Able Marine Energy Park – Material Change 1	To move an area (referred to as "Mitigation Area A" in the 2014 Order) proposed for ecological mitigation to a new site. Change granted.	1
Quays and industrial facility	Able Marine Energy Park – Material Change 2	To alter the alignment of the quay, removing the specialist berth at the southern end of the quay and setting back the quay line at the northern end, creating a barge berth. The Application also seeks changes to the 2014 Order to allow amendments to dredging and sediment disposal patterns arising from the new quay alignment, and the option of a more efficient construction methodology, identified during the design process. I Proposed changes have been authorised.	1
Energy	South Humber Bank Energy Centre	The construction and operation of an energy from waste plant of up to 95 megawatts gross capacity. DCO granted in 2021. The project website advises that construction of SHBEC will commence as early as 2022. The construction phase is expected to last for approximately 36	1

Development type	Project	Status and details	Tier
		months, with the EfW power station entering operation in 2025.	
Highways	A160-A180 Port of Immingham Improvement	The project would widen the existing single carriageway section of the A160 to dual carriageway, Granted in 2015.	1
Offshore wind	Dogger Bank South Offshore Windfarms (East and West)	Offshore of East Yorkshire. Onshore study area north of Hull. Plan to publish the PEIR around Spring 2023.	
Pipeline	Humber Low Carbon Pipelines	New onshore pipeline infrastructure to transport the captured carbon emissions from the region's industrial emitters for safe storage in the North Sea, and enable industries to fuel-switch from fossil fuels to low-carbon hydrogen. PEIR submitted 2022.	1
Energy	North Killingholme Power Project	The proposal is for a new thermal generating station that will operate either as a Combined Cycle Gas Turbine (CCGT) plant or as an Integrated Gasification Combined Cycle (IGCC) plant, with a total electrical output of up to 470 Mwe. Granted in 2014.	1
Pipeline	River Humber Gas Pipeline Replacement Project	The replacement of a 42 natural gas transmission pipeline, housed within a tunnel beneath the Humber Estuary commencing approximately 2 miles	1

Development type	Project	Status and details	Tier
		north east of Goxhill, North Lincolnshire, terminating approximately 1 mile south east of Paull, East Riding of Yorkshire Decided 2016.	
Highways	A63 Castle Street Improvement Hull	The Scheme comprises improvements to approximately 1.5km of the A63 and connecting side roads in Hull between Ropery Street and the Market Place/Queen Street junction. Granted in 2020.	1
Energy	Medworth Energy from Waste Cobined Heat and Power (CHP) Facility	An Energy from Waste combined heat and power facility with a maximum gross capacity of 58MW. Examination in 2023. Located ~24 km from the Project and 16 km from the Wash SPA and Ramsar.	1

9 Summary of Designated Sites

9.1.1 Summary information on each designated site screened in for potential LSE alone and/or in combination is provided in the Screening Report (Outer Dowsing Offshore Wind, 2022), including the designated feature(s), key literature sources describing the site and the features/effects screened for potential LSE. The conservation objectives for each site are also provided in addition to being presented at the beginning of each alone assessment.

10 Stage 2: Assessment of Adverse Effect Alone

10.1.1 Where potential for LSE on a designated 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 information is presented below according to the following receptor groupings:

- Benthic and Intertidal Ecology;
- Marine Mammals;
- Offshore Ornithology;
- Migratory Fish; and
- Onshore Ecology.

10.1.2 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 LSE. To minimise the potential for repetition, the determination of AEoI 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.

10.1.3 The nature of each relevant effect is then described (e.g. in terms of scale, duration, frequency, etc), drawing on the relevant project literature, and summarising the relevant conclusion from the PEIR. A conclusion on AEoI is then drawn for each site feature screened in, with these conclusions summarised on a site-by-site basis in Table 13.1.

10.2 Benthic and Intertidal Ecology

Assessment criteria

10.2.1 This draft RIAA has been prepared in accordance with Advice Note 10: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (the Inspectorate, 2017), with the method for determining potential impact with respect to benthic and intertidal ecology being compliant with the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines (CIEEM, 2016).

10.2.2 The assessment criteria and conclusions presented within Part 6, Volume 1, Chapter 9: Benthic 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.

10.2.3 Full details of the assessment criteria and assignment of significance applied within the PEIR are provided within Section 3.6 of Part 6, Volume 1, Chapter 9: Benthic 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); and
- Significance of potential effect in terms of large/moderate/slight and negative/beneficial (defined in a matrix combining sensitivity and magnitude).

Maximum Design Scenario

10.2.4 Table 10.2Below summarises the Maximum Design Scenario(s) considered for benthic and intertidal ecology as described in Table 9.10 within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology. The full project description is provided in Part 6, Volume 1, Chapter 3: Project Description for full reference.

Table 10.1: Maximum Design Scenario for Benthic and Intertidal Ecology from the Project Alone

Potential effect	Maximum design scenario assessed	Justification
Construction		
Habitat loss/disturbance	Temporary habitat disturbance of 34,129,640m^2. **<u>Array Area</u>** **Foundation seabed Preparation** = 860,600 m^2 ▪ 93 WTGs (jacket foundations with suction buckets) = 762,600m^2 ▪ A maximum of four Offshore Substations (jacket foundations with suction buckets) = 78,400m^2 ▪ One accommodation platform= 19,600m^2 **Jack-up vessels (JUV) and anchoring operations** = 1,035,700m^2 ▪ 475 JUV operations with a maximum disturbance of 1,500m^2 per operation = 712,500m^2 ▪ 388 anchoring operations with a maximum disturbance of 800m^2 per operation = 310,400m^2 ▪ 16 anchoring operations with a maximum disturbance of 800m^2 per operation for Offshore Substation (OSS) installation = 12,800m^2 **Cable seabed preparation and installation in the array area** = 17,091,000m^2 ▪ Total area of seabed disturbed by sandwave clearance in array = 8,545,500m^2 ▪ Total area of seabed disturbed by boulder clearance in array = 8,545,500m^2 **Cable burial** ▪ Total area of seabed disturbed by cable burial in array (total length 351,000m) = 6,318,000m^2	The subtidal temporary disturbance relates to seabed preparation for foundations and cables, jack up and anchoring operations, and cable installation. It should be noted that where boulder clearance overlaps with sandwave clearance, the boulder clearance footprint will be within the sandwave clearance footprint. The MDS for temporary habitat disturbance in the intertidal area from the trenchless technique is included. It is important to note that trenchless technique exit pits are likely to be located below MLWS.

Potential effect	Maximum design scenario assessed	Justification
	Offshore ECC **Cable seabed preparation in the offshore ECC** = 9,260,000m^2 ▪ Total area of seabed disturbed by sandwave clearance for offshore ECC = 4,630,000m^2 ▪ Total boulder clearance impact area in offshore ECC = 4,630,000m^2 **Cable burial in the offshore ECC** = 5,840,640m^2 ▪ Burial of export cables (total length 514,800m) length = 5,840,640m^2 ▪ The seabed footprint for cable jointing is within the Project design envelope for seabed preparation and cable installation. **Temporary intertidal habitat disturbance =** 2,500m^2 ▪ Temporary intertidal trenchless technique exit pit working area = 2,500m^2 **Offshore Reactive Compensation Platforms** = 39,200 m^2 ▪ A maximum of two Offshore Reactive Compensation Platforms (ORCPs) = 39,200 m^2 ▪ 16 anchoring operations with a maximum disturbance of 800m^2 per operation for ORCPs installation = 12,800m2	
Temporary increase in suspended sediment and sediment deposition	**Total sediment volume = 40,654,120m^3** **Foundation seabed preparation** = 3,715,400m^3 ▪ 93 GBS WTG foundations = 3,375,900m^3 ▪ Four offshore transformer substations (GBS foundations) = 194,000m^3 ▪ One Accommodation platform GBS foundations = 48,500m^3 ▪ Two ORCPs = 97,000m^3	The MDS for foundation installation results from the largest volume suspended from seabed preparation and presents the worst case for WTG installation. For cable installation, the MDS results from the greatest volume from

Potential effect	Maximum design scenario assessed	Justification
	Sandwave clearance for cable installation in the array = 15,245,280m^3 ▪ Sandwave clearance for array cables resulting in the suspension of 10,108,800m^3 of sediment ▪ Sandwave clearance for interlink cables resulting in the suspension of 3,564,000m^3 of sediment ▪ Sandwave clearance for 128.7km of export cables within the array area resulting in the suspension of 1,572,480m^3 of sediment **Sandwave clearance for cable installation in the offshore ECC = 5,840,640m^3** ▪ Sandwave clearance for 101.4km of export cables within the offshore ECC resulting in the suspension of 5,840,640m^3 of sediment. **Cable trenching = 15,832,800 m^3** ▪ Installation of 123.75km of inter-array cables and export cables by mass flow excavation resulting in the suspension of 15,832,800m^3 of sediment **Trenchless techniques – Exit Pits** ▪ Up to 6 exit pits (allowing for two failures) resulting in the suspension of up to 20,000 m^3 which will be side cast onto the adjacent seabed. Backfilling of exit pits will recover a similar amount from the surrounding seabed, as required.	sandwave clearance and installation. This also assumes the largest number of cables and the greatest burial depth. The MDS for temporary habitat disturbance in the intertidal area from the trenchless technique is included. It is important to note that HDD exit pits are likely to be located below MLWS. The maximum volume of bentonite which could be released as part of the landfall activities is considered. For this assessment, it is considered that the bentonite would not be captured and is released into the marine environment.
Direct and indirect seabed disturbances leading to the release of sediment contaminants	The MDS for seabed disturbance are presented in the temporary increase in suspended sediment and sediment deposition effect above	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.

Potential effect	Maximum design scenario assessed	Justification
Operation and Maintenance		
Habitat loss	**Habitat loss of 5,535,794m²** ▪ Turbine total structure footprint including scour protection, based on 93 GBS (WTG-type) foundations = 1,143,900m² ▪ Structure footprint of four offshore transformer substations (GBS) = 64,968m³ ▪ One Accommodation platform = 16,242m² ▪ Two ORCPs = 32,484m² ▪ Total area of seabed covered by cable protection (export cables and inter-array) required for cable crossings = 320,000m² ▪ Total area of seabed covered by cable protection (export cables and inter-array), assuming 25% of the cable requires protection =3,958,200m² ▪	The MDS is defined by the maximum area of seabed lost as a result of the placement of structures, scour protection, cable protection and cable crossings. The MDS also considers that scour protection is required for all foundations. Habitat loss from the presence of drill arisings generated in the construction phase is of a smaller magnitude than the presence of project infrastructure.
Habitat disturbance	**Total direct disturbance to seabed from repair activities= 17,741,760m²** ▪ Total seabed area disturbed by array cable repairs = 150,000m² ▪ Total seabed area disturbed by OP and accommodation platform repairs = 90,000m² ▪ Total seabed area disturbed by export cable repairs = 7,650,000m² ▪ Total seabed area disturbed by export cable reburial = 5,580,000m² ▪ Total seabed area disturbed by interlink cable reburial =1,800,000m² ▪ Total seabed area disturbed by interlink cable repairs = 60,000m² ▪ Total seabed area disturbed by WTG repairs = 2,411,760m² **Total direct disturbance to seabed from replacement activities= 7,641,500m²** ▪ Total seabed disturbance from array cable remedial burial = 5,250,000m²	Defined by the maximum number of jack-up vessel operations and the total cable replacement through life maintenance activities that could have an interaction with the seabed anticipated during operation.

Potential effect	Maximum design scenario assessed	Justification
	▪ Total seabed disturbance from OP and accommodation platform component replacement = 67,500m^2 ▪ Total seabed disturbance from OP and accommodation platform foundation anode replacement = 63,000m^2 ▪ Total seabed disturbance from ECC remedial burial = 5,580,000m^2 ▪ Total seabed disturbance from ECC repairs = 765,000m^2 ▪ Total seabed disturbance from ECC repairs jacking up activities = 76,500m^2 ▪ Total seabed disturbance from interlink cable remedial burial = 1,800,000m^2 ▪ Total seabed disturbance from interlink cable repairs = 60,000m^2 ▪ Total seabed disturbance from interlink cable repairs jacking up activities = 9,000m^2	
Colonisation of the WTGs and scour/cable protection	**Total surface area of introduced hard substrate in the water column = 7,933,384m^2** ▪ Total area of introduced hard substrate at seabed level = 7,514,102m^2 ▪ Total surface area of subsea portions of WTG foundations in contact with the water column: 407,282m^2 ▪ Total surface area of subsea portions of OSS foundations in contact with the water column: 12,000m^2	Maximum scenario for introduced hard substrate is as for the maximum scenario for loss of habitat.
Increased risk of introduction or spread of marine INNS	▪ **Total area of introduced hard substrate = 7,933,384m^2** (calculated from **Impact 3** above) ▪ Total of 2216 annual round trips for all O&M vessels	Maximum scenario for increased risk of introduction or spread of marine INNS is as for the maximum scenario introduced hard substrate.
Changes in physical processes	▪ See MDS presented in Volume 1, Chapter 7: Marine Processes	
EMF	▪ Up to 351km of inter-array cables, operating up to 132kV ▪ Up to 123.75km of interlink cables, operating up to 275kV. ▪ Up to 514.8km of export cable, operating at +/-275kV	Maximum scenario for EMF is defined by the maximum electric current, least favourable cable

Potential effect	Maximum design scenario assessed	Justification
	▪ Cable burial depth (Inter-array, interlink and export cable) = up to 3m	type and cable laying geometry and shallowest depth of burial.
Decommissioning		
Habitat disturbance	MDS is identical (or less) to that of the construction phase. Temporary habitat disturbance of 34,129,640m^2.	MDS is identical (or less) to that of the construction phase.
Temporary increase in suspended sediment and sediment deposition	MDS is identical (or less) to that of the construction phase. Total subtidal sediment volume = **40,654,120**m^3	MDS is identical (or less) to that of the construction phase.
Direct and indirect seabed disturbances leading to the release of sediment contaminants	MDS is identical (or less) to that of the construction phase. Total subtidal sediment volume = **40,654,120**m^3	MDS is identical (or less) to that of the construction phase.

250000 300000 350000 400000 450000 500000

6050000 6000000 5950000 5900000 5850000 5800000

N

Humber Estuary

Gibraltar Point

The Wash

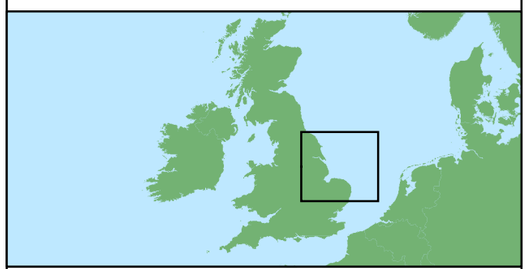
The Wash and North Norfolk Coast

Inner Dowsing, Race Bank and North Ridge

North Norfolk Sandbanks and Saturn Reef

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Ramsar Site
- Special Areas of Conservation



Coordinate System: WGS 1984 UTM Zone 31N

0 25 50 km

Scale: 1:1,000,000

Sites Considered for Benthic and Intertidal Ecology

Figure 10.1

OUTER DOWSING OFFSHORE WIND

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Description of significance

10.2.5 A description of the significance of project level effects upon the receptors grouped under 'Benthic and intertidal Ecology', as relevant to the designated sites and associated features that were screened in for potential LSE is provided below.

10.2.6 As described in Table 8.1, and presented within Figure 10.1 there are seven sites which have the potential for LSE for benthic and intertidal ecology features. The sites are discussed below in relation to the LSE identified.

Construction and decommissioning

Temporary increases in suspended sediment/deposition

10.2.7 This section addresses the potential for AEoI from effects associated with the dispersion of suspended sediments and any associated deposition and smothering, expected from foundation and cable installation works (including intertidal works) and seabed preparation works (including, for example, sandwave clearance). This assessment should be read in conjunction with Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology, and Part 6, Volume 1, Chapter 7: Marine Processes which provides the detailed offshore physical environment assessment (including project specific modelling of sediment plumes). Table 5.12 within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology presents the MDS associated with increases in SSC and deposition for benthic and intertidal ecology receptors.

10.2.8 The potential for an AEoI as a result of temporary increases in suspended sediment /deposition during construction and decommissioning relates to the following designated sites and relevant features (i.e. those features screened in for potential LSE):

- North Norfolk Sandbanks and Saturn Reef SAC;
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC;
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC;
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - Salicornia and other annuals colonizing mud and sand; and
  - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Humber Estuary Ramsar;

- Dune systems with humid dune slacks,
- Estuarine waters;
- Intertidal mud and sand flats;
- Saltmarshes; and
- Coastal brackish/saline lagoons.

- Humber Estuary SAC;
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - Salicornia and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- Gibraltar Point Ramsar; and
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes.
- The Wash Ramsar.
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels.

10.2.9 The conservation objectives for these sites 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.

10.2.10 Sediment plumes caused by seabed preparation and construction activities are expected to be restricted to within a single tidal excursion from the point of release, which is captured by the benthic ecology study area and secondary zones of influence (ZoIs) (Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology). Sediment plumes are expected to quickly dissipate after cessation of the construction activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels (i.e., within a couple of tidal cycles). Sediment deposition will consist primarily of coarser sediments deposited close to the source (a few hundred meters), with a small proportion of silt deposition (reducing exponentially from source).

10.2.11 Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology supports this and details that the results of the modelling can be summarised broadly in terms of three main zones of effect: 0-50 m, 50 to 500 m and 500 m to the tidal excursion buffer distance. As can be expected, the highest increase in SSC and greatest likely thickness of deposition will occur in the 0-50 m zone, where all gravel sized sediment and also a large proportion of sands that are not resuspended high into the water column will settle. As distance increases the thickness of deposition and levels of SSC is likely to decrease with mainly fines remaining in suspension.

10.2.12 There is the potential for an increase in SSCs and subsequent deposition to result from construction and decommissioning operations. The conservation objectives for the site are identified above, with these taken into account when concluding the potential for effect.

10.2.13 Temporary, intermittent and localised increases in SSC 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 activities including seabed preparation, sediment disposal and the cable installation works. Volume 2, Annex 7.1: Marine Processes Technical Baseline provides a full description of the physical assessment, Part 6, Volume 1, Chapter 7: Marine Processes assessed the increase in suspended sediments, with the subsequent effect on benthic habitats and species assessed in Part 6, Volume 1, Chapter 9: Benthic Subtidal and Intertidal Ecology. A summary of the existing baseline and the maximum design scenarios associated with the impact summarised below.

10.2.14 Background surface SSCs within the Project array area are known to vary seasonally, with higher concentrations occurring during spring tides and storm conditions, with the greatest concentrations encountered close to the bed. Within the array area, surface SSCs are generally low, with concentrations up to 5mg/l recorded between the period 1998 to 2015 (Cefas, 2016). Within the nearshore zone of the offshore ECC, SSCs are much higher, being directly under the influence of terrestrial sources from the Humber Estuary and Holderness Cliffs, such that concentrations reach around 60mg/l, between the period 1998 to 2015 (Cefas, 2016). These concentrations also coincide with the winter months when a greater frequency of storm events and fluvial inputs (including storm runoff) can be expected to occur. During the summer months, for example July, maximum values are of the order of 12mg/l (Cefas, 2016). Site specific turbidity data from a metocean buoy currently deployed in the array area show similar concentrations, with surface values of approximately 5mg/l, rising to up to 12mg/l in the mid-water, and up to 18mg/l lower in the water column during the summer months.

10.2.15 Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology states that the maximum distance and as such the overall spatial extent that any resultant plume might be reasonably experienced can be estimated as the spring tidal excursion distance. Specifically, MFE, seabed levelling and sandwave clearance activities may produce sediment plumes with SSC up to thousands of mg/l, however these concentrations will be spatially restricted and of short-lived. Elevated SSC may be advected by tidal currents up to 20km away, although these concentrations will be low. In the vast majority of cases, elevated SSC will be indistinguishable from background levels after 20 hours from the start of activities and can therefore be considered temporary and localised. Associated deposition from sediment plumes is generally in the order of tens to low hundreds of mm within several hundreds of metres from the point of disturbance. Sediment deposition following MFE activities of up to 50mm is expected in the immediate vicinity of the active disturbance. With thicknesses between 5 and 20mm deposited up to 600m away from the active disturbance area, reducing to low tens of mm downstream of the disturbance. Sediment deposition is generally not measurable beyond 3km to 5km away from the associated activities and is therefore generally small-scale and restricted to the near-field. This deposition is likely to become integrated into the local sediment transport regime and will be redistributed by tidal currents.

10.2.16 As described within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology, due to the presence of the designated *Sabellaria spinulosa* reef feature, there are minor adverse effects to the Inner Dowsing, Race Bank and North Ridge SAC, while effects to the Greater Wash SPA are considered to be limited. The smothering and deposition impacts that are most likely to significantly disturb benthic communities are considered to be in the immediate vicinity of the works (0-50m), and whilst this will occur within these two sites where the offshore ECC overlaps (8.3% and 2.4% of the sites respectively), the impacts are considered to be and highly localised. *S. spinulosa* reef are considered to have some level of tolerance, resilience and recoverability to SSC effects.

10.2.17 No impacts to the Wash and North Norfolk Coast SAC and Norfolk Sandbanks and Saturn Reef SAC are expected due to the distance from construction activities, where SSC are not expected to be present at concentrations sufficient to negatively impact benthic features and there will be no measurable thickness of deposition.

10.2.18 It is concluded that given the short-term and temporary nature of the construction and decommissioning works, the reversibility of effect, recoverability of receptors, localised nature of effects and distance between the high concentration areas and the designates sites, and implementation of relevant mitigation (Table 7.1); that the sites conservation objectives will be maintained in the long-term for the identified sites. There is, **therefore, no potential for AEoI, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC, North Norfolk Sandbanks and Saturn Reef SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar, in relation to suspended sediment/deposition from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term**.

Physical habitat loss/disturbance

10.2.19 The potential for an AEoI as a result of physical habitat loss and disturbance on benthic subtidal and intertidal habitats during construction and decommissioning relates to the following designated site and the associated, relevant features:

- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.

10.2.20 This section addresses the potential for AEoI from effects associated with physical habitat loss/disturbance from construction and decommissioning activities from the Project. This assessment should be read in conjunction with Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology, and Part 6, Volume 1, Chapter 7: Marine Processes which provides the detailed offshore physical environment assessment (including project specific modelling of sediment plumes). Table 5.12 within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology also presents the MDS associated with habitat disturbance. The sites and features identified for this impact are identified within Table 8.1, and the conservation objectives are listed above.

10.2.21 The Offshore ECC passes directly through the Inner Dowsing, Race Bank and North Ridge SAC, crossing two of the designated sandbank features within the SAC, the North Ridge sandbank and the Inner Dowsing sandbank. The maximum total area within the SAC that is expected to be disturbed by sandwave clearance is approximately 4.63km^2 which equates to circa 0.55% of the total area of the SAC. The total area of the designated sandbank features intersected by the offshore ECC is approximately 19.2km^2, which equates to circa 5.3% of the designated sandbanks. However, the duration of the impact is limited to the duration of construction activities only, and therefore is considered to be short-term and intermittent. Furthermore, any material dredged from within the SAC will be deposited back within the SAC. Following re-settlement of the deposited sediments, they will be immediately available again for transport at the naturally occurring rate and direction, controlled entirely by natural processes. As such, the sediment will have immediately re-joined the natural sedimentary environment within the local area and so by definition is not 'lost from the system' due to the dredging/spoil disposal process. Due to the dynamic nature of the sandwaves, these morphological features are considered to have moderate levels of recoverability (Part 6, Volume 1, Chapter 7: Marine Processes).

10.2.22 The patterns of processes governing the overall evolution of the systems (the flow regime, water depths and sediment availability) are at a much larger scale than, and so would not be affected by, the proposed local works. As a result, the proposed clearance is not likely to influence the overall form and function of the system and eventual recovery via natural processes is therefore expected. The rate of recovery would vary in relation to the rate of sediment transport processes, faster infill and recovery rates will be associated with higher local flow speeds and more frequent wave influence (Part 6, Volume 1, Chapter 7: Marine Processes). Pre- and repeated post-construction monitoring of the Race Bank offshore cable route (DONG Energy, 2017) has demonstrated partial recovery of sandwave crest features, following sandwave clearance, within a four-month period for which data are presently available. The sediment type and distribution is anticipated to return to the pre-impacted state over time, therefore it is considered that will be no adverse effect on the conservation objectives for the sandbanks which are slightly covered by sea water all of the time feature of the Inner Dowsing, Race Bank and North Ridge SAC.

10.2.23 The SAC is also designated for *S. spinulosa* reef, yet whilst this was not recorded during the ground-truth site-specific ground-truth investigations of the PEIR boundary according to the Gubbay et al. (2007) and Hendrick and Foster-Smith (2006) criteria, the geophysical data of the site did not allow any further delineation on the extent of potential *S. spinulosa* features within the PEIR boundary (as detailed in paragraph 9.4.107 of Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology).

10.2.24 Whilst *S. spinulosa* reef was not recorded during the site-specific ground-truth investigations, a precautionary approach will be applied by undertaking a pre-construction survey for this feature (Table 7.1). If at this stage reef is located across the PEIR boundary, a mitigation plan will be approved by the MMO in consultation with Natural England to identify the most appropriate measures to minimise impacts to potential reef features. For this reason, the magnitude of the potential *S. spinulosa* reef as a designated feature of the Inner Dowsing, Race and North Ridge SAC is therefore, regarded as negligible.

10.2.25 The biotope '*S. spinulosa* on stable circalittoral mixed sediment' (MC2211) is described as having a 'medium' MarESA sensitivity to a disturbance of this nature. Encrusting *S. spinulosa* and patchy occurrences of potential *S. spinulosa* reef were prevalent across the array and offshore ECC and are known to occur throughout the wider region in both reef and encrusting form. The species is fixed to the substratum, so substratum abrasion and disturbance is likely to lead to mortality. However, *S. Spinulosa* is most frequently found in disturbed sediment conditions and is a r-strategist (a life strategy which allows a species to deal with the vicissitudes of climate and food supply by responding to suitable conditions with a high rate of reproduction. R-strategists are continually colonizing habitats of a temporary nature). *S. spinulosa* occurs in high densities on subtidal gravels that would be expected to be disturbed every year or perhaps once every few years due to storms. Areas where *S. spinulosa* had been lost due to winter storms appeared to recolonize up to a maximum thickness of 2.4cm during the following summer (R. Holt, pers. Comm. In Jones *et al*., 2000). Recoverability is therefore expected to be high for the species.

10.2.26 Research from the marine aggregate industry revealed that the recovery time for *S. spinulosa* community structure can range from two to seven years, depending on the intensity of dredging (Cooper *et al*., 2007). Samples revealed significant increase in abundance, species count, and total biomass less than a year after dredging operations had concluded (Cooper *et al*., 2007). Additionally, a year after the dredging, there was an abundance of juvenile *S. spinulosa* which may have survived to form a reef, according to SSS data (Cooper *et al.,* 2007). Additionally, in a study of the Wash, the more established *S. spinulosa* reef were found in areas of the ground that had been clearly damaged by dredging action and it was hypothesised that the exposed sediments are more suitable for colonisation (Foster-Smith and White, 2001).

10.2.27 *S. spinulosa* reefs are often only approximately 10cm thick, surface abrasion can, therefore, severely damage and/or remove a reef and whilst recoverability is expected to be high where this *S. spinulosa* occurs in high densities, a precautionary sensitivity assessment of high has been attributed to *S. spinulosa* reef.

10.2.28 To ensure impacts to this feature are avoided, a precautionary approach will be applied by undertaking pre-construction surveys for this feature (Table 7.1). If at this stage reef is located across the PEIR boundary, implementation of mitigation options will be agreed with Natural England to identify the most appropriate measures to minimise impacts to potential reef structures, including option such as micrositing of infrastructure. Therefore, due to the high recoverability of the species, negligible magnitude of the impact following the implementation of project specific mitigation, and short-term and intermittent nature of the effects associated with the construction and decommissioning works, it is considered that there is no adverse effect on the conservation objectives for the reef feature of the Inner Dowsing, Race Bank and North Ridge SAC.

10.2.29 It is concluded that given the short-term and temporary nature of the construction and decommissioning works, the reversibility of effect, recoverability of receptors, localised nature of effects, and implementation of relevant mitigation; that the sites conservation objectives will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of Inner Dowsing, Race Bank and North Ridge SAC, in relation to physical habitat loss/disturbance from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.**

Accidental and Indirect Pollution

10.2.30 The potential for an AEoI as a result of accidental and indirect pollution on benthic and intertidal habitats during construction and decommissioning relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - *Saliconia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;

- Sandbanks which are slightly covered by sea water all the time;
- Salicornia and other annuals colonizing mud and sand; and
- Atlantic salt meadows.

- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.31 The potential for an AEoI as a result of an increase in accidental and indirect pollution on benthic subtidal and intertidal habitats during construction and decommissioning relates to the sites identified for consideration of this effect are presented within Table 8.1. The Screening Report (Outer Dowsing Offshore Wind, 2022) provides the conservation objectives for the sites, with these taken into account when concluding the potential for effect. Due to the similar nature of accidental and indirect pollution, the two effects have been grouped together in this assessment for clarity and ease of understanding.

10.2.32 The potential for accidental pollution to affect benthic subtidal and intertidal habitats was not considered in the PEIR assessments (Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology), given there was no pathway for effect when factoring the Project specific mitigation (specifically the PEMP and supporting MPCP, as detailed within Table 7.1), beyond consideration of the potential for contaminants to be released from sediments disturbed during construction or decommissioning activities). It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1Table 7.1.

10.2.33 There is potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic ecology receptors, as a result of construction and decommissioning activities and associated sediment mobilisation. As detailed within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology, the impact of direct and indirect seabed disturbances leading to the release of sediment contaminants is considered to be of negligible magnitude due to sediment contaminants being below both guideline and action levels, where relevant (i.e. levels are below those deemed to have the potential to result in deleterious effects on fauna).

10.2.34 The implementation of the PEMP, produced in consultation with relevant bodies, in addition to sediment bound contaminants across the site being below both guideline and action levels, enables the conclusion that there is, **therefore, no potential for an AEoI to the conservation objectives of the designated features at the North Norfolk Sandbanks and Saturn Reef SAC, Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar sites in relation to accidental and indirect pollution from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.**

INNS

10.2.35 The potential for an AEoI as a result of INNS on benthic subtidal and intertidal habitats during construction and decommissioning relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - *Saliconia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;

- Mudflats and sandflats not covered by seawater at low tide;
- Sandbanks which are slightly covered by sea water all the time;
- Salicornia and other annuals colonizing mud and sand; and
- Atlantic salt meadows.

- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.36 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, particularly if work vessels arrive from outside the UK. All the sites identified for consideration of this effect are presented within Table 8.1. The Screening Report (Outer Dowsing Offshore Wind, 2022) provides the conservation objectives for the sites, with these taken into account when concluding the potential for effect.

10.2.37 There will be up to 4471 round trips to and from port during the construction phase (a combination of all maximum construction vessel return trips), 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). It should be noted that it is by no means certain that any vessel will arrive from a non-UK port and/or contain ballast water, especially given the type of vessels involved and the proximity of the Project to UK ports. A series of mitigation measures are, nonetheless, proposed including a PEMP with a marine biosecurity plan (see Table 7.1) which will ensure that the risk of potential introduction and spread of INNS is appropriately managed.

10.2.38 There is a lack of evidence to date from other offshore windfarm developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of INNS. The distance to the site is also a variable when considering potential effects. For all the identified sites apart from the North Norfolk Sandbanks and Saturn Reef SAC and Inner Dowsing, Race Bank and North Ridge SAC, the majority of the vessel movements associated with the array area will be greater than 45 km away, therefore allowing for very limited potential for linkage between any INNS and the sites. For the North Norfolk Sandbanks and Saturn Reef SAC and Inner Dowsing, Race Bank and North ridge SAC, the majority of vessel movements would be approximately 6 km and 17 km away respectively. However, the conclusions of the PEIR for all of the sites considered above is that the magnitude would be negligible and that regardless of sensitivity of a feature the overall significance is negligible, therefore having no significance of effect.

10.2.39 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore windfarms, the proposed mitigation, and the PEIR conclusion of negligible significance, there is a low risk of promoting the spread of INNS. The conclusion is supported by the lack of any overlap between the array area and any SACs, where the majority of vessel movements will occur (within the array area boundary and therefore offering further limited potential for a linkage between any INNS and the SACs). This all supports the conclusion that the conservation objectives for the designated sites will be maintained in the long-term. There is, **therefore, no potential for an AEoI to the conservation objectives of the designated features at the North Norfolk Sandbanks and Saturn Reef SAC, Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar sites in relation to spread of INNS from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.**

Changes to physical processes

10.2.40 The potential for an AEoI as a result of changes to physical processes on benthic subtidal and intertidal habitats during construction and decommissioning relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;

- Large shallow inlets and bays;
- Reefs;
- *Saliconia* and other annuals colonizing mud and sand; and
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - Salicornia and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.41 The process of sediment removal activities, including dredging and disposal, may introduce changes to the local hydrodynamics 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.

10.2.42 Part 6, Volume 1, Chapter 7: Marine Processes considers the potential for changes to processes (including the result to designated sites during the construction and decommissioning stage of the Project). No direct or indirect interaction with physical processes at any SACs are noted, with the marine processes chapter of the PEIR stating 'the tidal current regime will not be measurably impacted as a result of the localised levelling and although the volume of sediment available in each local system will be locally redistributed by the levelling, it will not change in an overall net sense. As the controlling factors will also not change'.

10.2.43 Additionally, it is considered within Part 6, Volume 1, Chapter 7: Marine Processes that any levelled areas are not considered likely to create a barrier to sediment movement and displaced material will not be removed from the sedimentary system. Evidence drawn from aggregate dredging activities indicates that if any changes occur to the flow conditions or wave regime, these are localised in close proximity to the dredge pocket (with widths and lengths of several kilometres). The proposed works will be at a much smaller scale and footprint, with trench widths expected to be in the order of 30m. This means there is likely to be little to no influence on the flow or wave regime, which in turn means no change to the regional scale sediment transport processes across the array area and offshore ECC. With respect to cable protection measures (of particular relevance to the Inner Dowsing, Race Bank, and North Ridge SAC as the ECC passes through the site), it is considered that there will be no effect on existing transport processes, with some minor changes to sediment substrate.

10.2.44 It is generally considered that the patterns of processes governing the overall evolution of the systems are at a much larger scale than the proposed works, and any changes to seabed morphology are not considered likely to influence the overall form and function of the system. Additionally, the range of effects are considered to be limited and therefore, there is, **no potential for an AEoI to the conservation objectives of the designated features at the North Norfolk Sandbanks and Saturn Reef SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar sites in relation to changes to physical processes from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.**

10.2.45 Additional consideration is given to Inner Dowsing, Race Bank and North Ridge SAC as the ECC passes directly through the site. However, it is considered that the designated features have a moderate capacity to accommodate the proposed form of change. Therefore, combined with the limited potential for impacts associated with changes in physical processes, **there is no potential for an AEoI to the conservation objectives of the designated features at the Inner Dowsing, Race Bank and North Ridge SAC in relation to changes to physical processes from the Project alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.**

O&M

Physical habitat loss /disturbance

10.2.46 The potential for an AEoI as a result of an increase in physical habitat loss/disturbance on benthic subtidal and intertidal habitats during O&M relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - *Saliconia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - *Salicornia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- North Norfolk Coast Ramsar

- Sand dunes;
- Saltmarsh; and
- Intertidal mud and sand flats.

- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.47 The presence of the WTG and OSS foundations and the associated scour protection, along with the cable protection measures used at cable crossings and areas where cable burial is not possible, will lead to a change from a sedimentary habitat to one characterised by hard substrate. This will be long-term habitat loss (for the 35-year design life duration of the Project) and is therefore considered an impact of the operational phase of the development. It is assessed here as habitat loss and a potential adverse effect (due to the potential shift in the baseline condition), although it is noted that this also comprises potential beneficial effects, providing new habitats for different faunal assemblages to colonise, resulting in a likely increase in biodiversity and biomass.

10.2.48 While the impact will be locally significant and comprise a long-term change (for the operational lifetime of the project) in seabed habitat within the footprint of the structures and scour and cable protection, the effect is limited to the direct footprint of the area affected and is therefore highly localised. A change of subtidal sediment biotopes to rock or artificial hard substratum would alter the character of the biotope leading to reclassification and the loss of the sedimentary community. However, anything outside of the direct footprint will not be affected. Therefore, it is considered that for all sites identified with the exception of Inner Dowsing, Race Bank and North Ridge SAC, as there is no physical overlap with any of the identified designated sites, there will be no material deposited and there will be no impact on any of the designated features. Therefore **there is no potential for AEoI in relation to changes to physical habitat loss/disturbance to the North Norfolk Sandbanks and Saturn Reef SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, North Norfolk Coast Ramsar, Gibraltar Point Ramsar, and The Wash Ramsar from the Project alone during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term.**

10.2.49 For the Inner Dowsing, Race Bank and North Ridge SAC, the ECC passes directly through the site so there is potential for habitat loss from the presence of cable protection. However, the loss of habitat that might occur within the SAC has a discreet amount of overlap (circa 8.3% of the offshore ECC overlaps with the SAC). Given the current conservation status of *S. spinulosa* reef features (unfavourable – Inadequate) and the lack of resistance to habitat loss of *S. spinulosa* reef, it is considered that there could be a potential effect to this feature from cable protection.

10.2.50 A pre-construction Annex I habitat survey will be implemented to determine the location of any potential *S. spinulosa* reef features (Table 7.1Table 7.1). If at this stage reef is located across the PEIR Boundary, implementation of mitigation options will be agreed with Natural England to identify the most appropriate measures to minimise the use of cable protection and its impacts to potential reef structures. It is therefore anticipated that all habitat loss to *S. spinulosa* reef features within the SAC will be avoided, and therefore there will be no physical habitat loss with the designated reef features. Therefore, it is considered that **there is no AEoI on the Inner Dowsing, Race Bank and North Ridge SAC from the Project alone during O&M with respect to the biogenic reef features and therefore, subject to natural change, the designated feature will be maintained in the long-term.**

10.2.51 A preliminary CBRA has been undertaken by the Project for the section of the cable route which passes through the Inner Dowsing, Race Bank and North Ridge SAC. This is helping to further define the approach to cable installation as well as informing the requirement or otherwise for cable protection material over the designated sandbank features within the SAC site and the type, design and installation process for any such protection.

10.2.52 The Project intends to discuss the outcomes of the CBRA with stakeholders throughout the remaining pre-application period, principally through the EPP, in determining the Project design including (where a need is identified) such options for alternative, feasible cable installation and protection techniques that would demonstrably avoid any adverse effects on the integrity of the sandbank features. Future phases of the Project design will subsequently inform the RIAA that will accompany the DCO Application, and which will set out in full the assessment of the potential AEoI on the SAC sandbank features.

Accidental and Indirect Pollution

10.2.53 The potential for an AEoI as a result of an increase in accidental and indirect pollution on benthic subtidal and intertidal habitats during O&M relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC

- Sandbanks which are slightly covered by sea water all of the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Large shallow inlets and bays;
- Reefs;
- *Saliconia* and other annuals colonizing mud and sand; and
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - *Salicornia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- North Norfolk Coast Ramsar
  - Sand dunes;
  - Saltmarsh; and
  - Intertidal mud and sand flats.
- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;

- Shallow water; and
- Deep channels

10.2.54 The Screening Report (Outer Dowsing Offshore Wind, 2022) and the beginning of this section provides the conservation objectives for the sites, with these taken into account when concluding the potential for effect.

10.2.55 The potential for accidental pollution to affect benthic subtidal and intertidal habitats was not considered in the PEIR assessments (Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology), given there was no pathway for effect when factoring the Project specific mitigation (specifically the PEMP and supporting MPCP, as detailed within Table 7.1). It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1

10.2.56 The implementation of a PEMP (Table 7.1), produced in consultation with relevant bodies, and provided for in the DCO as above, enables the conclusion that **there is, therefore, no potential for an AEoI to the conservation objectives) of the designated features at the North Norfolk Sandbanks and Saturn Reef SAC, Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar sites in relation to accidental and indirect pollution from the Project alone during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term**

INNS

10.2.57 The potential for an AEoI as a result of the spread of INNS during O&M relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE):

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - *Saliconia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - *Salicornia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.58 The Screening Report (Outer Dowsing Offshore Wind, 2022) provides the conservation objectives for the site, with these taken into account when concluding the potential for effect. 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).

10.2.59 As presented in Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology a maximum habitat change of up to 7,933,384 m^2 will be introduced into the benthic subtidal ecology study area as a result of the presence of the windfarm structures, which will provide new habitat for potential colonisation by INNS. The majority of this will be within the Project array area and therefore at least 45 km distant from all designated sites apart from the North Norfolk Sandbanks and Saturn Reef SAC and Inner Dowsing, Race Bank and North Ridge SAC (therefore providing limited potential for linkage to those SACs). For the North Norfolk Sandbanks and Saturn Reef SAC and Inner Dowsing, Race Bank and North Ridge SAC, the work will be approximately 6 and 17 km away respectively, resulting in some potential for linkage from INNS. However, in relation to all sites, there will be up to 2,216 round trips to port by operational and maintenance vessels per year, which will contribute to the risk of introduction or spread of INNS (noting that these vessels will be stationed at a UK O&M base and therefore most would not be coming in from a non UK port, limiting the potential to introduce INNS).

10.2.60 A series of mitigation measures are proposed including PEMP with a marine biosecurity plan (Table 7.1Table 7.1) will, however, ensure that the risk of potential introduction and spread of INNS will be minimised. Further, there is a lack of evidence to date from other offshore windfarm development within the North Sea having had any adverse effects on key species and habitats through increasing the spread of INNS.

10.2.61 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore windfarms, the location of the Project relative to the designated sites (including the distance between array area, where the majority of hard substrate will be introduced, and the features), the UK base for O&M vessels (limiting INNS opportunities) and the proposed mitigation, there is a low risk of the introduction of and or promotion of the spread of INNS. It is considered that the sites conservation objectives will be maintained in the long-term. There is, **therefore, no potential for an AEoI to the conservation objectives of the designated features of the identified sites in relation to spread of INNS from the Project alone during O&M and therefore, subject to natural change, the designated features will be maintained in the long term.**

Changes to physical processes

10.2.62 The potential for an AEoI as a result of an increased potential for changes to physical processes on benthic subtidal and intertidal habitats during O&M relates to the following designated sites and their relevant features:

- North Norfolk Sandbanks and Saturn Reef SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC

- Sandbanks which are slightly covered by sea water all of the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Large shallow inlets and bays;
- Reefs;
- *Saliconia* and other annuals colonizing mud and sand; and
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - *Salicornia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes
- The Wash Ramsar
  - Saltmarshes;
  - Estuaries;
  - Major intertidal banks of sand and mud;
  - Shallow water; and
  - Deep channels

10.2.63 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 subtidal and intertidal ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

10.2.64 Part 6, Volume 1, Chapter 7: Marine Processes has determined that the impacts on hydrodynamic and wave regimes will be not significant to coastal and physical processes and will therefore not result in any significant changes to sediment transport. Therefore, it is considered that given the distance between the Project and all sites (with the exception of Inner Dowsing, Race Bank and North Ridge SAC) is significant enough that there will be no direct or indirect effects. For the Inner Dowsing, Race Bank and North Ridge SAC, the ECC passes directly through the site and therefore there may be changes to the local hydrodynamic regime due to the addition of cable protection. In areas of active sediment transport (indicated by the presence of mobile bedforms such as sandwaves and megaripples), following installation, and under favourable hydrodynamic conditions, an initial period of sediment accumulation would be expected to occur, creating a smooth slope against the cable protection. Once any void spaces have been infilled, saltation is expected to be largely unaffected by the presence of the cable protection such that existing transport process (including bedform migration) will remain unaffected (Part 6, Volume 1, Chapter 7: Marine Processes).

10.2.65 Therefore, based on both the lack of significant changes to physical processes (as considered within Part 6, Volume 1, Chapter 7: Marine Processes, and Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology) and the small proportion of the site impacted (circa 8.3% of the SAC), **there is no potential for AEoI to the conservation objectives of the designated features of the identified sites in relation to changes to physical processes from the Project alone during O&M and, subject to natural change, the designated features will be maintained in the long-term.**

EMF

10.2.66 The potential for an AEoI as a result of EMF on benthic subtidal and intertidal habitats during O&M relates to the following designated sites and their relevant features:

- Inner Dowsing, Race Bank, and North Ridge SAC
  - Reefs; and
  - Sandbanks which are slightly covered by sea water all of the time.
- The Wash and North Norfolk Coast SAC
  - Sandbanks which are slightly covered by sea water all of the time;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Large shallow inlets and bays;
  - Reefs;
  - *Saliconia* and other annuals colonizing mud and sand; and

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- Humber Estuary Ramsar
  - Dune systems with humid dune slacks,
  - Estuarine waters;
  - Intertidal mud and sand flats;
  - Saltmarshes; and
  - Coastal brackish/saline lagoons
- Humber Estuary SAC
  - Estuaries;
  - Mudflats and sandflats not covered by seawater at low tide;
  - Sandbanks which are slightly covered by sea water all the time;
  - *Salicornia* and other annuals colonizing mud and sand; and
  - Atlantic salt meadows.
- Gibraltar Point Ramsar
  - Estuarine mudflats;
  - Sandbanks;
  - Saltmarsh; and
  - Dunes

10.2.67 EMF are generated by the current that passes through an electric cable. It is known that EMF can be detected by fish and elasmobranchs, and it is thought that many benthic invertebrates can also detect EMF. Three types of fields are generated by underwater electric cables: electric fields (E-fields), magnetic fields (B-fields) and induced electric fields (iE-fields). Standard industry practice is for the cables used to have sufficient shielding to contain the E-fields generated and the cable system descriptions for the inter-array and export cables have abided by this (Volume 1, Chapter 3). Shielding and/or burial does not reduce the B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields.

10.2.68 EMFs will be generated by subsea cables and may be detectable above background levels in close proximity to the cables. Although burial does not mask EMFs it increases the distance between species that may be affected by EMFs and the source. As the cable will be buried or protected, any behavioural responses are likely to be mitigated to a negligible level, therefore resulting in no AEoI on any of the designated sites, including the Inner Dowsing, Race Bank and North Ridge SAC, as despite the overlap between the ECC and the site, the impacts are considered so highly localised that there will be no effect on the receptors or any benthic communities that may exist in and around the features. **Therefore, there is no potential for AEoI to the conservation objectives of the designated features of the identified sites in relation to changes to EMF from the Project alone during O&M and, subject to natural change, the designated features will be maintained in the long-term.**

10.3 Marine Mammals

Assessment criteria

10.3.1 The assessment of the risk of injury in marine mammals follows the draft 2010 advice issued by JNCC, the Countryside Council for Wales (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 – and the same definition for injury is applied here for seals. 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 (i.e. permanent reduction in hearing sensitivity)).

10.3.2 The assessment of disturbance for harbour porpoise draws on SNCB guidance, issued as final in May 2020 (JNCC *et al*., 2020). As regards piling, JNCC *et al.,* (2020) draw on a body of literature, 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) (contained within Popper & Hawkins, 2012)), Braasch *et al.,* (2013) and Thompson *et al.,* (2010). These studies reported direct observations during windfarm construction at projects across Europe, thus enabling an Effective Deterrent Radius (EDR) of 26 km to be established for percussive piling (monopiles). 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. For example, the final advice (JNCC *et al*., 2020) provided an EDR for pin-pile of 15 km and an EDR for monopiles with noise abatement of 15 km.

10.3.3 For seismic survey (air guns), the 2020 advice identified an EDR of 12 km, reducing to 5 km for high resolution geophysical survey. It is understood that should further evidence be provided, then the relevant EDR could be refined further. The draft RIAA has assumed an EDR of 5 km applies (unless the survey specifically identifies the use of air guns).

10.3.4 The advice from JNCC *et al* (2020) also notes a precautionary 26 km EDR for high order detonation of UXOs. For low order detonation there is no recommended EDR (JNCC, 2020), as such a 5 km EDR has been assumed based on the suggestion proposed by Sofia Offshore Windfarm Marine Licence Application for UXO detonation (Marine Licence MLA/2020/00489). Low order detonation is the primary method of clearance for the Project, with high order clearance maintained as a contingency measure, this is in line with the SNCB joint interim position statement[7] which recommends that low noise alternatives should be prioritised. Although there is no empirical evidence of harbour porpoise avoidance, UXOs are one of the loudest sources of underwater noise. JNC (2020) further notes that although a one-off explosion would probably be of a too short duration to cause widespread displacement, these detonations are usually part of campaigns with potentially several detonations in the same general area over several days.

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

- An EDR of 26 km from the location of piling (monopiles);
- An EDR of 15 km from the location of piling (pin-pile);
- An EDR of 5 km for geophysical survey (unless air guns are specifically mentioned in the survey methodology) from the location of activity;
- An EDR of 26 km from high-order UXO clearance; and
- An EDR of 5 km from low order UXO clearance.

10.3.6 The spatial aspect of disturbance in harbour porpoise within the Southern North Sea SAC, as defined through the relevant EDRs, has a defined limit above which disturbance would be considered significant. That limit (confirmed in JNCC *et al*., 2020) is 20% of the relevant SAC 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 calendar day).

10.3.7 That spatial aspect is accompanied by a temporal element, as defined through the use of the temporal threshold, effectively 10% of the relevant area when averaged across a season (defined as per the spatial threshold).

10.3.8 For seals, the approach to assessing disturbance follows that used within the PEIR (as defined in Section 1.6 of Part 6, Volume 1, Chapter 11: Marine Mammals), as considered in the context of potential for site connectivity and the conservation objectives of the relevant sites. That approach effectively requires a density value for each species together with noise modelling results and a dose response curve.

10.3.9 In terms of the number of grey seals that may be affected and how these animals may relate to individual designated sites, the assessment for grey seals draws on the following:

[7] Available at: https://www.gov.uk/government/publications/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement Accessed on: 12.04.2023

- Consideration of site connectivity - grey seal are wide ranging animals and are not necessarily defined as 'Humber grey seals' for example. The work utilised data on grey seal tagging at sea; and
- Consideration of the grey seal population- how it has increased since site designation and the contribution made by the proportion of seals at sea when haul out counts are made.

10.3.10 In terms of the number of harbour seals that may be affected and how these animals may relate to individual designated sites, the assessment for harbour seals draws on the following:

- Consideration of harbour seal population – how it has decreased in recent years, the 2019 count for the east coast of England was 25% lower that the mean of the previous 5 years and the 2020 and 2021 counts confirm continued decline (SCOS, 2022)

Maximum Design Scenario

10.3.11 Table 10.2 below summarises the Maximum Design Scenario(s) considered for marine mammals, as described in Table 1.7 within Part 6, Volume 1, Chapter 11: Marine Mammals. The full project description is provided in Part 6, Volume 1, Chapter 3: Project Description for full reference.

Table 10.2: Maximum Design Scenario for Marine Mammals from the Project Alone

Potential effect	Maximum design scenario assessed	Justification
Construction		
Underwater noise from UXO clearance	Maximum number of clearance events within 24-hours: 2 Indicative intervention duration (UXO location, preparation, detonation and recovery of debris): 25 days MDS clearance method: high-order detonation Expected to occur prior to foundation installation. Max charge size: 800kg + donor Low order (deflagration) charge: 0.5kg	Estimated maximum design. A detailed UXO survey will be completed prior to construction. The type, size and number of possible detonations and duration of UXO clearance operations is not known at this stage. The Applicant is not currently anticipated to seek to license the disposal of UXO, but it is included in the impact assessment.
Underwater noise from piling	Monopile WTG: ▪ 93 WTG foundations ▪ Max 13m pile diameter ▪ Max hammer energy: 6,600kJ ▪ Max 8 hours per pile ▪ Max 24 hours piling per day ▪ Max 2 simultaneous piling events ▪ Max 2 monopiles/day ▪ Expected number of piling days: 93 (average of one per day) Monopile other structures: ▪ Max 7 OSS, ORCP and Accommodation Platforms foundations ▪ Max pile diameter 14m	The piling scenario with the largest PTS impact ranges represent the maximum 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-pile have a larger PTS impact range whereas for low frequency cetaceans, monopiles have a larger PTS impact range). The maximum number of piled foundations would represent the temporal maximum design scenario for disturbance. The ORCPs will be positioned within the Offshore ECC ORCP Search Area – there will be no simultaneous piling

Potential effect	Maximum design scenario assessed	Justification
	▪ Max hammer energy 6,600kJ ▪ Max 8 hours piling per monopile Multi-leg pin-piled jacket WTG: ▪ Max 93 WTG foundations ▪ 4 legs per foundation ▪ Max 372 jacket legs in total ▪ Max 372 pin piles in total ▪ Max pin pile diameter 5m ▪ Max hammer energy 3,500kJ ▪ Max 24-hours piling per day ▪ Max 6 hours per pile ▪ Max 2 simultaneous piling events ▪ Max 8 pin-pile installed per day ▪ Average of 4 pin-piles per day = 186 piling days Multi-leg pin piled jacket OP: ▪ Max 7 OP foundations ▪ Max 8 legs per platform ▪ 3 pin-pile per leg ▪ Number pin-pile total 168 ▪ Max pin pile diameter 5m ▪ Max hammer energy 3,500kJ ▪ Max 2 legs per day Indicative foundation installation period: 2027-2029	between the ORCP foundations and foundations in the array area. The maximum predicted impact range for underwater noise for piled foundations would represent the spatial maximum design scenario for disturbance.

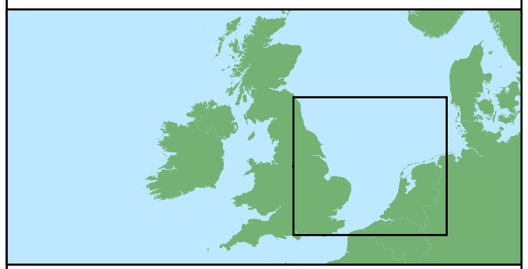
Potential effect	Maximum design scenario assessed	Justification
	Total monopiles (WTG + OPs): up to 100 Total pin-piles (WTG + OPs): up to 540 Piling construction duration: 1 year	
Underwater noise from other construction activities	Seabed preparation: levelling, drilling, and/or dredging of soft mobile sediments Cable route clearance methods: mass flow excavation, dredging Cable burial methods: jet trenching, pre-cut and post-lay ploughing, mechanical trenching, dredging, max flow excavation, vertical injection and rock cutting Offshore construction indicative dates: 2027 - 2029	Maximum potential for underwater noise impacts from all construction and pre-construction works.
Collision risk from vessels Disturbance from vessels	Max total construction vessels: 131 Max total round trips per year: 4,471 Indicative peak vessels on-site in a given 5km^2 area simultaneously: ten Offshore construction indicative dates: 2027-2029 Max round trips over 3 years: 13,413	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance
Indirect impacts from prey	Assessment is based on the MDS presented in Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology.	

Potential effect	Maximum design scenario assessed	Justification
Water quality impacts	Maximum amount of suspended sediment released during construction activities and associated duration - see Part 6, Volume 1, Chapter 7: Marine Processes and Part 6, Volume 1, Chapter 8: Marine Water Quality.	
Disturbance at haul out sites	Assessment is based on distances to vessel transit routes and landfall	
O&M		
Operational noise	Operational noise from offshore windfarms to date has been found to be not significant for marine mammals. However, the size of WTGs planned at the Proposed Development do not have empirical data for operational noise and therefore operational noise has been scoped in as a precaution. An updated assessment of predicted SPL from 16MW and 30MW turbines (proposed for the Project) presented in Part 6, Volume 2, Appendix 3.2: Underwater Noise Report.	
Collision risk from vessels	Total: 28 Annual round trips: 2,216 Peak vessel quantities: 28	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.
Disturbance from vessels		
Indirect impacts on prey	Assessment is based on the MDS presented in Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology.	
Decommissioning		
Underwater noise	Maximum levels of underwater noise during decommissioning would be from underwater cutting required to remove structures. This would give rise to much lower levels of underwater noise than would arise from pile driving used for construction and therefore impacts would be less than as assessed during the construction phase. Piled solutions assumed to be cut off at or below seabed	
Collision risk from vessels	Assumed to be similar vessel types, numbers and movements to construction phase (or less).	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.
Disturbance from vessels		
Indirect impacts from prey	Assessment is based on the MDS presented in Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology.	
Water quality impacts	Maximum amount of suspended sediment released during decommissioning activities and associated duration - see Part 6, Volume 1, Chapter 7: Marine Processes and Part 6, Volume 1, Chapter 8: Marine Water Quality.	

200000
350000
500000
650000
800000
6100000
5950000
5800000
5650000
N
Doggersbank
Klaverbank
Humber Estuary
Southern North Sea
Noordzeekustzone
Waddenzee
The Wash and North Norfolk Coast
Voordelta
Vlakte van de Raan
Vlaamse Banken
SBZ 3 / ZPS 3
Westerschelde & Saeftinghe
Bancs des Flandres
SBZ 2 / ZPS 2
SBZ 1 / ZPS 1

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Special Areas of Conservation (SAC/SCI)



Coordinate System: WGS 1984 UTM Zone 31N

0 50 100 km

Scale: 1:2,000,000

Sites Considered for Marine Mammals

Figure 10.2

OUTER DOWSING OFFSHORE WIND

Date: 18/04/2023
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Description of significance

10.3.12 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.

Construction and decommissioning

Underwater noise

10.3.13 The following assessment is in relation to the potential for effect during construction only. The Screening Report (Outer Dowsing Offshore Wind, 2022) 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. The sites and features identified for this impact are identified within Table 8.1 and Figure 10.2.

10.3.14 There are a number of sources of underwater noise associated with the Project alone during construction, with these identified within Part 6, Volume 1, Chapter 11: 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).

10.3.15 The approach taken by this draft RIAA is to assess each of these effects individually, with a conclusion of the effect from underwater noise drawn based on all four effects. The importance of underwater noise for marine mammals (including harbour porpoise, harbour seal and grey seal) is discussed in Part 6, Volume 1, Chapter 11: Marine Mammals and Volume 2, Annex 3.2: Underwater Noise Assessment. 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, is drawn on here in the context of the conservation objectives for each relevant designated site. Each of these effects are discussed in turn below, including the relevance for the features identified.

Underwater noise from percussive piling

Project mitigation

10.3.16 Project specific mitigation specifically included for pile driving is identified in Table 7.1 and includes the following:

- A maximum of two simultaneous piling events;

- A maximum hammer energy of 6,600 kJ and 3,500 kJ for monopiles and pin-pile respectively; and
- A piling MMMP will be developed in accordance with the Outline MMMP (Part 8, Document 8.4) and will be implemented during construction. The piling MMMP will include measures to ensure the risk of instantaneous permanent threshold shift (PTS) to marine mammals is negligible and will be in line with the latest relevant available 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.

10.3.17 Following best and established practice, the above measures are primarily focused on managing and mitigating any risk of PTS (injury) in marine mammals. The Draft Outline Site Integrity Plan (SIP) (which will be provided alongside the DCO Application), provides certainty that harbour porpoise risk with respect to disturbance will be managed appropriately going forward. The key points addressed within the SIP are discussed and considered within the assessments below.

Project level underwater noise

10.3.18 Underwater noise during construction of the Project has been studied specifically through the following, including that of direct relevance to marine mammals:

- Part 6, Volume 1, Chapter 11: Marine Mammals; and
- Part 6, Volume 2, Appendix 3.2: Underwater Noise Assessment.

10.3.19 Part 6, Volume 2, Appendix 3.2: Underwater Noise Assessment 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 the risk of onset of PTS. The threshold values applied for PTS (with the background to the various thresholds provided in Section 4.7 of Part 6, Volume 1, Chapter 11: Marine Mammals) in relation to impulsive noise within the PEIR are provided in Table 10.3 below.

Table 10.3: 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 SEL_{peak} (dB re 1 μPa^2s)
Impulse Noise		
VHF cetacean	155	202
PCW	185	218

10.3.20 Natural England and JNCC (JNCC *et al*., 2020) advise that a buffer of 26 km around the source location is used to determine the impact area from pile driving for monopiles and 15 km for pin-pile with respect to disturbance of harbour porpoise in the Southern North Sea SAC[8], with that approach applied here in the context of the 20% daily/10% seasonal thresholds described in The Screening Report (Outer Dowsing Offshore Wind, 2022). For harbour seals and grey seals, Part 6, Volume 1, Chapter 11: Marine Mammals describes the disturbance response in Section 4.7. The assessment of harbour seal and grey seal response to disturbance presented here draws on the findings of Part 6, Volume 1, Chapter 11: Marine Mammals in the context of the relevant designated sites and their conservation objectives.

10.3.21 The assessment of potential impact from risk of onset of PTS in harbour porpoise is presented in Section 4.7 of Part 6, Volume 1, Chapter 11: Marine Mammals. The assessment draws on results from underwater noise modelling at three separate locations and one simultaneous piling scenario of two locations. Of the three locations, the northeast location is considered to have the greatest propagation rate and therefore is the location of primary concern for harbour porpoise. The ranges presented are unmitigated ranges – i.e. these represent the maximum 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 7.1, and delivered through the DMLs), with Section 4.7 of the PEIR finding that the mitigation will reduce the potential for impact with regards PTS in harbour porpoise, harbour seal and grey seal to negligible and therefore 'not significant as defined in the assessment of significance matrix and is therefore not considered further in this assessment'.

10.3.22 As an unmitigated maximum value, the MDS predicted PTS onset impact ranges for harbour porpoise would reach 0.37, 0.51, and 0.59 km for the southwest, northwest, and northeast locations respectively from monopiles (instantaneous PTS, SPL_{peak}). For pin piles, the distances were 0.31, 0.44, and 0.51 km for the same three locations respectively (instantaneous PTS, SPL_{peak}). For cumulative PTS (SEL_{cum}), the impact ranges are 1.4, 2.2, and 3.4 km for th.e southwest, northwest, and northeast locations respectively for monopiles, and 0.73, 1.4, and 2.3 km for pin-pile at the same locations. The maximum unmitigated number of harbour porpoise predicted to be within the PTS onset impact area, and therefore at risk of auditory injury, for any individual piling is 64 animals (0.02% of the MU) from monopiles in the northeast location (cumulative PTS), and 736 from simultaneous piling of monopiles at the northeast and southwest locations at the same time (0.21% of the MU). For pin piles, the maximum number of porpoise predicted to be disturbed was 29 at the northeast location, and 641 at the northeast and southwest locations simultaneously (0.01 and 0.19% of the MU respectively).

10.3.23 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 1.7 of Part 6, Volume 1, Chapter 11: Marine Mammals, which will reduce the risk of PTS-onset to negligible levels. 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.

[8] http://jncc.defra.gov.uk/pdf/SNorthSea_ConsAdvice.pdf

10.3.24 The risk of onset of PTS in harbour seal and grey seal is considered in Part 6, Volume 1, Chapter 11: Marine Mammals in Section 1.7. The modelling locations are the same as those for harbour porpoise, with the ranges similarly being unmitigated. 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 4.7 of the PEIR finding that the mitigation will reduce the potential for impact with regards PTS in seals to negligible.

10.3.25 As an unmitigated maximum value, the predicted PTS onset impact ranges for harbour seal and grey seal for the MDS piling scenario presented within PEIR for all instances and at all locations is at most 100 m. 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 0 animals. In the context of the predicted range of unmitigated risk of onset of PTS, together with the planned mitigation within the piling MMMP the conclusion drawn is of negligible adverse significance for both seal species, which is not significant in EIA terms.

Project level underwater noise – MDS piling scenario and disturbance

10.3.26 Part 6, Volume 1, Chapter 11: Marine Mammals also considers the potential for behavioural disturbance to occur, and the potential impact on harbour porpoise, harbour seal and grey seal (Section 4.7). For the purposes of the draft RIAA, the assessment presented here for harbour porpoise is based on the relevant EDR (paragraph 10.3.5), and therefore is in a context of habitat availability and not numbers of animals. The assessment of disturbance here for harbour and grey seals is based on consideration of individuals as presented in the ES, in the context of relevant designated. A summary of the information presented for harbour seal and grey seal within the PEIR is provided below.

10.3.27 For harbour seals, the highest disturbance levels for monopiles were predicted for simultaneous piling on the northeast and southwest locations, where a maximum of 35 harbour seals are predicted to be disturbed for the installation process, which represents 0.72% of the reference population (not all of which will be associated with a specific designated site). The equivalent number for pin-pile at the same locations is 30 animals (0.62% 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.

10.3.28 For grey seals, the highest potential disturbance levels on a spatial basis were also predicted for simultaneous piling at the northeast and southwest locations, where an estimated 615 (75-1139) grey seals have the potential to be disturbed, which represents 1.16% of the reference population (i.e., all other foundation locations would result in a reduced level of effect). The equivalent number for pin-pile at the same location is 534 animals (1.01% of the population) which represents the highest level of disturbance in temporal terms. As above for harbour seals, not all of these seals will be associated with a designated site.

10.3.29 Overall, the PEIR found that the predicted impact (in the context of the number of animals that may be affected and both duration and frequency of effect) were such that although there is 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 those animals are repeatedly displaced from foraging areas, it is not expected that the predicted level, frequency and duration of impact would be sufficient to result in a population level change. Given that grey seals are expected to return to their previous behavioural states/activities after the impact has ceased (within 2 hours), it is not expected that this will result in any significant impact on survival or fertility rates unless the same individual is exposed repeatedly across numerous days (Booth *et al.,* 2019). In the unlikely event that individuals were repeatedly disturbed across the 12- month construction period, any effect on vital rates are expected to be limited to 1 breeding cycle for a very limited proportion of the management unit, and as such the magnitude is assessed as minor in the ES, since vital rates are very unlikely to be impacted to the extent that the population trajectory would be altered.

10.3.30 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.

10.3.31 Overall, the PEIR found that for grey and harbour seals, the effect from piling on behavioural disturbance is of slight adverse significance, which is not significant in EIA terms.

Consideration of harbour porpoise

10.3.32 A single site for harbour porpoise has been screened in for assessment - the SNS SAC.

10.3.33 The consideration of the risk of onset of PTS for harbour porpoise given above draws on Part 6, Volume 1, Chapter 11: Marine Mammals, which is presented in the context of the total population of animals within the MU. The conservation objectives 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.

10.3.34 The JNCC Advice 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.'

10.3.35 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 favourable Conservation Status (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).'

10.3.36 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*').

10.3.37 Mitigation for risk of onset of PTS (injury) is provided for within the MMMP process (Table 7.1) 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 Outline SNS SIP which will be provided alongside the DCO Application (Table 7.1).

10.3.38 Given that the MMMP 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 concluded that the Project 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 the Project alone during construction and decommissioning 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.**

10.3.39 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 the relevant EDR, which for monopiles is 26 km but for pin-pile is 15 km.

10.3.40 The seasonal nature of the SNS SAC is important here, with the Project array area being more than 26 km distant from the winter extents of the SNS SAC at its closest point. As such, any noisy activity within the Project array area that takes place in the winter season (October-March inclusive) would fall outside the need for assessment here. Any noisy activity within the Project's array area during the summer season (April-September inclusive) would, however, require consideration through the HRA process.

10.3.41 For pile driving within the Project array area, the maximum overlap from a single monopile foundation location within the summer extents of the SNS SAC would be 1726.3 km^2 from the northeast location (6.38% of the summer extents), or depending on location of the foundation as low as 149.2 km^2 from the southwest location (0.55%). For pin piled foundations, that reduces to a maximum of 699 km^2 from the northeast location (2.6%) or a minimum of 0 km^2 from the southwest location (0%). 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.

10.3.42 As a 'maximum design scenario for disturbance from piling', piling could occur at up to two separate foundation locations per 24-hours, termed concurrent piling. No project level separation distance has been set (which would limit the distance between two concurrent piling events and therefore limit the combined footprint of effect), however there remains potential for a separation distance to be applied to the Project as mitigation, if required.

10.3.43 For pile driving within the Project array area, the maximum overlap with the summer area of the SNS SAC from a concurrent monopiling is 2084.6 km^2 from the northeast and southwest locations (7.71% of the summer extents) or depending on location of the foundation as low as 246.2 km^2 from the southwest and north-southwest location (0.91%). For pin piled foundations, that reduces to a maximum of 974.9 km^2 from the northeast and southeast locations (3.61%), with a minimum of 0 km^2 from the southwest and north-southwest locations (0%).

10.3.44 No overlap with the winter extents would result from pile driving within the Project array area, regardless of the type or number of foundations. Additionally, there is no overlap with the SAC (either season) from piling at the ORCP search area.

10.3.45 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 of monopiles would occur within the array area by a single piling rig, which for worst case 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 (assuming the maximum 6.38% per day for every day of the season), would therefore be 6.38%, well within the 10% seasonal threshold.

10.3.46 The number of harbour porpoise potentially disturbed by unmitigated piling for the Offshore Reactive Compensation Platform (ORCP) is 1 individual which works out to <0.01% of the MU.

10.3.47 Therefore, it is concluded that there will not be an AEoI in relation to disturbance on the Conservation Objective for harbour porpoise for the SNS SAC as a result of pile driving from the Project alone during construction and decommissioning under any pile driving scenario and therefore, subject to natural change, in the long-term, there will be no significant disturbance of harbour porpoise.

10.3.48 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 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 Part 6, Volume 1, Chapter 7: Marine Processes. That chapter has concluded the potential for effect to be slight adverse at most (and therefore not significant in EIA terms). The scale of any potential such effect is also found to be localised to the Project and therefore spatially much smaller than the overall SNS SAC and of trivial consequence for physical processes at that scale.

10.3.49 Although specific prey species for harbour porpoise in the SNS SAC are unknown, sandeels are a known prey item for harbour porpoise, with herring also taken. The potential for impact to sandeel and herring are addressed in full in Section 4.7 of Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology. Sandeel and herring are the primary focus of the assessment made. The scale, frequency and duration of construction works resulted in a conclusion of slight adverse at most and is therefore not significant in EIA terms. Part 6, Volume 1, Chapter 11: Marine Mammals further considers fish and marine mammals during construction in the context of a potential reduction in foraging ability, resulting from issues around turbidity, visibility and the ability to locate prey. The magnitude of the impact is concluded to be negligible and have no significant effect. Given the conclusions in the ES, in the wider context of the scale of the SNS SAC relative to the scale of the Project, no potential for adverse effect has been identified.

10.3.50 There is, **therefore, no AEoI to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from the Project alone during construction and decommissioning 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 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 (Netherlands) SAC and Klaverbank SCI).

10.3.51 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.

10.3.52 The objectives for transboundary sites are:

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

10.3.53 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.

10.3.54 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 habitat is considered within Part 6, Volume 1, Chapter 7 Marine Processes. 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, Part 6, Volume 1, Chapter 11: Marine Mammals further considers fish and marine mammals during construction in the context of a potential reduction in foraging ability, resulting from issues around turbidity, visibility and the ability to locate prey. The magnitude of the impact is concluded to be negligible and have no significant effect. Given the conclusions in the ES, in the wider context of the scale of the available habitat and the distribution of harbour seal at sea relative to the Project (Russell, 2017), all relative to the scale of the Project, no potential for adverse effect has been identified.

10.3.55 There is, therefore, no AEoI to the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC, Doggersbank (Netherlands) SAC or Klaverbank SCI from the Project alone during construction and decommissioning and therefore, subject to natural change, the supporting habitat for harbour seal and their prey will be maintained in the long-term.

10.3.56 The potential to affect the population and distribution of harbour seal is considered within Part 6, Volume 1, Chapter 11: Marine Mammals with respect to potential for injury (risk of onset of PTS) and disturbance. The following assessment takes account of that, in the context of the relevant SACs and their conservation objectives.

10.3.57 As for consideration of harbour porpoise above, the risk of onset of PTS in all marine mammal species will be addressed in the MMMP (Table 7.1), 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). Additionally, Part 6, Volume 1, Chapter 11: Marine Mammals considers that there will be 0 harbour seal predicted to experience PTS from piling. **Therefore, it is concluded that the Project alone during construction and decommissioning does not have an AEoI on harbour seal as a result of mortality or injury resulting from percussive piling at the Project alone.**

10.3.58 Part 6, Volume 1, Chapter 11: 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 disturbance levels for monopiles were predicted for simultaneous piling on the northeast and southwest locations, where an estimated 35 harbour seals are predicted to be disturbed for the installation process, which represents 0.72% of the reference population (not all of which will be associated with a specific designated site). The equivalent number for pin-pile at the same locations is 30 animals (0.62% of the population), which represents the highest level of disturbance in temporal terms. The number of harbour seal potentially disturbed by unmitigated piling for the ORCP is 110 individuals which works out to 2.3% of the MU.

10.3.59 In relation to harbour seals associated with the Wash and Norfolk Coast SAC, and to place the population level numbers in context, the JNCC cites the harbour seal population at the Wash as being 7% of the UK total, which is given by the JNCC as 48,000-56,000. 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 and for the worst case noted above of 35 individual seals (concurrent piling of northeast and southwest location), between 0.89% and 1.04% of the Wash SAC population of harbour seal may be temporarily disturbed. SCOS (SCOS, 2022) identifies that the harbour seal population of the Wash has been relatively constant since 2012 (following recovery from phocine distemper) until 2019, when it fell by approximately 25% (considered to have occurred across a 2-year period). The mean population count between 2019 and 2021 for the Wash and North Norfolk Coast SAC was 2,883. Should the lower population of 2,883 be applied, that would result in up to 1.2% being subject to temporary disturbance depending on pile type and location. However, when factoring in “at-sea” seals (following the scalar presented in Russel *et al.,* 2016), the population estimate using the 2019-2021 count for the Wash and North Norfolk Coast SAC is 3,690 harbour seals. Using this population estimate, the worst case piling scenario (concurrent piling at the northeast and southwest location) would result in 0.95% of the population being subject to temporary disturbance.

10.3.60 For the Doggersbank and Klaverbank SCIs, there are an estimated 6,000 harbour seal in the Dutch section of the North Sea and Wadden Sea. No population level for either SCI has been sourced (the standard data forms both read a population of zero). The conservation objectives refer to the population of the species and the distribution of that species within the site. As any effect is predicted to be at distance from both transboundary harbour seal sites, it will not have a direct effect on the distribution of individuals within the sites. Further, the effect will be both temporary and small scale, being at most 5 individuals. Even if all those individuals were attributed to the Dutch section of the North Sea and Wadden Sea (with an estimated population of 6,000 individuals) in the context of the population, even as an unrealistic worst case that would still be <1%. Therefore, no detectable change is predicted with respect to harbour seals associated with transboundary sites.

10.3.61 Part 6, Volume 1, Chapter 11: Marine Mammals found that the area of sea within which noise sufficient to result in disturbance of harbour seal has a low density of harbour seals, and is not considered an important foraging ground for the species. Whilst the area affected by the ORCP piling has a relatively higher density of harbour porpoise, this would be for a maximum of two foundations and therefore the duration of the works is very short. 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 that does occur 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 at designated site level populations (where known).

10.3.62 There is, therefore, no AEoI for the harbour seal population and distribution with respect to the Wash and North Norfolk Coast SAC, Doggersbank (Netherlands) SAC, Doggersbank SCI and Klaverbank SCI from the Project alone during construction and decommissioning and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.

Consideration of grey seal

10.3.63 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; and
- Transboundary sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbak SCI, Noordzeekustone SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlaamse Banked SCI, Vlakte van de Raan SCI, Voordelta SCI, Waddenzee SCI, and Westerschelde & Saeftinghe SCI)

10.3.64 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.

10.3.65 The objectives for transboundary sites are:

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

10.3.66 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.

10.3.67 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 Part 6, Volume 1, Chapter: 7 Marine 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, Part 6, Volume 1, Chapter 11: Marine Mammals further considers fish and marine mammals during construction in the context of a potential reduction in foraging ability, resulting from issues around turbidity, visibility and the ability to locate prey. The magnitude of the impact is concluded to be negligible and have no significant effect. Additionally, all of the transboundary sites are at a significant distance (the closest project is Klaverbank, which is 95.9 km away from the array). Given the conclusions in the PEIR, in the wider context of the scale of the available habitat and the distribution of harbour seal at sea relative to the Project (Russell, 2017), all relative to the scale of the Project, no potential for adverse effect has been identified.

10.3.68 There is, therefore, no AEoI to the supporting habitats relevant to grey seal and their prey for the Humber Estuary SAC, Humber Estuary Ramsar, Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbak SCI, Noordzeekustone SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlaamse Banked SCI, Vlakte van de Raan SCI, Voordelta SCI, Waddenzee SCI, and Westerschelde & Saeftinghe SCI from the Project alone during construction and decommissioning and therefore, subject to natural change, the supporting habitat for harbour seal and their prey will be maintained in the long-term.

10.3.69 The potential to affect the population and distribution of harbour seal is considered within Part 6, Volume 1, Chapter 11: Marine Mammals with respect to potential for injury (risk of onset of PTS) and disturbance. The following assessment takes account of that, in the context of the relevant SACs and their conservation objectives.

10.3.70 As for consideration of harbour seal above, the risk of onset of PTS in all marine mammal species will be addressed in the MMMP (Table 7.1), 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). Additionally, Part 6, Volume 1, Chapter 11: Marine Mammals considers that there will be 0 grey seal predicted to experience PTS from piling. **Therefore, it is concluded that the Project alone during construction and decommissioning does not have an AEoI on grey seal as a result of mortality or injury resulting from percussive piling at the Project alone.**

10.3.71 Part 6, Volume 1, Chapter 11: 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 for monopiles were predicted for simultaneous piling on the northeast and southwest locations, where an estimated 615 grey seals are predicted to be disturbed for the installation process, which represents 1.16% of the reference population (not all of which will be associated with a specific designated site). The equivalent number for pin-pile at the same locations is 534 animals (1.01% of the population), which represents the highest level of disturbance in temporal terms. The number of grey seal potentially disturbed by unmitigated piling for the ORCP is 388 individuals which works out to 0.73% of the MU.

10.3.72 In relation to grey seals associated with the Humber Estuary SAC, and to place the population level numbers in context, SCOS 2022 cites the grey seal population for Donna Nook (a close proxy to the Humber Estuary SAC) as being 3080. However, when factoring in "at-sea" seals (following the scalar presented in Russel *et al.,* 2016), the population estimate is 3942 seals. If all the grey seal disturbed originate from the Humber Estuary SAC, that would indicate that in an unmitigated scenario and for the worst case noted above of 615 individual seals (concurrent piling of northeast and southwest location), which is approximately 15.6% of the Humber Estuary SAC population of harbour seal may be temporarily disturbed.

10.3.73 As no population estimate is given for the Humber Estuary Ramsar, due to the close proximity with the Humber Estuary SAC, the SAC population estimate (3942 as above) is used. If all the grey seal disturbed originate from the Humber Estuary Ramsar, that would indicate that in an unmitigated scenario and for the worst case noted above of 615 individual seals (concurrent piling of northeast and southwest location), which is approximately 15.6% of the Humber Estuary Ramsar population of harbour seal, may be temporarily disturbed.

10.3.74 For the transboundary grey seal sites, population estimates have been sourced where available (from the standard data forms) for sites in Dutch waters (Doggersbank (Netherlands) 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 a population of 0), SBZ 2 SCI (gives a population of 0), SBZ 3 SCI (gives a population of 0 and Vlakte van de Raan SCI (0-400)). Given the absence of numbers for a lot of sites and large range for those sites with numbers, a qualitative approach is taken to this assessment for grey seals.

10.3.75 The highest disturbance levels for monopiles were predicted for simultaneous piling on the northeast and southwest locations, where an estimated 615 grey seals are predicted to be disturbed for the installation process. Due to the generalist diet, mobility, life history and adequate fat stores of grey seals, it is considered that grey seals would require moderate-high levels of repeated disturbance before there was any effect on fertility rates to reduce fertility. Grey seals are capital breeders and store energy in a thick layer of blubber, which means that, in combination with their large body size, they are tolerant of periods of fasting as part of their normal life history.

10.3.76 Part 6, Volume 1, Chapter 11: Marine Mammals found that the area of sea within which noise sufficient to result in disturbance of grey seal has a low density of grey seals, and is not considered an important foraging ground for the species. Grey seals are also highly adaptable to a changing environment and are capable of adjusting their metabolic rate and foraging tactics, to compensate for different periods of energy demand and supply (Beck *et al.,* 2003; Sparling *et al.,* 2006). Grey seals are also very wide ranging and are capable of moving large distances between different haul out and foraging regions (Russell *et al.,* 2013). 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 grey seal density quickly recovers once piling has ceased, and so any disturbance that does occur is likely to be short lived and temporary in nature. 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.

10.3.77 There is, therefore, no AEoI for the grey seal population and distribution with respect to the Humber Estuary SAC, Humber Estuary Ramsar, Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbak SCI, Noordzeekustone SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlaamse Banked SCI, Vlakte van de Raan SCI, Voordelta SCI, Waddenzee SCI, and Westerschelde & Saeftinghe SCI from the Project alone during construction and decommissioning and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.

Underwater noise from UXO clearance

10.3.78 Experience from other OWF projects in the southern North Sea suggests that there is the potential for UXO to occur within the array and export cable corridor for the Project 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 clearance of any UXO, if required.

10.3.79 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 within the pre-construction phase (broadly 2025 - 2028), with the proposed date for piling being 2027. Therefore, the earliest any such clearance may occur is anticipated to be in early 2026.

10.3.80 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 offshore wind projects. 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. However, it should be noted that it expected that low order techniques will be used as the primary clearance method at the point of activities occurring, following the trend towards this method as best-practise within the industry. This is expected to result in a significantly reduced magnitude of effect.

10.3.81 Consideration of impact from UXO is made on a risk of injury basis (defined as risk of onset of PTS) and a disturbance element. Part 6, Volume 1, Chapter 11: Marine Mammals considers how onset of PTS is defined and predicted in Section 4.7, with that information not repeated here. Depending on the charge weight of the UXO, it is clear (based on Table 11.15 of that Chapter) that the potential range of PTS for an unmitigated high order detonation is potentially high. Given that should PTS occur it would be unrecoverable, and in line with the PEIR, it is expected that should UXO clearance be required for the Project, there will be a requirement 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 Marine Management Organisation (MMO).

10.3.82 Further, although UXO clearance is not currently proposed, if it is required, the primary method of clearance would likely be using low-order detonation (small shape charge to penetrate the casing and vaporize the explosive material) as stated as the preferential method in the position statement on UXO clearance (Department for Business, Energy, and Industrial Strategy, now known as the Department for Energy Security and Net Zero, 2022).opposed to the commonly used high-order detonation where the explosive material is detonated. It is known that low-order deflagration detonations produce underwater noise that is over 20dB lower than high-order detonation (Robinson *et al*., 2020).

10.3.83 Natural England and JNCC advise that a buffer of 26 km around the source location is used to determine the impact area from high-order UXO clearance with respect to disturbance of harbour porpoise in the Southern North Sea SAC. In line with the justification presented within Part 6, Volume 1, Chapter 11: Marine Mammals a 5 km buffer for low-order has been used. 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 high-order detonations (considered to be the worst case), and a 5 km buffer for low-order detonations. This approach is consistent with Part 6, Volume 1, Chapter 11: Marine Mammals.

10.3.84 Section 4.7 of Part 6, Volume 1, Chapter 11: Marine Mammals concluded the significance of impact for all marine mammals from the risk of PTS from UXO detonation to be negligible, rising slightly to minor for disturbance in harbour porpoise, harbour seal and grey seal.

10.3.85 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

10.3.86 The only designated sites screened in for harbour porpoise is the SNS SAC. The conservation objectives for that site are given in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.87 Given that the anticipated requirement for a UXO-MMMP (Table 7.1) 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 the Project alone does not have an AEoI on the viability of harbour porpoise as a result of mortality or injury (the first conservation objective) resulting from UXO clearance at the Project alone during construction and decommissioning 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.**

10.3.88 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 26 km EDR.

10.3.89 The seasonal nature of the SNS SAC is important here, with the Project array area being more than 26 km distant from the winter extents of the SNS SAC at its closest point. As such, any UXO clearance within the array that takes place in the winter season (October-March inclusive) would fall outside the need for assessment here. Any UXO clearance within the Project array area during the summer season (April-September inclusive) would, however require consideration through the HRA process. For UXO clearance within the offshore ECC, any that fall within 26 km 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. Towards the western end of the export cable corridor, provided any UXO are more than 26 km 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. The assessment below is made based on maximum design scenario assumptions.

10.3.90 For UXO clearance within the Project array area, the maximum overlap (based on high-order detonations with the largest charge size as dictated by the MDS described in Table 7.1) per individual UXO clearance with the summer extents of the SNS SAC would be 1,726.3 km^2 from the northeast location (6.38% of the summer extents). Should five UXO be cleared within a single day, located such to result in the maximum possible footprint within the summer extents, that could result in up to 31.9% of the summer extent being affected. Such locations would be managed through the SIP process to avoid any such threshold exceedance. There is therefore capacity within the threshold (20% per 24-hours) for more than one UXO detonation to occur within the Project array area, with the maximum number of potential detonations that could be cleared within the threshold being dependant on size, location, method of clearance and in-combination risk. The use of a SIP will ensure that should multiple UXO be cleared per day, locations would be managed to ensure the thresholds would not be exceeded.

10.3.91 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). For UXO clearance in the overall export cable corridor, the values in the summer season vary (depending on location) between 0km^2 (0%) and 149 km^2 (0.55%). There is no overlap at all with the winter season area. As noted above, it is clear that capacity exists for clearance of more than one UXO within the Offshore ECC per 24-hours without exceeding the 20% daily threshold (dependant on location and in-combination risk), with the use of a SIP ensuring that should multiple UXO be cleared per day, locations would be managed to ensure the thresholds would not be exceeded.

10.3.92 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, as a single UXO as a maximum would result in 6.38% of the SAC affected. Should UXO clearance be undertaken at a rate greater than one per day (including up to the five per day noted above), this would reduce the seasonal contribution by condensing the timeframe of works.

10.3.93 Whilst there is no information on the number of UXO that could be required to be cleared, for the purposes of a realistic assessment, it has been assumed that up to 50 UXO detonations may be required, with one per day as a worst case. The maximum seasonal effect in the summer (assuming up to 6.83% per day for up to 50 days of the 183 day season) would therefore be 1.87%, with no maximum seasonal effect on the SNS SAC winter area. This value is precautionary (assuming a worst case of effect each time) and well within the 10% seasonal threshold.

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

10.3.95 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 Activities (JNCC, 2019) 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 Part 6, Volume 1, Chapter 7: Marine Processes. That chapter has concluded at most a minor adverse effect (which is not considered significant in EIA terms). For example, the chapter concluded no measurable effect on wave conditions at the coast and no impact on longshore drift. The scale of any potential effect on habitat and physical processes specific to the SNS SAC from individual UXO clearance would be highly localised to the UXO, contained within the scale of any wider project level effect, would be spatially much smaller than the overall SNS SAC and therefore of trivial consequence for physical processes at that scale. Potential for prey species to be affected are considered within Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology. As the impacts to prey are highly localised, short-term and recoverable that chapter considers that there is no significance of effects on fish species. Additionally, as marine mammals are generalist feeders it is considered that even in the unlikely event that there is a minor impact on fish species, it will not result in a population level effect on any marine mammal species.

10.3.96 There is, therefore, no AEoI to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from the Project alone during construction and decommissioning 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

10.3.97 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.

10.3.98 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 Part 6, Volume 1, Chapter 7: Marine Processes. That chapter has concluded slight adverse significance in all cases (which is not significant in EIA terms), certainly insufficient to reach any habitat designated for harbour seal. Similarly, Part 6, Volume 1, Chapter 11: 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. The harbour seal SACs are all located at distance from the Project (at least 90.5 km for the closest, the Klaverbank SCI), with the potential for effect on the habitats within the sites therefore inconsequential.

10.3.99 There is, therefore, no AEoI to the supporting habitats relevant to harbour seal and their prey from the Project alone during construction and decommissioning and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.

10.3.100 The potential to affect the population and distribution of harbour seal is considered within Part 6, Volume 1, Chapter 11: Marine Mammals with respect to potential for injury (risk of onset of PTS) and disturbance.

10.3.101 As for consideration of harbour porpoise above, the risk of onset of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-specific 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 the Project alone during construction and decommissioning does not have an AEoI on harbour seal as a result of mortality or injury resulting from UXO clearance at the Project alone.**

10.3.102 Part 6, Volume 1, Chapter 11: Marine Mammals considers that using TTS-onset as a proxy for disturbance is the most appropriate method for considering disturbance for grey seal. Table 1.19 within that chapter presents the impact ranges, number of animals disturbed and the percentage of the MU impacted, for a range of UXO charge sizes. The counts will vary with the size of UXO, however given the very short duration, intermittent nature and high reversibility of the effect, the significance was concluded to be slight, which is not significant in EIA terms.

10.3.103 With respect to the potential to affect harbour seals associated with a specific designated site, neither the Klaverbank SCI citation nor the Doggersbank (Netherlands) citation provide a population size. For the Wash and North Norfolk SAC, the citation has a population of 1,001-10,000. SCOS (2018) found that the population had risen between 2006 and 2012, with the more recent SCOS (2019) indicating the Wash harbour seal population is at or approaching carrying capacity, with the most recent counts for the Wash being similar to pre-PDV epidemic levels recorded in 1988 and 2002. As noted above, the most recent reports indicate a Wash population of around 2,883, or 3690 when factoring in "at-sea" seals (following Russel *et al.,* 2016).

10.3.104 The PEIR considered that harbour seal are not at risk of PTS from UXO detonations, however numbers were calculated for the risk of disturbance during UXO clearance (considering high-order detonation on the largest charge size considered as the worst case), with 11 harbour seals disturbed (equivalent to 0.24% of the Management Unit reference population). With respect to the Wash and North Norfolk SAC citation population, 11 individuals represents approximately 0.29% of the population (based on a population of 3,690). The potential for a very small proportion of the population to be impacted by very short term, temporary and intermittent occurrences, all located within an area of sea not considered important for harbour seals, means that the potential for effect is considered not significant.

10.3.105 There is, therefore, no AEoI for the harbour seal population and distribution with respect to the Wash and North Norfolk Coast SAC, Doggersbank (Netherlands) SAC and Klaverbank SCI from the Project alone during construction and decommissioning and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.

Consideration of grey seal

10.3.106 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.

10.3.107 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 Part 6, Volume 1, Chapter 7: Marine Processes. That chapter has concluded minor adverse significance in all cases (which is not significant in EIA terms), certainly insufficient to reach any habitat designated for grey seal. Similarly, Part 6, Volume 1, Chapter 11: 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. Given the distance between designated sites and the Project, combined with the large overall habitat availability, the minor or negligible changes found in the PEIR, no significant effect for grey seal habitat or prey, and in the context of relevant designated sites, no potential for significant or adverse effect has been identified.

10.3.108 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 (Netherlands) 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 the Project alone from UXO clearance and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.

10.3.109 The potential to affect the population and distribution of grey seal is considered within Part 6, Volume 1, Chapter 11: Marine Mammals with respect to potential for injury (risk of onset of PTS) and disturbance.

10.3.110 As for consideration of harbour porpoise, and harbour seal above, the risk of onset 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 the Project alone during construction and decommissioning does not have an AEoI on grey seal as a result of mortality or injury resulting from UXO clearance at the Project alone.**

10.3.111 Part 6, Volume 1, Chapter 11: Marine Mammals considers that using TTS-onset as a proxy for disturbance is the most appropriate method for considering disturbance for grey seal. Table 1.19 within that chapter presents the impact ranges, number of animals disturbed and the percentage of the MU impacted, for a range of UXO charge sizes. The counts will vary with the size of UXO, however given the very short duration, intermittent nature and high reversibility of the effect, the significance was concluded to be minor, which is not significant in EIA terms.

10.3.112 The PEIR considered that harbour seal are not at risk of PTS from UXO detonations, however numbers were calculated for the risk of disturbance during UXO clearance (considering high-order detonation on the largest charge size considered as the worst case), with 75 harbour seals disturbed (equivalent to 0.14% of the Management Unit reference population). With respect to the Humber Estuary SAC citation population, 75 individuals represents approximately 1.9% of the population (based on a population of 3690). The potential for a very small proportion of the population to be impacted by very short term, temporary and intermittent occurrences, all located within an area of sea not considered important for harbour seals, means that the potential for effect is considered not significant.

10.3.113 Each individual UXO clearance will result in a very short term source of noise, occurring intermittently across the construction phase. The number of animals that may be disturbed as a result of a single clearance is a worst case for a coastal UXO clearance. As noted above, should grey seals respond to the noise in terms of temporary displacement, alternative feeding grounds are available. Such a very short duration, intermittent and fully reversible effect on such a small proportion of individual site populations is therefore not considered sufficient to result in more than a short term, localised and temporary change in the distribution of grey seal associated with individual designated sites.

10.3.114 There is, therefore, no AEoI for grey seal population and distribution with respect to the Humber Estuary SAC and Ramsar, Berwickshire and North Northumberland Coast SAC, Doggersbank (Netherlands) 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 the Project alone during UXO clearance and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.

Underwater noise from geophysical and seismic survey

10.3.115 Geophysical survey, by definition, results in the emission of underwater noise. The pre-construction geophysical survey for the Project is likely to occur within the pre-construction phase, broadly 2026 - 2027, however no specific information is yet available (in terms of timing, nature, extent or duration). As noted above, the use of a SIP ensures that the assessment for the SNS SAC will be revisited for the Project according to the timeframe set out within the Outline SNS SAC SIP and will therefore include geophysical survey known at that time.

10.3.116 The type of geophysical survey carried out for OWF is not typically considered likely to result in PTS in marine mammals, as such a risk is mainly derived from surveys in water >200m and/or using airguns (not typical of OWFs within the North Sea). 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 AEoI for all sites and marine mammal features screened in can therefore be drawn from geophysical and seismic surveys.**

10.3.117 In the final guidance on noise disturbance in the SNS SAC, it was determined that some types of marine survey can be sufficient to result in an EDR, with airgun surveys connected to an EDR of 12km and some sub-bottom profiler and multi-beam surveys connected to an EDR of 5km. It is clear 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 the Project through the SIP process, as noted above). CSA (2020) demonstrated that the maximum distance to the disturbance threshold (120dB SPLrms) was 141m for a medium sub-bottom profiler so it is not anticipated to result in any significant disturbance or contribution to the thresholds. Additionally, whilst the frequencies of the equipment may overlap with the auditory band for harbour porpoise, they are in the mid to high frequency range so the level of attenuation is rapid. The equipment often used focused beam widths (less than 15 degrees) which limits horizontal propagation within the water column therefore minimising potential disturbance further.

10.3.118 To that end, the potential for disturbance in marine mammals from geophysical surveys (given that any such surveys for the Project would not be expected to contribute to the thresholds) 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

10.3.119 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).

10.3.120 A simple assessment of the noise impacts from non-piling noise is presented in Volume 2, Annex 3.2: Underwater Noise Assessment. 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.

10.3.121 The potential effects of cabling techniques used in the offshore windfarm industry was reviewed in a report by Business, Enterprise and Regulatory Reform (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). The minimal potential for impact is supported by the conclusion in the PEIR (Part 6, Volume 1, Chapter 11: Marine Mammals which summarises impacts scoped out of assessment), which found that no likely significant effects were identified at PEIR and therefore the effect will not beconsidered in detail within the ES.

10.3.122 Given the minimal potential for impact, a conclusion of no AEoI to all marine mammals in relation to underwater noise during seabed preparation and cable laying from the Project alone during construction and decommissioning has been drawn and therefore, subject to natural change, the marine mammal features associated with all relevant sites will be maintained in the long-term.

Vessel disturbance

10.3.123 The potential for an AEoI 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):

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

- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.124 The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase. The potential for vessel related disturbance on marine mammals alone has been assessed within the existing project literature (see Part 6, Volume 1, Chapter 11: Marine Mammals), with a summary of that provided here.

10.3.125 The area surrounding the Project already experiences a reasonable amount of vessel traffic throughout the year. In the summer there is an average of 64-65 unique vessels per day passing through the study area, and 10 unique vessels per day through the array area with less in the winter (see Part 6, Volume 1, Chapter 15: Shipping and Navigation). Therefore, the introduction of vessels during construction is not a novel impact for marine mammals present in the area.

10.3.126 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 ten vessels are present in a given 5 km^2 construction area. This level of activity is unlikely to occur across the entire array area at any one time, rather this intensity is expected across approximately three or four 5 km^2 blocks. The piling window is expected to fall within the window of ~Q4 2027 - ~Q4 2029. 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.

10.3.127 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.

10.3.128 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 array area, even considering the addition of construction traffic (a maximum of ten at any one time), will still be below this figure.

10.3.129 It is therefore not expected that the level of vessel activity during the construction of the Project would cause a significant increase in the risk of disturbance by vessels or collision risk with vessels. The adoption of a vessel management plan (Table 7.1) 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.

10.3.130 It is worth noting that overall, Part 6, Volume 1, Chapter 11: 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

10.3.131 Harbour porpoise are screened in for potential LSE with respect to vessel disturbance during construction and decommissioning for the following sites:

- The Southern North Sea SAC

10.3.132 The existing vessel traffic movements within the Project array area (an average of ten unique vessels per day passing through the array area in the summer and a reduced number in the winter), combined with up to ten vessels per 5km^2 block during construction, remains well 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.

10.3.133 The relevant conservation objectives for harbour porpoise are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.134 The first two conservation objectives address risk of injury and disturbance. Part 6, Volume 1, Chapter 11: Marine Mammals found (in the context of existing shipping levels, the increase in those levels proposed during construction at the Project and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of the Project is insufficient to result in mortality, injury or significant disturbance in marine mammals. That conclusion is supported at a site-based level by Heinänen and Skov (2015) as above.

10.3.135 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 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'. Shipping will not lead to a direct impact on the habitats and processes.

10.3.136 There is, therefore, no AEoI relevant to harbour porpoise for the SNS SAC from vessel disturbance from the Project alone during construction and decommissioning and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.

Consideration of harbour seal and grey seal

10.3.137 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);
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and

- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.138 The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase. The relevant conservation objectives for harbour seal and grey seal are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.139 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 Part 6, Volume 1, Chapter 7: Marine Processes. That chapter has concluded slight adverse significance in all cases (which is not significant in EIA terms) and certainly insufficient to reach habitats designated for harbour and grey seal. Similarly, Part 6, Volume 1, Chapter 11: 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.

10.3.140 There is, therefore, no AEoI to the supporting habitats relevant to both harbour seal and grey seal and their prey for the designated sites identified above from the Project alone during construction and decommissioning and therefore, subject to natural change, the supporting habitat for harbour seal and grey seal prey will be maintained in the long-term.

10.3.141 The potential to affect the population and distribution of harbour seal and grey seal is considered within Part 6, Volume 1, Chapter 11: Marine Mammals with respect to potential for mortality, injury (risk of onset of PTS) and disturbance. No indication was found that disturbance from shipping can result in risk of onset of PTS in marine mammals, with consideration given to the risk of disturbance below.

10.3.142 As regards the risk of disturbance, it is clear from the summary presented above (which draws on Part 6, Volume 1, Chapter 11: Marine Mammals) that (in the context of existing shipping levels, the increase in those levels proposed during construction at the Project and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of the Project is insufficient to result in mortality, injury or significant disturbance in marine mammals. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

10.3.143 There is, therefore, no AEoI relevant to both harbour seal and grey seal and their prey for the designated sites identified above from the Project alone during construction and decommissioning and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.

Collision risk

10.3.144 The potential for an AEoI as a result of vessel collision risk with 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):

- Southern North Sea SAC (harbour porpoise);

- Humber Estuary SAC (harbour seal)
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary Ramsar (grey seal);
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.145 The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase. It should be noted that the potential for collision risk is limited to individuals that may come into direct contact with vessels, in comparison to consideration of, for example, disturbance from underwater noise, where individuals could be disturbed at distance from source. The sites screened in for potential LSE for collision risk are therefore limited to those where potential for direct connectivity between individuals from a designated site and the Project array, Offshore ECC, and/or vessel transit routes are identified.

10.3.146 The potential for vessel collision risk with marine mammals alone has been assessed within the existing project literature (see Part 6, Volume 1, Chapter 11: Marine Mammals), with a summary of that provided here.

10.3.147 The area surrounding the Project already experiences a reasonable amount of vessel traffic throughout the year, with an average of ten vessels per day passing through the array area in the summer and a reduced number in winter (see Part 6, Volume 1, Chapter 15: Shipping and Navigation). Therefore, the introduction of additional vessels during construction is not a novel impact for marine mammals present in the area.

10.3.148 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. These injuries include blunt trauma to the body or injuries consistent with propeller strikes. The risk of collision of marine mammals with vessels would be directly influenced by the type of vessel and the speed with which it is travelling (Laist *et al.,* 2001) and indirectly by ambient noise levels underwater and the behaviour the marine mammal is engaged in.

10.3.149 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 Strandings Investigation Programme (CSIP) documents the annual number of reported strandings and the cause of death for those individuals examined at post-mortem. The CSIP data shows that very few strandings have been attributed to vessel collisions[9], 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. However, it is important to note that the strandings data are biased to those carcases that wash ashore for collection and therefore may not be representative.

10.3.150 Harbour porpoises 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 (Table 7.1) will ensure that vessel traffic moves along predictable routes and will define how vessels should behave in the presence of marine mammals.

10.3.151 Further, it is highly likely that a proportion of vessels will be stationary or slow moving throughout construction activities for significant periods of time. Therefore, the actual increase in vessel traffic moving around the site and to/from port to the site will occur over short periods of the offshore construction activity.

10.3.152 Overall, Part 6, Volume 1, Chapter 11: Marine Mammals found that the effect is of minor adverse significance, which is not significant in EIA terms.

Consideration of harbour porpoise

10.3.153 Harbour porpoise are screened in for potential LSE with respect to vessel disturbance during construction and decommissioning for the following sites:

- The Southern North Sea SAC

10.3.154 The existing vessel traffic movements within the Project array area (an average of ten vessels per day passing through the array area in the summer and a reduced number in the winter), combined with up to ten vessels per 5km^2 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.

10.3.155 The relevant conservation objectives for harbour porpoise are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

[9] CSIP (2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018)

10.3.156 The first two conservation objectives address risk of injury and disturbance. Part 6, Volume 1, Chapter 11: Marine Mammals found (in the context of existing shipping levels, the increase in those levels proposed during construction at the Project and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of the Project is insufficient to result in an increase in the risk of mortality or injury in marine mammals as a result of collisions. That assessment applies equally to harbour porpoise associated with the SNS SAC, given the localised nature of any effect together with the location of that effect relative to the SAC.

10.3.157 The third conservation objective is focused on maintaining the supporting habitats and processes, together with availability of harbour porpoise prey, within the SNS SAC. Vessel collision risk does not have the potential to affect such habitats or processes.

10.3.158 There is, therefore, no AEoI relevant to harbour porpoise for the SNS SAC from the Project alone during construction and decommissioning and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.

Consideration of harbour seal and grey seal

10.3.159 Harbour seal and grey seal are screened in for potential LSE with respect to vessel collision risk 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);
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.160 The relevant conservation objectives for seals are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.161 Part 6, Volume 1, Chapter 11: Marine Mammals found (in the context of existing shipping levels, the increase in those levels proposed during construction at the Project and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of the Project is insufficient to result in an increase in the risk of mortality or injury in marine mammals as a result of collisions.

10.3.162 There is, therefore, no AEoI relevant to grey or harbour seal for the identified sites from the Project alone during construction and decommissioning and therefore, subject to natural change, the grey and harbour seal feature at these sites will be maintained in the long-term.

Indirect pollution

10.3.163 The potential for an AEoI as a result of indirect pollution on marine mammals during construction and decommissioning 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).

10.3.164 The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase. The potential for indirect pollution to affect marine mammals was not considered in the PEIR (Part 6, Volume 1, Chapter 11: Marine Mammals), given the Project specific mitigation and conclusion of no significant effect, which enabled the effect to be scoped out from assessment in the ES. The reason for that is given as the development of a MPCP, which will form part of a wider PEMP.

10.3.165 It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1.

10.3.166 The implementation of the PEMP, produced in consultation with relevant bodies, and provided for in the DCO as above, enables the conclusion that there is, **therefore, no AEoI to marine mammals in relation to indirect pollution from the Project alone and/or in-combination and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for indirect pollution during construction and decommissioning.**

Accidental Pollution

10.3.167 The potential for an AEoI as a result of accidental pollution on marine mammals during construction and decommissioning 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).

10.3.168 The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase. The potential for accidental pollution to affect marine mammals was not considered in the PEIR (Part 6, Volume 1, Chapter 11: Marine Mammals), given the Project specific mitigation and conclusion of no significant effect, which enabled the effect to be scoped out from assessment in the ES. The reason for that is given as the development of a MPCP, which will form part of a wider PEMP.

10.3.169 It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1.

10.3.170 The implementation of the PEMP, produced in consultation with relevant bodies, and provided for in the DCO as above, enables the conclusion that there is, **therefore, no AEoI to marine mammals in relation to accidental pollution from the Project alone and/or in-combination during construction and decommissioning and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for accidental pollution.**

Changes to prey

10.3.171 The potential for an AEoI as a result of changes to prey on marine mammals during construction and decommissioning 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).

10.3.172 The relevant conservation objectives for harbour porpoise at the SNS SAC are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.173 The potential for adverse effects from changes to prey species for harbour porpoise during construction and decommissioning is considered in Part 6, Volume 1, Chapter 11: Marine Mammals. The key effects that may result in changes to prey are underwater noise, vessel disturbance, collision risk or accidental pollution. It is not expected that the level of any of these effects during the construction and decommissioning phases of the Project would result in an AEoI for any marine mammal prey species, therefore including harbour porpoise. The assessments presented within the PEIR and this draft RIAA conclude no potential for underwater noise to impact to harbour porpoise. The adoption of a vessel management plan (Table 7.1), that includes preferred transit routes and guidance for vessel operations in the vicinity of harbour porpoise, will minimise the potential for any impact from vessel disturbance and collision risk. The adoption of the PEMP will ensure that there is no adverse effect from indirect or accidental pollution.

10.3.174 This therefore enables the conclusion that there is no AEoI to harbour porpoise in relation to changes to prey from the Project alone and/or in-combination during construction and decommissioning and therefore, subject to natural change, the harbour porpoise feature will be maintained in the long-term with respect to the potential for changes to prey.

O&M

Underwater noise

10.3.175 The potential for an AEoI as a result of underwater noise on marine mammals during O&M 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).

10.3.176 The relevant conservation objectives for harbour porpoise are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.177 Operational WTGs will produce underwater noise as a result of vibration from the rotating machinery in the turbines, which is transmitted through the structure of the pile and foundations.

10.3.178 The MMO (2014) review of post-consent monitoring at OWFs found that available data on the operational WTG noise, from the UK and abroad, in general showed that noise levels from operational WTGs are low and the spatial extent of the potential impact of the operational WTG noise on marine receptors is generally estimated to be small, with behavioural response only likely at ranges close to the WTG. This is supported by several published studies which provide evidence that marine mammals are not displaced from operational windfarms. For example, a number of reviews have concluded that operational windfarm 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 windfarms (Diederichs *et al.,* 2008; Scheidat *et al.,* 2011) and may be attracted to offshore windfarms for increased foraging opportunities (Lindeboom *et al.,* 2011).

10.3.179 The potential for operational noise to affect marine mammals is noted in Part 6, Volume 1, Chapter 11: Marine Mammals, where it is concluded that no likely significant effect is considered. Specifically, that 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 mammal 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). Given the evidence of their presence in and around existing operational offshore windfarms, marine mammals are deemed to be of low vulnerability and have high recoverability to the impact of operational noise.

10.3.180 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. Such an occurrence is extremely unlikely and would be atypical behaviour for such a highly mobile species. 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).

10.3.181 With respect to the potential for disturbance to result in displacement of individuals, and given existing evidence which demonstrates that harbour porpoise are not displaced from offshore windfarms 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.

10.3.182 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 Part 6, Volume 2, Annex 3.2: Underwater Noise Assessment), finding that the risk of TTS (over a period of 12 hours) is 150m. Further consideration is given to fish in Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology, including during operation, with a behavioural response only expected at very close range.

10.3.183 It can therefore be concluded that there is no AEoI to harbour porpoise in relation to operational noise from the Project alone during O&M and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term.

Vessel disturbance

10.3.184 The potential for an AEoI as a result of vessel disturbance on marine mammals during O&M 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);
- Humber Estuary SAC (harbour seal);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary Ramsar (grey seal);
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.185 The relevant conservation objectives for harbour porpoise, harbour seal and grey seal are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.186 The potential for vessel disturbance (and any associated vessel collision risk) in marine mammals during O&M is considered in Part 6, Volume 1, Chapter 11: Marine Mammals. It is not expected that the level of vessel activity during the O&M of the Project would cause a significant increase in the risk of disturbance by vessels. The adoption of a vessel management plan (Table 7.1), 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.

10.3.187 Given the localised, temporary and intermittent nature of the effect, the conclusions of the PEIR are considered to be directly relevant to the designated sites under consideration. As such, given that the O&M vessel movements are not expected to result in a significant change on existing conditions, and in light of the conclusions drawn above with respect to vessel disturbance during O&M, of **no AEoI for all marine species screened in (when potential for vessel related disturbance is greater), it can be concluded that the same conclusion of no AEoI applies equally during the operation & maintenance phase of works.**

Collision risk

10.3.188 The potential for an AEoI as a result of vessel disturbance on marine mammals during O&M 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);
- Humber Estuary SAC (harbour seal)
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary Ramsar (grey seal);

- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (Bancs des Flandres SAC, Doggersbank (Netherlands) SAC, Klaverbank 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).

10.3.189 The relevant conservation objectives for harbour porpoise seal species are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

10.3.190 Part 6, Volume 1, Chapter 11: Marine Mammals notes that given the conclusions drawn at PEIR (of no likely significant effect), the potential for vessel collision with marine mammals will not be considered in detail in the ES. Specifically, it is not expected that the level of vessel activity during O&M would cause an increase in the risk of mortality from collisions. The adoption of a vessel management plan (Table 7.1) will minimise the potential for any impact.

10.3.191 Given that, in the context of existing shipping levels, the increase in vessel traffic proposed during O&M at the Project (in the context of relevant project mitigation) is insufficient to result in an increase in the risk of mortality or injury in marine mammals as a result of collisions. That assessment applies equally to all marine mammals and therefore includes harbour porpoise, harbour seals, and grey seals that may be associated with the identified sites. Therefore, there is **no AEoI to marine mammals in relation to collision risk from the Project alone and/or in-combination during O&M and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for collision risk.**

Indirect pollution

10.3.192 The potential for an AEoI as a result of indirect pollution on marine mammals during O&M 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).

10.3.193 The potential for indirect pollution to affect marine mammals was not considered in the PEIR (Part 6, Volume 1, Chapter 11: Marine Mammals), given the Project specific mitigation and conclusion of no significant effect, which enabled the effect to be scoped out from assessment in the ES. The reason for that is given as the development of a Marine Pollution Contingency Plan (MPCP), which will form part of a wider PEMP. A similar approach to screening out the effect has not been applied to the draft RIAA.

10.3.194 It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1.

10.3.195 The implementation of the PEMP, produced in consultation with relevant bodies, and provided for in the DCO as above, enables the conclusion that there is, therefore, **no AEoI to marine mammals in relation to indirect pollution from the Project alone and/or in-combination during O&M and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for indirect pollution.**

Accidental Pollution

10.3.196 The potential for an AEoI as a result of accidental pollution on marine mammals during O&M 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).

10.3.197 The potential for accidental pollution to affect marine mammals was not considered in the PEIR (Part 6, Volume 1, Chapter 11: Marine Mammals), given the Project specific mitigation and conclusion of no significant effect, which enabled the effect to be scoped out from assessment in the ES. The reason for that is given as the development of a MPCP, which will form part of a wider PEMP. A similar approach to screening out the effect has not been applied to the draft RIAA.

10.3.198 It is noted that this mitigation will be secured in the DCO. For full details on the mitigation please see Table 7.1.

10.3.199 The implementation of the PEMP, produced in consultation with relevant bodies, and provided for in the DCO as above, enables the conclusion that there is, **therefore, no AEoI to marine mammals in relation to accidental pollution from the Project alone and/or in-combination during O&M and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for accidental pollution.**

Changes to prey

10.3.200 The potential for an AEoI as a result of changes to prey on marine mammals during O&M 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).

10.3.201 The potential for adverse effects from changes to prey species in marine mammals during O&M is considered in Part 6, Volume 1, Chapter 11: Marine Mammals. They key effects that may result in changes to prey are underwater noise, vessel disturbance, collision risk or accidental pollution. It is not expected that the level of any of these effects during the O&M of the Project would result in an AEoI for any marine mammal prey species and therefore marine mammal receptors. The assessments presented within the PEIR and this draft RIAA conclude no potential for underwater noise to impact any receptors. The adoption of a vessel management plan (Table 7.1), 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 from vessel disturbance and collision risk. The adoption of the PEMP will ensure that there is no adverse effect from indirect or accidental pollution.

10.3.202 This therefore enables the conclusion that there is no AEoI to marine mammals in relation to changes to prey from the Project alone and/or in-combination during O&M, and therefore, subject to natural change, the marine mammal feature will be maintained in the long-term with respect to the potential for changes to prey.

10.4 Offshore and Intertidal Ornithology

Introduction

Assessment Criteria

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

10.4.2 The precautionary screening criteria used for screening is presented in the Project's Screening Report (Outer Dowsing Offshore Wind, 2022). The relevant guidance and literature used to identify the species sensitive to disturbance and/or displacement; and/or a sensitive to collision with the array were Bradbury *et al.,* 2014; Furness and Wade, 2012; Furness *et al.,* 2013; Dierschke *et al.,* 2016 and SNCB guidance 2022. Bird usage of UK waters and of specific sites and habitats varies throughout the year depending on the requirements of the species. Therefore, to increase accuracy the assessments are split into relevant biological seasons (bio-seasons) for each species (e.g. breeding, spring/autumn migration, wintering). Site-specific data from the array area and 4km buffer, were used to identify the species more susceptible to impacts during different bio-seasons.

10.4.3 The determination of AEoI 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.

10.4.4 An adverse effect on integrity cannot immediately be ruled out where predicted impacts (either in project alone or in-combination) equate to an increase in baseline mortality of greater than 1% of the relevant population. If the increase in baseline mortality exceeds 1%, then further consideration of the significance of the mortality is required to determine if an adverse effect can be ruled out, e.g. through population modelling (Population Viability Analysis (PVA)). This approach is recommended by Natural England (Parker *et al.,* 2022) and can incorporate known population trends and density dependence, where it is considered appropriate, to assess the impacts on a population more accurately. Note that PVA and migratory Collision Risk Modelling (mCRM) is not included in this draft RIAA but will be undertaken on the relevant species and sites post-PEIR and to inform the final RIAA to accompany the DCO application. Sites and features screened in for migratory collision risk are provided in Table 10.39 but are not considered further in the assessment at this stage.

Description of Significance

10.4.5 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 the assessment is provided below.

Description of Designation

10.4.6 The description of designated sites and the conservation objects for each site can be found in The Screening Report (Outer Dowsing Offshore Wind, 2022). Table 10.4 highlights the relevant conservation objective for species within designated sites.

Table 10.4: Designated sites for ornithological receptors with conservation objectives associated with each feature.

Site	Feature	Conservation Objective
Greater Wash SPA	Red-throated diver	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 and/or restoring;* ▪ The extent and distribution of the habitats of the q*ualifying features;* ▪ The structure and function of the habitats of the qu*alifying features;* ▪ The supporting processes on whi*ch 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.
	Common scoter	
FFC SPA	Guillemot	
	Razorbill	
	Puffin*	
	Gannet	
	Kittiwake	
	Herring Gull	
Alde-ore Estuary SPA	Lesser Black-backed Gull	
North Norfolk Coast SPA	Sandwich tern	
Coquet Island SPA	Puffin*	
	Common tern	
	Sandwich tern	
Farne Island SPA	Kittiwake*	
	Guillemot	
	Puffin	
	Sandwich Tern	
Scottish sites		
Buchan Ness to Collieston Coast SPA	Guillemot*; Kittiwake*	"To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying
Calf of Eday SPA	Guillemot*; Kittiwake*	

Site	Feature	Conservation Objective
Copinsay SPA	Guillemot*; Kittiwake*	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; and ▪ No significant disturbance of the species.
East Caithness Cliffs SPA	Guillemot*; Razorbill*; Kittiwake*	
Fair Isle SPA	Guillemot*; Razorbill*; Puffin*; Kittiwake*; Gannet*	
Forth Islands (UK) SPA	Guillemot; Razorbill; Puffin; Kittiwake; Gannet	
Foula SPA	Guillemot; Razorbill*; Puffin; Kittiwake*	
Fowlsheugh SPA	Guillemot; Razorbill*; Kittiwake*	
Hermaness, Saxa, Vord and Valla Field SPA	Guillemot*; Puffin; Kittiwake*; Gannet	
Hoy SPA	Guillemot*; Puffin*; Kittiwake*	
Marwick Head SPA	Guillemot*; Kittiwake*	
North Caithness Cliffs SPA	Guillemot; Razorbill*; Puffin*; Kittiwake*	
Noss SPA	Guillemot; Puffin*; Kittiwake*; Gannet	
Rousay SPA	Guillemot*; Kittiwake*	
St Abb's Head SPA	Guillemot*; Razorbill*; Kittiwake*	
Sumburgh Head SPA	Guillemot*; Kittiwake*	
Troup, Pennan and Lion's Heads SPA	Guillemot; Razorbill*; Kittiwake*	
West Westray	Guillemot; Razorbill*; Kittiwake*	

*Species listed as Assemblage features

Maximum design scenario

10.4.7 Table 10.5 below summarises the Maximum Design Scenario(s) considered for ornithological receptors, as described in Part 6, Volume 1, Chapter 12: Offshore and Intertidal Ornithology. The full project description is provided in Part 6, Volume 1, Chapter 3: Project Description for full reference.

Table 10.5: Maximum Design Scenario for Ornithology from the Project Alone

Potential effect	Maximum design scenario assessed	Justification
Construction phase		
Impact 1: Disturbance and displacement: Offshore ECC.	Construction Vessels within ECC: ▪ Three cable laying vessels (20 return trips); ▪ Three cable jointing vessels (16 return trips); ▪ Three cable burial vessels (16 return tips); ▪ 16 support vessels (1,070 return trips); ▪ 16 helicopter return trips; and ▪ Single phase of offshore construction over approximately four years (2026 – 2029).	The assumption is that vessels would be in situ from start to finish, so any disturbance events would be throughout entire period.
Impact 2: Disturbance and displacement: Intertidal ECC.	Trenchless Installation: ▪ 6 offshore exits pits; ▪ Exit pits only within the subtidal; ▪ Small 4x4 vehicles related to emergency response on the beach. Cable Laying: ▪ Maximum duration of cable laying via trenchless methods is a 24 month period.	The assumption is that the process would be undertaken by trenchless methods, so no open trenching, cable laying and burial of the export cable would be required. No exit pits will be made within the intertidal ECC. Therefore, MDS activities to be assessed are limited to monitoring activities or emergency response, though they are to take place over a maximum of a 24 month period.
Impact 3: Disturbance and displacement: Array.	Construction Vessels within Array Area: ▪ Max total construction vessels: 131 ▪ Max total round trips per year: 4,471 ▪ Up to 10 construction vessels in a given 5km^2 area simultaneously. Single phase of offshore construction over approximately 4 years (2026 – 2029).	The maximum estimated number of development areas within the array area with vessels operating concurrently would cause the greatest disturbance to birds on site.

Potential effect	Maximum design scenario assessed	Justification
Impact 4: Indirect impacts on IOFs due to effects on prey species habitat loss: Array.	See MDS for Fish and Shellfish Ecology assessment (Volume 1, Chapter 10 - Fish and Shellfish Ecology) and for the benthic and intertidal ecology assessment (Volume 1, Chapter 9 - Benthic and Intertidal Ecology).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the fish and shellfish ecology or benthic and intertidal ecology assessments. The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications in Volume 1, Chapter 10 - Fish and Shellfish Ecology and Volume 1, Chapter 9 - Benthic and Intertidal Ecology.
Impact 5: Indirect impacts on IOFs due to effects on prey species habitat loss: Offshore ECC.	See MDS for Fish and Shellfish Ecology assessment (Part 6, Volume 1, Chapter 10 - Fish and Shellfish Ecology) and for the benthic and intertidal ecology assessment (Part 6, Volume 1, Chapter 9 - Benthic and Intertidal Ecology).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Fish and Shellfish Ecology or benthic and intertidal ecology assessments. The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications in Volume 1, Chapter 10 - Fish and Shellfish Ecology and Volume 1, Chapter 9 - Benthic and Intertidal Ecology.
O&M		
Impact 1: Disturbance and displacement: Array.	Array Area: ▪ WTG deployment across the full array area (500km^2). ▪ Up to 93 WTGs; ▪ Minimum height of lowest blade tip above MSL: 30m; and	Displacement would be assumed from the entire array area that contains WTGs and other associated structures, which maximises the potential for disturbance and displacement. Assessment of extent/varying displacement from array area and a buffer is species specific due to their sensitivity levels.

Potential effect	Maximum design scenario assessed	Justification
	▪ Maximum rotor blade diameter: 340m. O&M: ▪ Up to 1,339 return visits to wind turbines per year; ▪ Up to 409 return visits to wind turbine foundations per year; ▪ Up to 55 return visits to offshore platforms (structural scope) per year; ▪ Up to 115 return visits to offshore platforms (electrical scope) per year; and ▪ Up to 2,216 total trips per year completed by helicopter and/or vessels.	
Impact 2: Collision risk: Array.	▪ WTG deployment across the full array area (500km^2) area. ▪ Up to 93 WTGs; ▪ Minimum height of lowest blade tip above MSL: 30m; and ▪ Maximum rotor blade diameter: 340m.	This represents the maximum number of the largest WTGs, which represents the greatest total swept area to be considered for collision risk.
Impact 3: Indirect impacts on IOFs due to impacts on prey species habitat loss: Array.	See MDS for Fish and Shellfish Ecology assessment (Volume 1, Chapter 10 - Fish and Shellfish Ecology) and for the benthic and intertidal ecology assessment (Volume 1, Chapter 9 - Benthic and Intertidal Ecology).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Fish and Shellfish Ecology or Benthic and Intertidal Ecology assessments. The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications in Volume 1, Chapter 10 - Fish and Shellfish Ecology) and Volume 1, Chapter 9 - Benthic and Intertidal Ecology.
Decommissioning phase		

Potential effect	Maximum design scenario assessed	Justification
Impact 1: Disturbance and displacement: Array.	As with construction	As with construction
Impact 2: Disturbance and displacement: Offshore ECC.	As with construction	As with construction
Impact 3: Indirect impacts on IOFs due to impacts on prey species habitat loss: ECC.	See MDS for Fish and Shellfish Ecology assessment (Volume 1, Chapter 10 - Fish and Shellfish Ecology) and for the Benthic and Intertidal Ecology assessment (Volume 1, Chapter 9 - Benthic and Intertidal Ecology).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Fish and Shellfish Ecology or benthic and intertidal ecology assessments. The maximum indirect impact on birds would result from the maximum direct impact on fish, shellfish and benthic species and habitats. The maximum design scenario is therefore as per justifications in Volume 1, Chapter 10 - Fish and Shellfish Ecology) and Volume 1, Chapter 9 - Benthic and Intertidal Ecology.

Disturbance and Displacement

10.4.8 There is potential for adverse effects on seabirds through disturbance originating from construction activities including the installation of foundations, towers, blades, export cables and other infrastructure and the movement of vessels and helicopters during the construction phase of the Project. This disturbance may result in displacement of birds from the OWF site, driving a temporary habitat loss and resultant reduction in area available to birds for feeding, resting and moulting.

10.4.9 The effect of disturbance and displacement from construction are considered to be short-term, temporary and reversable in nature, with birds returning to the area following the end of construction activity. Effects are likely to predominantly affect birds foraging within the construction area, with the extent of effects depending on the activities taking place.

10.4.10 The screening process and consultation with Natural England has identified the features and sites to have potential for disturbance and displacement during the construction and decommissioning phases (LSE cannot be ruled out) as those presented in Table 10.6 below.

Table 10.6 Site identified for potential AEoI within the construction and decommissioning phase with information on designated features, impacts and bio-season.

Site	Feature	Bio-season
The Greater Wash SPA	Red-throated diver	Non-breeding
	Common scoter	Non-breeding
FFC SPA	Guillemot	Breeding and non-breeding
	Razorbill	Breeding and non-breeding
	Puffin*	Breeding and non-breeding
	Gannet	Breeding and non-breeding
Farne Islands SPA	Guillemot	Non-breeding
	Puffin	Non-breeding
Coquet Island SPA	Puffin*	Breeding and non-breeding
Scottish SPAs		
Buchan Ness to Collieston Coast SPA	Guillemot*	Non-breeding
Calf of Eday SPA	Guillemot*	Non-breeding
Copinsay SPA	Guillemot*	Non-breeding
East Caithness Cliffs SPA	Guillemot*; Razorbill*	Non-breeding
Fair Isle SPA	Guillemot*; Razorbill*; Puffin*	Non-breeding
Forth Islands (UK) SPA	Guillemot; Razorbill; Puffin; Gannet	Non-breeding
Foula SPA	Guillemot; Razorbill*; Puffin	Non-breeding
Fowlsheugh SPA	Guillemot; Razorbill*	Non-breeding
Hermaness, Saxa, Vord and Valla Field SPA	Guillemot*; Puffin; Gannet	Non-breeding
Hoy SPA	Guillemot*; Puffin*	Non-breeding

Site	Feature	Bio-season
Marwick Head SPA	Guillemot*	Non-breeding
North Caithness Cliffs SPA	Guillemot; Razorbill*; Puffin*	Non-breeding
Noss SPA	Guillemot; Puffin*	Non-breeding
Rousay SPA	Guillemot*	Non-breeding
St Abb's Head SPA	Guillemot*; Razorbill*	Non-breeding
Sumburgh Head SPA	Guillemot*	Non-breeding
Troup, Pennan and Lion's Heads SPA	Guillemot; Razorbill*	Non-breeding
West Westray	Guillemot; Razorbill*	Non-breeding

* Species listed as Assemblage features

10.4.11 Assessments of bird disturbance and displacement from activities associated with the Project's site are based on several measures. A scoring system for disturbance factors is available from Garthe and Hüppop (2004) and is widely used in OWF EIAs. In Scottish waters, Furness and Wade (2012) have developed disturbance ratings for certain species, in addition to a scoring system based on habitat flexibility and conservation importance. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. Bradbury *et al.,* (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters.

10.4.12 Disturbance from construction activities will affect bird species differently, with some species being more susceptible to effects such as displacement. For example, Dierschke *et al.,* (2016) note variation in avoidance and displacement by some species, while some were instead attracted to offshore windfarms. Divers have been shown to avoid shipping, with red-throated diver flushing at a median value of 400m and max of 2km (Bellebaum *et al.,* 2006), and is therefore at risk of displacement from cable laying vessels within the ECC during construction of the Project. Gannet and auk species have also been noted to avoid construction activities (i.e. are displaced), and so are also at risk of displacement from the array area.

10.4.13 The assessment for displacement has been carried out for the Project 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 a maximum of three vessels simultaneously, across the entire ECC;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 four-years for a single phase of offshore construction; and

10.4.14 Where construction activities do not occur, such as locations without WTG foundation, cables, OSS or ORCP installation, such areas shall remain largely uninfluenced by construction activities.A lack of evidence is currently available to provide definitive empirical displacement rates for the construction phase of OWFs. However, studies have noted that displacement rates for auks are either comparable to the operation phase or significantly lower (Royal HaskoningDHV, 2013; Vallejo *et al.,* 2017). Similarly, Krijgsveld *et al.,* (2011) demonstrate flight paths of gannets are higher for operating vs non-operating turbines. Based on this evidence, and the above presented temporal and spatial restrictions of the construction and decommissioning phase in comparison to the operational phase, it is considered that the level of displacement used for assessment for auks and gannet would be half of that of the operational phase. Notably, for red-throated diver, a precautionary approach was taken with a displacement rate of 100%. A precautionary mortality rate of 1% is also used for all species, with a range of 1-10% presented for auk species, red-throated diver and common scoter.

10.4.15 A summary of the level of displacement used for the assessment of disturbance and displacement during the construction and decommissioning phases are as presented in Table 10.7 below. Reference should be made to the operational and maintenance phase for a full description and justification for the displacement and mortality rates used.

10.4.16 For Auk species and gannet, birds within the array and 2km buffer were assumed to be at risk of displacement as per the latest SNCB advice (MIG-Birds, 2022). For red-throated diver, all birds within the full survey area (array area and 4km buffer) were assumed to be at risk of displacement.

Table 10.7 Displacement rates used for assessment in the construction and decommissioning phase based on half that in the construction and decommissioning phase.

Species	Displacement rate	Mortality rate
Gannet	35% (plus a range of 30% to 40%)	1%
Auk species	25% (plus a range of 15% to 35%)	1% (plus a range of 1% to 10%)
Red-throated diver.	100% (plus a range of 90% to 100%)	1% (plus a range of 1% to 10%)
Common scoter	100% (plus a range of 90% to 100%)	1% (plus a range of 1% to 10%)

10.4.17 The displacement assessments undertaken for this draft RIAA are considered to be over-precautionary based on the following:

- The population assessed 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, whereas in reality the abundance of each species is likely to be considerably less for much of the bio-season;
- The maximum extent of displacement considered for each species within the assessment is likely to be greater than actually experienced within the array area and buffer zone;

- The 1% mortality of displaced birds is highly unlikely, as the species assessed in this draft RIAA are not solely dependent upon the area within the Project array area and buffer for all their foraging needs either within the breeding or non-breeding bio-seasons;
- The apportionment assumptions are highly precautionary. For example, 100% of adult gannets within the array during the migration-free breeding season are breeding birds from FFC SPA.

Approach to O&M

Disturbance and Displacement

10.4.18 The construction and presence of WTGs have the potential to disturb and displace seabirds that would normally reside within and around the area of sea where the Project is proposed to be developed. This in effect represents indirect habitat loss, potentially reducing the area available to those seabirds to forage, loaf and/or moult that currently occur within and around the Project 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.

10.4.19 There is a variation in responses from seabird species to the presence of offshore windfarms and the associated infrastructure, including shipping activity related to maintenance activities and the presence of WTGs. As offshore windfarms are relatively new features in the marine environment, there is limited evidence of the long-term effects of displacement and disturbance of operational infrastructure.

10.4.20 A scoring system for disturbance factors was developed by Garthe and Hüppop (2004), which has been used widely throughout offshore windfarm HRAs. Furness and Wade (2012) developed a similar system with disturbance ratings for seabird species which was applied alongside scores for habitat flexibility and conservation importance to define an index value that highlights each species' sensitivity to displacement and disturbance.

10.4.21 The potential for disturbance and displacement to result in an AEoI relates to the designated sites and the relevant features in Table 10.8.

Table 10.8 Sites and features identified for potential AEoI for disturbance and displacement impacts within the O&M phase.

Site	Feature	Bio-season
The Greater Wash SPA	Red-throated diver	Non-breeding
	Common Scoter	Non-breeding
FFC SPA	Guillemot	Breeding and non-breeding
	Razorbill	Breeding and non-breeding
	Puffin (Assemblage feature)	Breeding and non-breeding
	Gannet	Breeding and non-breeding
Farne Islands SPA	Guillemot	Non-breeding
	Puffin	Non-breeding

Site	Feature	Bio-season
Coquet Island SPA	Puffin	Breeding and non-breeding
Scottish SPAs		
Buchan Ness to Collieston Coast SPA	Guillemot	Non-breeding
Calf of Eday SPA	Guillemot	Non-breeding
Copinsay SPA	Guillemot	Non-breeding
East Caithness Cliffs SPA	Guillemot; Razorbill	Non-breeding
Fair Isle SPA	Guillemot; Razorbill; Puffin	Non-breeding
Forth Islands (UK) SPA	Guillemot; Razorbill; Puffin; Gannet	Non-breeding
Foula SPA	Guillemot; Razorbill; Puffin	Non-breeding
Fowlsheugh SPA	Guillemot; Razorbill	Non-breeding
Hermaness, Saxa, Vord and Valla Field SPA	Guillemot; Puffin; Gannet	Non-breeding
Hoy SPA	Guillemot; Puffin	Non-breeding
Marwick Head SPA	Guillemot	Non-breeding
North Caithness Cliffs SPA	Guillemot; Razorbill; Puffin	Non-breeding
Noss SPA	Guillemot; Puffin	Non-breeding
Rousay SPA	Guillemot	Non-breeding
St Abb's Head SPA	Guillemot; Razorbill	Non-breeding
Sumburgh Head SPA	Guillemot	Non-breeding
Troup, Pennan and Lion's Heads SPA	Guillemot; Razorbill	Non-breeding
West Westray	Guillemot; Razorbill	Non-breeding
Buchan Ness to Collieston Coast SPA	Guillemot	Non-breeding

10.4.22 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 windfarm developments. This has been superseded recently by a joint SNCB interim displacement advice note (SNCBs 2022), 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 windfarms. These guidance notes have shaped the assessment provided for each site and their interest features presented below.

10.4.23 A summary of the level of displacement used in the assessment for disturbance and displacement during the O&M phase are as presented in Table 10.9 below.

10.4.24 For gannets, available evidence indicates a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and 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 windfarm (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). 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%. Based on available evidence, a displacement rate of 70% is used, though a range of 60% to 80% is also presented to reflect the most recent SNCB guidance (MIG-Birds, 2022). A mortality rate of 1% was selected for gannet, based on expert judgement supported by additional evidence that suggests that gannet have a large mean-maximum (315km) and maximum (709km) foraging range (Woodward *et al.,* 2019) and feed on a variety of different prey items that provide sufficient alternative foraging opportunities despite the potential loss of habitat within the Project array area and 2km buffer.

10.4.25 Auk species (guillemot, razorbill and puffin) 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). A review by Dierschke *et al.,* (2016) has summarised auk displacement responses in relation to OWFs across thirteen European OWF sites, comparing changes in seabird abundance between baseline and post-construction surveys. From the review, the outcomes for auks was 'weak displacement' but highly variable across all OWFs. Since the publication of this review, there have been a number of additional OWF sites which have reported displacement effects on auks (APEM, 2017; Webb *et al.,* 2017; Vanermen *et al.,* 2019; Peschko *et al.,* 2020; MacArthur Green, 2021). Additionally, a review undertaken by APEM (APEM, 2022), found highly variable displacement rates for auks, ranging from attraction to displacement effects. However, conclusions from the study reported a displacement rate of up to 50% for the array area and 2km buffer would be most applicable, and also suitably precautionary. This rate is also supported by a review of OWF data in the German North Sea undertaken by Peschko *et al.,* (2020). Consequently, the displacement rate of 50% was considered appropriate for the assessment, with a range of 30% to 70% also presented as recommended in the most recent SNCB guidance (MIG-Birds, 2022) as advised by Natural England (Parker *et al*. 2022). Also, as per SNCB guidance, a mortality range of 1-10% was presented, with 1% used as the Applicant's approach based on available evidence suggesting this rate is both appropriate and representing a precautionary approach for the assessment of auks (Norfolk Boreas Limited, 2019; SPR, 2019; Ørsted, 2018; Kooten *et al.,* 2019).

Table 10.9: displacement and mortalities used for assessment during O&M

Species	Displacement rate	Mortality rate
Gannet	70% (plus a range of 60% to 80%)	1%
Auk species	50% (plus a range of 30% to 70%)	1% (plus a range of 1% to 10%)

Species	Displacement rate	Mortality rate
Red-throated diver	100% (plus a range of 90% to 100%)	1% (plus a range of 1% to 10%)

10.4.26 The detailed methods and results of the displacement assessment are presented in the Displacement Annex (Part 6, Volume 2, Appendix 12.3: Displacement Assessment Annex).

10.4.27 The assessments provided within this draft 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 assessed 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 draft RIAA are not solely dependent upon the area within the Project array area and buffer for all their foraging needs; and
- 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.

Collision Risk

10.4.28 The potential for mortality resultant from collision risk to result in an AEoI relates to the designated sites and the relevant features found in Table 10.10. Herring gull has been assessed as part of the seabird assemblage of FFC SPA.

Table 10.10 Sites and features identified for potential AEoI for collision risk impacts within the O&M phase.

Site	Feature	Bio-season
North Norfolk Coast SPA	Sandwich tern	Breeding and non-breeding
FFC SPA	Kittiwake	Breeding and non-breeding
	Gannet	Breeding and non-breeding
	Herring gull*	Breeding and non-breeding
Alde-Ore Estuary SPA	Lesser Black-backed Gull	Breeding and non-breeding
Coquet Island	Sandwich tern	Non-breeding
Farne Island SPA	Kittiwake	Breeding and non-breeding
	Sandwich tern	Non-breeding
Scottish sites		

Site	Feature	Bio-season
Buchan Ness to Collieston Coast SPA	Kittiwake	Non-breeding
Calf of Eday SPA	Kittiwake	Non-breeding
Copinsay SPA	Kittiwake	Non-breeding
East Caithness Cliffs SPA	Kittiwake	Non-breeding
Fair Isle SPA	Kittiwake	Non-breeding
Forth Islands (UK) SPA	Kittiwake; Gannet	Non-breeding
Foula SPA	Kittiwake	Non-breeding
Fowlsheugh SPA	Kittiwake	Non-breeding
Hermaness, Saxa, Vord and Valla Field SPA	Kittiwake	Non-breeding
Hoy SPA	Kittiwake	Non-breeding
Marwick Head SPA	Kittiwake	Non-breeding
North Caithness Cliffs SPA	Kittiwake	Non-breeding
Noss SPA	Kittiwake	Non-breeding
Rousay SPA	Kittiwake	Non-breeding
St Abb's Head SPA	Kittiwake	Non-breeding
Sumburgh Head SPA	Kittiwake	Non-breeding
Troup, Pennan and Lion's Heads SPA	Kittiwake	Non-breeding
West Westray	Kittiwake	Non-breeding

*assemblage feature

10.4.29 There is a potential collision risk to birds which fly through the Project 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 WTG rotors and associated infrastructure resulting in injury or fatality.

10.4.30 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 Part 6, Volume 2, Appendix 12.2: Collision Risk Modelling Assessment Annex, 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 18 months of digital 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 windfarm developments.

10.4.31 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 Part 6, Volume 2, Appendix 12.2: Collision Risk Modelling Assessment Annex.

10.4.32 The assessment of collision risk follows an evidence led approach making use of a mixture of site-specific data collected from within the Project array area and the most recent literature on seabirds and their behaviour in relation to OWFs (Part 6, Volume 2, Appendix 12.2: Collision Risk Modelling Assessment Annex).

10.4.33 Within this report the Shinyapp outputs for Band Option 2 only are presented, which applies a uniform distribution of bird flights between the lowest and the highest levels of the rotors. The proportion at collision height (PCH) was determined from the results of the Strategic Ornithological Support Service (SOSS02) project (Cook *et al*., 2012) that analysed the flight height measurements taken from boat surveys conducted around the UK. The project was updated following Johnston *et al.,* (2014), and the revised published spreadsheet is used to determine the 'generic' percentage of flights at PCH for each species based on the proposed project's wind turbine parameters. This Band Option has been relied upon as the model to carry through to the assessment of collision risk for kittiwake, gannet and Sandwich tern collision risk assessments.

Precautionary nature of CRM

10.4.34 CRM accounts for several different species-specific behavioural aspects of the seabirds 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. Parameters used were based on the most recent guidance for Natural England (Natural England, 2022), notably accounting for updates to avoidance rates and nocturnal activity factors provided in this recent guidance. These values are provided in Part 6, Volume 2, Appendix 12.2: Collision Risk Modelling Assessment Annex.

10.4.35 It should be noted that these parameters are considered precautionary based on available evidence. Considering avoidance rates, a study funded by the Offshore Renewables Joint Industry Programme (ORJIP), studied birds around Thanet OWF over 2 years (between 2014 and 2016). The study found that of 12,000 birds recorded during the two-year period, only 6 birds (all gull species) were reported to have collided with WTGs (Skov et al., 2018). Further review undertaken for gannet by both Cook (2018) and APEM (2014) have found that actual gannet avoidance rates are likely higher than the rate used, with APEM reporting an actual avoidance rate as high as 100% during migratory periods (though a rate of 0.995 was suggested as more realistically appropriate).

10.4.36 Additionally, a recent report undertaken at Aberdeen Offshore Windfarm Limited (AOWFL, 2023) at the European Offshore Wind Development Centre (EOWDC) found that collision rates of birds are likely to be significantly lower than predicted based on input parameters, implying further precaution of the current methodology used. The two-year study used a combination of video and radar to look at turbine avoidance and found that no collisions or even narrow escapes were recorded in over 10,000 bird videos, highlighting that avoidance rates are likely to be even higher in reality.

10.4.37 Considering flight speeds, a review undertaken for Norfolk Boreas Offshore Windfarm (Royal HaskoningDHV, 2020) estimate that the flight speed of 13.1m/sec used for kittiwake is an overestimate, and that a value of 10.8m/s (±0.9) is more realistic based on a range of monitoring methods. A study undertaken by Skov et al., (2018) estimated an even lower value of 8.7 m/s (±3.2 m/s) to be more appropriate, and also suggested a value of 13.3m/s (± 4.2m/s) would be more appropriate for gannet than the currently used 14.9m/s, and a value of 9.8m/s (± 3.6 m/s) for large gull species. This data was based on large sample sizes of bird species recorded in the Thanet OWF. This assessment has followed the current guidance; however, it is of note that if these lower flight speeds and lower nocturnal activity factors were used in the models then the collision rates would be lowered considerably. Therefore, it is considered that the CRM input parameters used in the assessment of collision risk to seabirds for the Project and those from other projects at the in-combination level, incorporate a high degree of precaution.

Assessment Data

10.4.38 Information used to inform the apportioning of impacts to individual SPAs is provided in Appendix 7.1.4: Offshore and Intertidal Ornithology Apportioning, including the following:

- Bio-seasons used for the assessment;
- Adult proportions of relevant SPAs;
- The proportion of adults apportioned to each SPA in the breeding and non-breeding bio-seasons; and
- SPA population sizes (both citation counts and more recent counts where relevant).

Construction and Decommissioning Assessment

Disturbance and Displacement

Coquet Island SPA – Puffin

10.4.39 Puffin has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.40 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The citation count is 31,686 and the latest population estimate is 25,029 based on the most recent 2019 colony counts.

10.4.41 The Project array area is located 258km from Coquet Island SPA which is within the mean max plus 1 standard deviation (SD) foraging distance of 265.4km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding bio-season for the months of April to July and the non-breeding bio-season defined as August to March by Furness (2015) (presented in Appendix 7.1.4: Offshore and Intertidal Ornithology Apportioning).

Breeding Bio-season

10.4.42 During the breeding bio-season, the number of puffins estimated to occur in the array area and 2km buffer is 884 (883.8) individuals. Assuming the proportion of adult birds in the array is 49%, and assuming a sabbatical rate of 7% for adult puffin, the total number of breeding adults in the array at risk of displacement is 403 (402.7) during the full breeding bio-season.

10.4.43 Of these 403 breeding adults, 56.5% are predicted to be breeding birds from Coquet Island SPA (Appendix 7.1.4). Therefore, 228 (227.5) breeding adults at risk of displacement are attributed to Coquet Island SPA. Assuming a displacement rate of 25% and a mortality rate of 1%, the consequent mortality is estimated at less than one (0.6) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.11.

10.4.44 Based on the citation count of 31,686 breeding adults and annual background mortality of 1,932.8 individuals, the addition of less than one predicted breeding adult mortality would represent a 0.029% increase in baseline mortality during the breeding bio-season.

10.4.45 As the population of puffin has changed significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 25,029 individuals and an annual background mortality of 1,526.8 individuals. On this basis, less than one (0.6) mortality would represent a 0.037% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.46 In the non-breeding bio-season the mean-peak number of puffins estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals. On the basis that 10.6% of these puffins within the array area are deemed to be breeding adults from Coquet Island SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults from the SPA estimated to be displaced from array plus 2km buffer is 124 (124.2) (Table 10.11). Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.3) individual during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.11.

10.4.47 This consequent estimated mortality equates to an increase in baseline mortality of 0.016% in the non-breeding bio-season relative to the citation count and increase of 0.020% based on the most recent counts.

Annual Total

10.4.48 Across all bio-seasons, the number of puffin estimated to occur in the array area and a 2km buffer is 2,051 (2,050.8) individuals, with 352 (351.7) of these being breeding adults from the Coquet Island SPA. The total predicted displacement consequent mortality throughout the construction & decommissioning of the Project is less than one (0.9) breeding adult from Coquet Island SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.11.

10.4.49 The predicted mortality of one breeding adult from Coquet Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.045% based on the citation count and 0.058% when considering the recent count. This level of impact, below 0.1% increase in baseline mortality, is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.50 **Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of Coquet Island SPA in relation to disturbance and displacement effects in the construction & decommissioning phase from the Project alone can be ruled out as, subject to natural change, puffin will be maintained as a feature in the long-term**.

Table 10.11: Range-based displacement mortalities during the construction and decommissioning phases for puffin at Coquet Island SPA based on the values advocated by SNCBs for the most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Breeding	227.5	0.6	0.3 – 8.0	0.029	0.018 – 0.412
Non-breeding	124.2	0.3	0.2 – 4.3	0.037	0.022 – 0.522
Annual Total	**351.7**	**0.9**	**0.5 – 12.3**	**0.058**	**0.035 – 0.806**

Farne Islands SPA – Guillemot

10.4.51 Guillemot has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the Farne Island SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.52 Based on the above the conservation objective for the Farne Island SPA the specific target for the guillemot feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 32,875 breeding pairs (65,750 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 64,042 breeding adults based on the most recent 2019 colony count.

10.4.53 The Project array area is located 284.2km from the Farne Island SPA which is beyond the mean max plus 1SD foraging distance of 153.7km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, defined as August to February by Furness (2015) (Appendix 7.1.4).

Non-breeding Bio-season

10.4.54 In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 22,248 (22,248.0) individuals.

10.4.55 On the basis that 3.7% of these guillemots within the array area are deemed to be breeding adults from the Farne Islands SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from array plus 2km buffer and attributable to this SPA is 830 (830.3). Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at two (2.1) individuals during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.12.

10.4.56 Based on a citation population of 65,751 breeding adults and an annual background mortality of 4,010.8 breeding adults per annum, the addition of approximately 2 predicted breeding adult mortalities would represent an increase in baseline mortality of 0.052%. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.12.

10.4.57 As the population of guillemot has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 64,042 individuals and an annual background mortality of 3,906.6 individuals. On this basis, the level of predicted effect would represent a 0.053% increase in baseline mortality in the non-breeding bio-season. This level of impact is considered to be *de minimis* as it would be indistinguishable from natural fluctuations in the population.

10.4.58 Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of Farne Island SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out as, subject to natural change, guillemot will be maintained as a feature in the long-term.

Table 10.12: Range-based displacement mortalities during the construction and decommissioning phases for guillemot at Farne Island SPA based on the values advocated by Natural England for the most recent counts (Seabird Monitoring Programme, 2019)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1-10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Non-breeding	830.3	2.1	1.3 – 29.1	0.052	0.031 – 0.725	0.053	0.032 – 0.744

Farne Islands SPA – Puffin

10.4.59 Puffin has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the Farne Island SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.60 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The latest population estimate is 43,752 based on the most recent 2019 colony counts.

10.4.61 The Project array area is located 284.2km from the Farne Islands SPA which is beyond the mean max plus 1SD foraging distance of 265.4km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, defined as August to March by Furness (2015) (Appendix 7.1.4).

Non-breeding Bio-season

10.4.62 In the non-breeding bio-season the mean-peak number of puffin estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals.

10.4.63 On the basis that 34.5% of these puffins within the array area are deemed to be breeding adults from the Farne Island SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults from array plus 2km buffer attributed to the Farne Islands SPA is 403 (402.6). Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at one (1.0) individual during the non-breeding bio-season. Based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.13.

10.4.64 Based on a citation population of 76,798 breeding adults and an annual background mortality of 4,684.7 breeding adults per annum, the addition of one predicted breeding adult mortality would represent an increase in baseline mortality of 0.021%. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.13.

10.4.65 As the population of puffin has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 43,752 individuals and an annual background mortality of 2,668.9 individuals. On this basis, this would represent a 0.038% increase in baseline mortality in the non-breeding bio-season. This level of impact is considered to be *de minimis* as it would be indistinguishable from natural fluctuations in the population.

10.4.66 Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of Farne Island SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out, subject to natural change, puffin will be maintained as a feature in the long-term.

Table 10.13: Range-based displacement mortalities during the construction and decommissioning phases for puffin at Farne Island SPA based on the values advocated by Natural England for the most recent counts (2019 Seabird Monitoring Programme).

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	25-35% displacement, 1- 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Non-breeding	402.60	1.0	0.6 – 14.1	0.021	0.013 – 0.301	0.038	0.023 – 0.528

Flamborough and Filey Coast SPA – Guillemot

10.4.67 Guillemot has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.68 Based on the above the conservation objective for the FFC SPA the specific target for the guillemot feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 41,607 breeding pairs (83,214 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 121,754 breeding adults based on the most recent 2017 colony count.

10.4.69 The Project array area is located 92.8km from the FFC SPA which is within the mean max plus 1SD foraging distance of 73.2±80.5km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding bio-season for the months of March to July and the non-breeding bio-season defined as August to February by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.70 During the breeding bio-season, the number of guillemots estimated to occur in the array area and 2km buffer is 23,173 (23,172.8) individuals. Assuming the proportion of adult birds in the array is 57%, and assuming a sabbatical rate of 7% for adult guillemot, the total number of breeding adults in the array at risk of displacement is 12,284 (12,283.9) during the full breeding bio-season.

10.4.71 Of these 12,284 breeding adults, 100% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 12,284 (12,283.9) breeding adults at risk of displacement are attributed to FFC SPA. Assuming a displacement rate of 25% and a mortality rate of 1%, the consequent mortality is estimated at less than 31 (30.7) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.14.

10.4.72 Based on a citation population of 83,214 breeding adults and annual background mortality of 5,076 individuals, the addition of 31 predicted breeding adult mortalities would represent a 0.605% increase in baseline mortality during the breeding bio-season.

10.4.73 As the population of guillemot has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 121,754 individuals and an annual background mortality of 7,427 individuals. On this basis, this would represent a 0.413% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.74 In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 22,248 (22,248.0) individuals.

10.4.75 On the basis that 4.4% of these guillemots within the array area are deemed to be breeding adults from the FFC during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 982 (981.6). Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than three (2.5) individuals during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.14.

10.4.76 This consequent estimated mortality equates to an increase in baseline mortality of 0.048% in the non-breeding bio-season relative to the citation population and 0.033% relative to the most recent count.

Annual Total

10.4.77 Across all bio-seasons, the number of guillemot estimated to occur in the array area and a 2km buffer is 45,421 (45,420.8) individuals, with 13,267 (13,265.5) of these being breeding adults from the FFC SPA. The total predicted displacement consequent mortality throughout the construction & decommissioning of the Project is 33 (33.2) breeding adult per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.14.

10.4.78 The predicted mortality of 33 breeding adults from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.653% when considering the citation population or an increase in baseline mortality of 0.447% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.79 **Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of FFC SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out as, subject to natural change, guillemot will be maintained as a feature in the long-term.**

Table 10.14: Range-based displacement mortalities during the construction and decommissioning phases for guillemot at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme).

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1-10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Breeding	12,283.9	30.7	19.8 – 462.3	0.605	0.390 – 9.107	0.413	0.267 – 6.225
Non-breeding	981.6	2.5	1.5 – 34.4	0.048	0.029 – 0.677	0.033	0.020– 0.463
Annual Total	**13,265.5**	**33.2**	**21.3 – 496.7**	**0.653**	**0.419 – 9.784**	**0.447**	**0.287 – 6.687**

Flamborough and Filey Coast SPA – Razorbill

10.4.80 Razorbill has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.81 Based on the above the conservation objective for the FFC SPA the specific target for the razorbill feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 10,570 breeding pairs (21,140 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 40,506 breeding adults based on the most recent 2017 colony count.

10.4.82 The Project array area is located 92.8km from the FFC SPA which is within the mean max plus 1SD foraging distance of 88.7 ± 75.9km (Woodward *et al.,* 2019) and has therefore been screened in for the migration-free breeding season (April-July), the post-breeding migration bio-season (August to October), the return migration bio-season (January-March), and the migration-free winter bio-season (November to December) as defined by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.83 During the migration-free breeding bio-season, the number of razorbills estimated to occur in the array area and 2km buffer is 5,163 (5,163.0) individuals. Assuming the proportion of adult birds in the array is 57%, and assuming a sabbatical rate of 7% for adult razorbill, the total number of breeding adults in the array at risk of displacement is 2,737 (2,736.9) during the migration-free breeding bio-season.

10.4.84 Of these 2,737 breeding adults, 100% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 2,737 (2,736.9) breeding adults at risk of displacement are attributed to FFC SPA. Assuming a displacement rate of 25% and a mortality rate of 1%, the consequent mortality is estimated at less than seven (6.8) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.15.

10.4.85 Based on a citation population of 21,140 breeding adults and annual background mortality of 2,219.7 individuals, the addition of seven predicted breeding adult mortalities would represent a 0.308% increase in baseline mortality during the breeding bio-season.

10.4.86 As the population of razorbill has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 40,506 individuals and an annual background mortality of 4,253.1 individuals. On this basis, this would represent a 0.161% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.87 The mean-peak number of razorbills estimated to occur in the array area and 2km buffer is estimated at 5,229 (5,229.0) individuals in the return migration, 2,339 (2,339.0) individuals during the post-breeding migration bio-season and 2,570 (2,570.0) individuals in the migration-free winter bio-season.

10.4.88 On the basis that 3.4% of these razorbills within the array area are deemed to be breeding adults from the FFC during the return migration and post-breeding bio-seasons (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 177 (176.7) during the return migration, 79 (79.0) during the post-breeding migration and 24 (23.5) in the migration-free winter bio-season.

10.4.89 Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.4) individual return migration, less than one (0.2) during the post-breeding migration and less than one (0.1) in the migration-free winter bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.15.

10.4.90 This consequent estimated mortality equates to an increase in baseline mortality of 0.020% in the return-migration bio-season, 0.009% in the post-breeding bio-season and 0.003% in the migration-free winter bio-season based on the citation population and 0.011%, 0.005% and 0.020% respectively relative to the most recent counts.

10.4.91 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.7) breeding adult per annum. This represents an increase of 0.032% in baseline mortality of the citation population and 0.017% increase using the most recent count.

Annual Total

10.4.92 Across all bio-seasons, the number of razorbill estimated to occur in the array area and a 2km buffer is 10,138 (10,138.0) individuals, with 3,017 (3,017.4) of these being breeding adults from the FFC SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning of the Project is less than eight (7.55) breeding adults from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.15.

10.4.93 The predicted mortality of less than eight breeding adults from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.340% when considering the citation population or an increase of 0.177% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.94 **Therefore, the potential for an AEoI to the conservation objectives of the razorbill feature of FFC SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out as, subject to natural change, razorbill will be maintained as a feature in the long-term.**

Table 10.15: Range-based displacement mortalities during the construction and decommissioning phases for razorbill at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1- 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Migration–free Breeding	2,736.9	6.8	4.1 – 95.8	0.308	0.185 – 4.316	0.161	0.097 – 2.253
Post-breeding migration	79.5	0.2	0.1 – 2.8	0.009	0.005 – 0.125	0.005	0.003 – 0.065
Return-breeding migration	177.8	0.4	0.3 – 6.2	0.020	0.012 – 0.279	0.010	0.006 – 0.145
Migration-free winter	23.2	0.1	0.0 – 0.8	0.003	0.002 – 0.037	0.002	0.001 – 0.020
Annual Total	**3,017.4**	**7.5**	**4.5 – 105.6**	**0.340**	**0.204 – 4.756**	**0.177**	**0.106 – 2.482**

Flamborough and Filey Coast SPA – Puffin

10.4.95 Puffin has been screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.96 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The latest population estimate is 4,279 based on the most recent 2018 colony counts.

10.4.97 The Project array area is located 92.9km from the FFC SPA which is within the mean max plus 1SD foraging distance of 137.1 ± 128.3km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding bio-season for the months of April to July and the non-breeding bio-season defined as August to March by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.98 During the breeding bio-season, the number of puffin estimated to occur in the array area and 2km buffer is 884 (883.8) individuals. Assuming the proportion of adult birds in the array is 49%, and assuming a sabbatical rate of 7% for adult puffin, the total number of breeding adults in the array at risk of displacement is 403 (402.7) during the full breeding bio-season.

10.4.99 Of these 403 breeding adults, 43.5% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 175 (175.2) breeding adults at risk of displacement are attributed to FFC SPA. Assuming a displacement rate of 25% and a mortality rate of 1%, the consequent mortality is estimated at less than one (0.4) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.16.

10.4.100 Based on the most recent counts of 4,279 breeding adults and annual background mortality of 261.0 individuals, the addition of less than one predicted breeding adult mortalities would represent a 0.168% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.101 In the non-breeding bio-season the mean-peak number of puffins estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals.

10.4.102 On the basis that 0.8% of these puffins within the array area are deemed to be breeding adults from the FFC during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 9 (9.3). Based on 25% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.0) individual during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 15% to 35% is also presented in Table 10.28.

10.4.103 This consequent estimated mortality equates to an increase in baseline mortality of 0.009% in the non-breeding bio-season relative to the most recent count.

Annual Total

10.4.104 Across all bio-seasons, the number of puffin estimated to occur in the array area and a 2km buffer is 2,051 (2,050.8) individuals. The total predicted consequent mortality from being displaced attributed to FFC SPA throughout the construction and decommissioning of the Project is less than one (0.4) breeding adult from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (15% displacement to 35% displacement, 1 to 10% mortality) are displayed in Table 10.16.

10.4.105 The predicted mortality of less than one (0.4) breeding adult from FFC SPA per annum across all bio-seasons is considered to be *de minimis* and represents an increase in baseline mortality of 0.177% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.106 **Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of FFC SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out as, subject to natural change, puffin will be maintained as an assemblage feature in the long-term.**

Table 10.16: Range-based displacement mortalities during the construction and decommissioning FFC SPA phases for puffin based on the values advocated by SNCBs for the most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme).

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1- 10% mortality	25% displacement, 1% mortality	15-35% displacement, 1 – 10% mortality
Breeding	402.8	0.4	0.3 – 6.1	0.168	0.101 – 2.349
Non-breeding	9.6	0.0	0.0 – 0.3	0.009	0.005 – 0.128
Annual Total	**412.4**	**0.4**	**0.3 – 6.4**	**0.177**	**0.106 – 2.477**

Flamborough and Filey Coast SPA – Gannet

10.4.107 Gannets were screened in for the construction and decommissioning phase to assess the potential for an AEoI from displacement from the Project array area in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each of the qualifying features.

10.4.108 Based on the above the conservation objective for the FFC SPA the specific target for the gannet feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- To maintain the size of the breeding population at a level which is above 8,469 breeding pairs (16,938 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest count is 26,784 adults based on the 2017 survey (Aitken *et al.,* 2017).

10.4.109 The Project array area is located 92.9km from the FFC SPA, which is within the mean-maximum plus 1SD foraging distance of 315.2 ± 194.2km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding season. In the non-breeding season, breeding gannets are not constrained by requirements to visit nests to incubate eggs or provision for chicks. It is therefore assumed that individuals will range more widely than during the breeding season, and therefore gannet has also been screened in for the non-breeding season. Gannets recorded during digital aerial surveys are therefore considered to come from a range of breeding colonies in the UK and further afield, as presented in Appendix 7.1.4.

10.4.110 The different bio-seasons for consideration of assessing potential risk from displacement on birds from FFC SPA includes the migration-free breeding season (April – August), the post-breeding migration bio-season (September to November) and the return migration bio-season (December to March), as defined by Furness (2015) (there is no migration free winter bio-season).

Migration-free Breeding Bio-season

10.4.111 During the migration-free breeding bio-season, the number of gannets estimated to occur in the array area and 2km buffer is 847 (846.8) individuals. Assuming the proportion of adult birds in the array is 55% (Furness 2015), and assuming a sabbatical rate of 10% for adult gannets, the total number of breeding adults in the array at risk of displacement is 419 (419.1) during the migration-free breeding bio-season.

10.4.112 Of these 419 breeding adults, 100% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 419 (419.1) breeding adults at risk of displacement are attributed to FFC SPA (Table 10.15)). Assuming a displacement rate of 35% and a mortality rate of 1%, the consequent mortality is estimated at less than two (1.5) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 40% is also presented in Table 10.15.

10.4.113 Based on a citation population of 16,938 breeding adults and annual background mortality of 1,372 individuals, the addition of two (1.5) predicted breeding adult mortalities would represent a 0.107% increase in baseline mortality during the migration-free breeding bio-season.

10.4.114 As the population of gannets has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 26,784 individuals and an annual background mortality of 2,170 individuals. On this basis, this would represent a 0.068% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding season

10.4.115 The mean-peak number of gannets estimated to occur in the array area and 2km buffer is estimated at 172 (171.5) and 169 (169.0) individuals during the return migration and the post-breeding migration bio-season, respectively.

10.4.116 On the basis that 6.2% of the gannets within the array area are deemed to be breeding adults from FFC SPA during the return migration and 4.8% during the post-breeding migration (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 11 (10.7) during the return migration and eight (8.2) during the post-breeding migration.

10.4.117 Based on 35% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.0) individual during the return migration bio-season and less than one (0.0) individual during the post-breeding migration bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 40% is also presented in Table 10.17.

10.4.118 This consequent estimated mortality equates to an increase in baseline mortality of 0.002% in both the return-migration bio-season and post-breeding bio-season based on the citation population and 0.002% relative to the most recent counts.

10.4.119 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.0) breeding adult per annum. This represents an increase of 0.004% in baseline mortality of the citation population and 0.003% increase using the most recent count.

Annual Total

10.4.120 Across all bio-seasons, the number of gannets estimated to occur in the array area and a 2km buffer is 1,187 (1,187.3) individuals, with 438 (438.0) of these being breeding adults from the FFC SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning of the Project is less than two (1.5) breeding adults from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 40% displacement, 1% mortality) are displayed in Table 10.17.

10.4.121 The predicted mortality of less than two breeding adult from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.111% when considering the citation population or an increase of 0.070% when considering the recent colony count. Based on the recent SMP count this level of impact is considered to be *de minimis* and indistinguishable from natural fluctuations in the population.

10.4.122 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature of FFC SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project alone can be ruled out as, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.17: Range-based displacement mortalities during the construction and decommissioning phases for gannet at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme).

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		35% displacement, 1% mortality	30-40% displacement, 1% mortality	35% displacement, 1% mortality	30-40% displacement, 1% mortality	35% displacement, 1% mortality	30-40% displacement, 1% mortality
Migration-free breeding	419.1	1.5	1.3 – 1.7	0.107	0.092 – 0.122	0.068	0.058 – 0.077
Post-breeding migration	8.20	0.0	0.0 – 0.00	0.002	0.002 – 0.002	0.001	0.001 – 0.002
Return migration	10.70	0.0	0.0 – 0.0	0.002	0.002 – 0.002	0.002	0.002 – 0.002
Annual Total	**438.0**	**1.5**	**1.3 – 1.7**	**0.111**	**0.095 – 0.127**	**0.070**	**0.060 – 0.080**

Greater Wash SPA – Common Scoter

10.4.123 Common scoter has been screened in for the assessment of the construction and decommissioning phase to assess the impacts from disturbance and displacement from the Project alone on the basis of its sensitivity to vessel presence during the process of the Offshore export cable laying and in relation to those parts of the Offshore ECC in shallower water, closer to the coast, where common scoter are most likely to be found.

10.4.124 The laying of the Offshore export cable between the array area and the cable landfall area for the Project would involve cable laying vessels being *in situ* for the entire offshore construction period of up to 48-months, potentially occurring in two consecutive non-breeding periods.

10.4.125 In order to assess the potential impact on common scoter a displacement effect distance has to be determined. A 2km 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.

10.4.126 Based on data by Lawson *et al.,* (2016), an average density of 0.004 and a maximum density of 0.029 common scoters are estimated to be present within the Project Offshore ECC. Based on a 2km buffer around each of the three construction vessels, the area disturbed per vessel was calculated to be circa 12.6km^2, resulting in a total worst case area of circa 37.7km^2 from which birds could be displaced. This is considered a precautionary approach, since vessels are unlikely to be spaced 2km apart at a given time, and there is also likely to be less than 3 vessels present at a time.

10.4.127 Based on the average density of 0.004 birds, and the total disturbance of area of circa 37.7km^2, less than one (0.1) common scoters are at risk of displacement. Of these, 40% are considered to be adult birds, resulting in a total of 0.0 adult birds at risk of displacement. Considering a displacement rate of 100%, and a mortality rate of 1%, this results in less than one (0.0) predicted displacement consequent mortalities. Considering a displacement range of 90% to 100% and a mortality range of 1% to 10%, the total displacement consequent mortality is estimated as 0.001 to 0.01 birds.

10.4.128 Of these, the total displacement consequent mortality is estimated at less than one (0.001) individual, based on 100% displacement and 1% mortality. Considering a displacement range of 90% to 100% and a mortality range of 1% to 10%, the total displacement consequent mortality is estimated as 0.0 to 0.0 birds. This would represent a <0.001% increase even at the worst case scenario of 100% displacement and 10% mortality, and therefore the impact is considered *de minimis*.

10.4.129 There is, therefore, no potential for an AEoI to the conservation objectives of the common scoter feature of Greater Wash SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project 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.

Greater Wash SPA – Red-throated Diver (ECC)

10.4.130 Red-throated diver has been screened in for the impact assessment for the construction and decommissioning phase to assess the impacts from disturbance and displacement from the Project alone, due to their sensitivity to vessel presence during the process of the offshore export cable laying and in relation to those parts of the offshore ECC in shallower water, closer to the coast, where red-throated diver are most likely to be found.

10.4.131 The laying of the export cable between the array area and the cable landfall area for Outer Dowsing would involve cable laying vessels being *in situ* for the entire offshore construction period of up to 48 months, potentially occurring in two consecutive non-breeding periods. Therefore, presence of the offshore export cable laying vessel was identified as potentially displacing red-throated divers during the construction phase of the Project.

10.4.132 The ECC route will run directly through the Greater Wash SPA. To assess the potential for individuals being within the offshore ECC, a separate method for estimating the potential abundance and density of this species was developed and agreed for use with Natural England (Section 5.3).

10.4.133 Based on data on red-throated diver densities presented by Lawson *et al.,* (2016), an average density of 0.2 birds/km^2 and a maximum density of 0.7 birds/km^2 are estimated to be present within the Project ECC. Based on a 2km buffer around each of the three construction vessels, the area disturbed per vessel was calculated to be circa 12.6km^2, resulting in a total worst case area of circa 37.7km^2 from which birds could be displaced. This is considered a precautionary approach, since in reality vessels are unlikely to be spaced 2km apart at a given time, and there is also likely to be less than three vessels present at a time.

10.4.134 Based on the average density of 0.2 birds, and the total disturbance of area of circa 37.7km^2, a total of 9 (8.8) red-throated divers are at risk of displacement. Of these, an estimated 60% are considered to be adults based on data presented in Furness (2015), resulting in a total of five (5.2) adult red-throated divers at risk of displacement.

10.4.135 Based on a displacement rate of 100% and a mortality rate of 1%, this results in a predicted mortality of less than one (0.1) birds per annum. Considering a displacement range of 90% to 100% and a mortality range of 1% to 10%, the total displacement consequent mortality is estimated as 0.0 to 0.5 birds.

10.4.136 Considering the impact on the citation population of 1,407 breeding adults, with a background mortality of 225 individuals per annum, the addition of less than one (0.1) mortality per annum would represent a 0.023% increase in baseline mortality. Considering the more recent 2016 population count of 1,787 breeding adults, with a background mortality of 286 individuals per annum, the addition of less than one mortality would represent a 0.018% increase in baseline mortality. This level of impact is considered to be *de minimis*.

10.4.137 There is, therefore, no potential for an AEoI to the conservation objectives of the red-throated diver feature of Greater Wash SPA in relation to disturbance and displacement effects in the construction and decommissioning phase from the Project 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.

O&M Assessment

Disturbance and Displacement

Coquet Island SPA – Puffin

10.4.138 Puffin has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the Coquet Island SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.139 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The citation count is 31,686 and the latest population estimate is 25,029 based on the most recent 2019 colony counts.

10.4.140 The Project array area is located 258km from Coquet Island SPA which is within the mean-max plus 1SD foraging distance of 265.4km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding bio-season for the months of April to July and the non-breeding bio-season defined as August to March by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.141 During the breeding bio-season, the number of puffins estimated to occur in the array area and 2km buffer is 884 (883.8) individuals. Assuming the proportion of adult birds in the array is 49%, and assuming a sabbatical rate of 7% for adult puffin, the total number of breeding adults in the array at risk of displacement is 403 (402.7) during the full breeding bio-season.

10.4.142 Of these 403 breeding adults, 56.5% are predicted to be breeding birds from Coquet Island SPA (Appendix 7.1.4). Therefore, 228 (227.5) breeding adults at risk of displacement are attributed to Coquet Island SPA (Table 10.16). Assuming a displacement rate of 50% and a mortality rate of 1%, the consequent mortality is estimated at less than two (1.1) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.18.

10.4.143 Based on the most recent counts of 31,686 breeding adults and annual background mortality of 1,932.8 individuals, the addition of less than two predicted breeding adult mortalities would represent a 0.059% increase in baseline mortality during the breeding bio-season.

10.4.144 As the population of puffin has changed significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 25,029 individuals and an annual background mortality of 1,526.8 individuals. On this basis, this would represent a 0.075% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.145 In the non-breeding bio-season the mean-peak number of puffins estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals.

10.4.146 On the basis that 10.6% of these puffins within the array area are deemed to be breeding adults from Coquet Island SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 124 (124.2) (Table 10.18). Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.6) individual during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.19.

10.4.147 This consequent estimated mortality equates to an increase in baseline mortality of 0.032% in the non-breeding bio-season relative to the citation count and increase of 0.041% based on the most recent counts.

Annual Total

10.4.148 Across all bio-seasons, the number of puffins estimated to occur in the array area and a 2km buffer is 2,051 (2,050.8) individuals, with 352 (351.7) of these being breeding adults from the Coquet Island SPA. The total predicted consequent mortality from being displaced attributed to Coquet Island SPA throughout the operational life of the Project is less than two (1.8) breeding adult from Coquet Island SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.19.

10.4.149 The predicted mortality of less than two (1.8) breeding adults from Coquet Island SPA per annum across all bio-seasons represents an increase of 0.091% based on the citation count and 0.115% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.150 **Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of Coquet Island SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out as, subject to natural change, puffin will be maintained as a feature in the long-term**.

Table 10.18: Range-based displacement mortalities during the operational and maintenance phases for puffin at Coquet Island SPA based on the values advocated by SNCBs for the most recent counts (Aitken *et al.,* (2017) (Seabird Monitoring Programme))

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1- 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Breeding	227.5	1.1	0.7 – 15.9	0.075	0.045 – 1.043
Non-breeding	124.2	0.6	0.4 – 8.7	0.041	0.024 – 0.569
Annual Total	**351.7**	**1.8**	**1.1 – 24.6**	**0.091**	**0.069 – 1.613**

Table 10.19: Puffin displacement matrix at Coquet Island SPA (array area plus two km buffer) with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	4	7	11	14	18	21	25	28	32	35
20	1	1	4	7	14	21	28	35	42	49	56	63	70
30	1	2	5	11	21	32	42	53	63	74	84	95	106
40	1	3	7	14	28	42	56	70	84	98	113	127	141
50	2	4	9	18	35	53	70	88	106	123	141	158	176
60	2	4	11	21	42	63	84	106	127	148	169	190	211
70	2	5	12	25	49	74	98	123	148	172	197	222	246
80	3	6	14	28	56	84	113	141	169	197	225	253	281
90	3	6	16	32	63	95	127	158	190	222	253	285	317
100	4	7	18	35	70	106	141	176	211	246	281	317	352

Farne Island SPA – Guillemot

10.4.151 Guillemot has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the Farne Island SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.152 Based on the above the conservation objective for the Farne Island SPA the specific target for the guillemot feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 32,875 breeding pairs (65,750 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 64,042 breeding adults based on the most recent 2019 colony count.

10.4.153 The Project array area is located 284.2km from the Farne Island SPA which is beyond the mean max plus 1SD foraging distance of 153.7km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, defined as August to February by Furness (2015) (presented in Appendix 7.1.4).

Non-breeding Bio-season

10.4.154 In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 22,248 (22,248.0) individuals.

10.4.155 On the basis that 3.7% of these guillemots within the array area are deemed to be breeding adults from the Farne Islands SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 830 (830.3). Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than five (4.9) individuals during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.20.

10.4.156 Based on a citation population of 65,751 breeding adults and an annual background mortality of 4010.8 breeding adults per annum, the addition of less than five predicted breeding adult mortalities would represent an increase in baseline mortality of 0.104%. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.21.

10.4.157 As the population of guillemot has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 64,042 individuals and an annual background mortality of 3906.6 individuals. On this basis, this would represent a 0.106% increase in baseline mortality in the non-breeding bio-season. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.158 Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of Farne Island SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, guillemot will be maintained as a feature in the long-term.

Table 10.20: Range-based displacement mortalities during the operational and maintenance phases for guillemot at Farne Island SPA based on the values advocated by SNCBs for the most recent counts (2019 Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Non-breeding	830.3	4.2	2.5 – 58.1	0.104	0.062 – 1.449	0.106	0.064 – 1.488

Table 10.21: Guillemot displacement matrix at Farne Island SPA (array area plus two km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Non-breeding	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	4	8	17	25	33	42	50	58	66	75	83
20	2	3	8	17	33	50	66	83	100	116	133	149	166
30	2	4	10	21	42	62	83	104	125	145	166	187	208
40	2	5	12	25	50	75	100	125	149	174	199	224	249
50	3	7	17	33	66	100	133	166	199	232	266	299	332
60	4	8	21	42	83	125	166	208	249	291	332	374	415
70	5	10	25	50	100	149	199	249	299	349	398	448	498
80	6	12	29	58	116	174	232	291	349	407	465	523	581
90	7	13	33	66	133	199	266	332	398	465	531	598	664
100	7	15	37	75	149	224	299	374	448	523	598	672	747

Farne Island SPA – Puffin

10.4.159 Puffin has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the Farne Island SPA:

- Maintain the population of each qualifying feature.

10.4.160 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The latest population estimate is 43,752 based on the most recent 2019 colony counts.

10.4.161 The Project array area is located 284.2km from the Farne Islands SPA which is beyond the mean max plus 1SD foraging distance of 265.4km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, defined as August to March by Furness (2015) (Appendix 7.1.4).

Non-breeding Bio-season

10.4.162 In the non-breeding bio-season the mean-peak number of puffin estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals.

10.4.163 On the basis that 34.5% of these guillemots within the array area are deemed to be breeding adults from the Farne Island SPA during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 403 (402.6). Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at two (2.0) individuals during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.22.

10.4.164 Based on a citation population of 76,798 breeding adults and an annual background mortality of 4,684.7 breeding adults per annum, the addition of two predicted breeding adult mortalities would represent an increase in baseline mortality of 0.043%. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.23.

10.4.165 As the population of puffin has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 43,752 individuals and an annual background mortality of 2668.9 individuals. On this basis, this would represent a 0.075% increase in baseline mortality in the non-breeding bio-season. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.166 Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of Farne Island SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, puffin will be maintained as a feature in the long-term.

Table 10.22: Range-based displacement mortalities during the operational and maintenance phases for puffin at Farne Island SPA based on the values advocated by SNCBs for the most recent counts (2019, Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Non-breeding	402.6	2.0	1.2– 28.2	0.043	0.026 – 0.602	0.075	0.045 – 1.056

Table 10.23: Puffin displacement matrix at Farne Island SPA (array plus two km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Non-breeding	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	4	8	12	16	20	24	28	32	36	40
20	1	2	4	8	16	24	32	40	48	56	64	72	81
30	1	2	6	12	24	36	48	60	72	85	97	109	121
40	2	3	8	16	32	48	64	81	97	113	129	145	161
50	2	4	10	20	40	60	81	101	121	141	161	181	201
60	2	5	12	24	48	72	97	121	145	169	193	217	242
70	3	6	14	28	56	85	113	141	169	197	225	254	282
80	3	6	16	32	64	97	129	161	193	225	258	290	322
90	4	7	18	36	72	109	145	181	217	254	290	326	362
100	4	8	20	40	81	121	161	201	242	282	322	362	403

Flamborough and Filey coast SPA – Guillemot

10.4.167 Guillemot has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.168 Based on the above the conservation objective for the FFC SPA the specific target for the guillemot feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 41,607 breeding pairs (83,214 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 121,754 breeding adults based on the most recent 2017 colony count.

10.4.169 The Project array area is located 92.9km from the FFC SPA which is within the mean max plus 1SD foraging distance of 153.7km (Woodward *et al.,* 2019) and has therefore been screened in for the full breeding bio-season for the months of March to July and the non-breeding bio-season defined as August to February by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.170 During the breeding bio-season, the number of guillemots estimated to occur in the array area and 2km buffer is 23,173 (23,172.8) individuals. Assuming the proportion of adult birds in the array is 57%, and assuming a sabbatical rate of 7% for adult guillemot, the total number of breeding adults in the array at risk of displacement is 12,284 (12,283.9) during the full breeding bio-season.

10.4.171 Of these 12,284 breeding adults, 100% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 12,284 (12,283.9) breeding adults at risk of displacement are attributed to FFC SPA. Assuming a displacement rate of 50% and a mortality rate of 1%, the consequent mortality is estimated at less than 62 (61.4) breeding adults.

10.4.172 Based on a citation population of 83,214 breeding adults and annual background mortality of 5,076 individuals, the addition of 62 predicted breeding adult mortalities would represent a 1.210% increase in baseline mortality during the breeding bio-season.

10.4.173 As the population of guillemot has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 121,754 individuals and an annual background mortality of 7,427 individuals. On this basis, this would represent a 0.827% increase in baseline mortality during the breeding bio-season.

Non-breeding season

10.4.174 In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 22,248 (22,248.0) individuals.

10.4.175 On the basis that 4.4% of these guillemots within the array area are deemed to be breeding adults from the FFC during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 982 (981.6). Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than five (4.9) individuals during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.24:.

10.4.176 This consequent estimated mortality equates to an increase in baseline mortality of 0.097% in the non-breeding bio-season relative to the citation population and 0.066% relative to the most recent count.

Annual Total

10.4.177 Across all bio-seasons, the number of guillemots estimated to occur in the array area and a 2km buffer is 45,421 (45,420.8) individuals, with 13,266 (13,265.5) being breeding adults from the FFC SPA. The total predicted consequent mortality attributed from FFC SPA from displacement throughout the operational life of the Project is 66 (66.3) breeding adults per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.25.

10.4.178 The predicted mortality of 66 breeding adults from FFC SPA per annum across all bio-seasons represents an increase of 1.307% when considering the citation population or an increase of 0.893% when considering the recent count.

10.4.179 Though the impact exceeds a 1% increase in baseline mortality, the in-combination impacts are not expected to impact the integrity of the guillemot feature of the FFC SPA, based on PVA undertaken by the Dudgeon and Sheringham Shoal extension project (Royal HaskoningDHV, 2022). Between 1986 and 2017, the guillemot population at the FFC SPA had an average annual growth rate of 3.8%. This rises to 4.6% when considering trends between 2008 and 2017. Assuming that the population continues to increase at the more precautionary rate of 3.8%, PVA analysis concluded that even the scenario based on a 70% displacement rate and 10% mortality rate, with an annual mortality of 3,079 individuals (for those projects), would not result in a population decline. Considering the impacts of the Project alone, the addition of 66 mortalities per annum, representing just 2% of the scenario assessed for the Dudgeon and Sheringham Shoal Extension projects PVA, would therefore not impact the integrity of the guillemot feature of the FFC SPA. Based on this PVA analysis, the level of impact resulting from the Project alone is predicted to be indistinguishable from natural fluctuations in the population.

10.4.180 **Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of FFC SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, guillemot will be maintained as a feature in the long-term.**

Table 10.24: Range-based displacement mortalities during the O&M phases for guillemot at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Breeding	12,283.9	61.4	39.6 – 924.6	1.210	0.781 – 18.215	0.827	0.534 – 12.449
Non-breeding	981.6	4.9	2.9 – 68.7	0.097	0.058 – 1.354	0.066	0.040 – 0.925
Annual Total	**13,265.5**	**66.3**	**42.6 – 993.3**	**1.307**	**0.839 – 19.568**	**0.893**	**0.573 – 13.374**

Table 10.25: Guillemot displacement matrix at FFC SPA (array plus two km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	13	27	66	133	265	398	531	663	796	929	1,061	1,194	1,327
20	27	53	133	265	531	796	1,061	1,327	1,592	1,857	2,123	2,388	2,653
25	33	66	166	332	663	995	1,327	1,658	1,990	2,322	2,653	2,985	3,317
30	40	80	199	398	796	1,194	1,592	1,990	2,388	2,786	3,184	3,582	3,980
40	53	106	265	531	1,061	1,592	2,123	2,653	3,184	3,714	4,245	4,776	5,306
50	66	133	332	663	1,327	1,990	2,653	3,317	3,980	4,643	5,306	5,970	6,633
60	80	159	398	796	1,592	2,388	3,184	3,980	4,776	5,572	6,368	7,164	7,960
70	93	186	464	929	1,857	2,786	3,714	4,643	5,572	6,500	7,429	8,358	9,286
80	106	212	531	1,061	2,123	3,184	4,245	5,306	6,368	7,429	8,490	9,552	10,613
90	119	239	597	1,194	2,388	3,582	4,776	5,970	7,164	8,358	9,552	10,745	11,939
100	133	265	663	1,327	2,653	3,980	5,306	6,633	7,960	9,286	10,613	11,939	13,266

Flamborough and Filey coast SPA – Razorbill

10.4.181 Razorbill has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.182 Based on the above the conservation objective for the FFC SPA the specific target for the razorbill feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 10,570 breeding pairs (21,140 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 40,506 breeding adults based on the most recent 2017 colony count.

10.4.183 The Project array area is located 92.9km from the FFC SPA which is within the mean max plus 1SD foraging distance of 164.6km (Woodward *et al.,* 2019) and has therefore been screened in for the migration-free breeding season (April – July), the post-breeding migration bio-season (August to October), the return migration bio-season (January to March), and the migration-free winter bio-season (November to December) as defined by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.184 During the migration-free breeding bio-season, the number of razorbills estimated to occur in the array area and 2km buffer is 5,163 (5,163.0) individuals. Assuming the proportion of adult birds in the array is 57%, and assuming a sabbatical rate of 7% for adult razorbill, the total number of breeding adults in the array at risk of displacement is 2,737 (2,736.9) during the migration-free breeding bio-season.

10.4.185 Of these 2,737 breeding adults, 100% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 2,737 (2,736.9) breeding adults at risk of displacement are attributed to FFC SPA (Table 10.26). Assuming a displacement rate of 50% and a mortality rate of 1%, the consequent mortality is estimated at less than 14 (13.7) breeding adults. However, based on advice from However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.26.

10.4.186 Based on a citation population of 21,140 breeding adults and annual background mortality of 2,219.7 individuals, the addition of 14 predicted breeding adult mortalities would represent a 0.617% increase in baseline mortality during the breeding bio-season.

10.4.187 As the population of razorbill has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 40,506 individuals and an annual background mortality of 4,253.1 individuals. On this basis, this would represent a 0.322% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

10.4.188 The mean-peak number of razorbills estimated to occur in the array area and 2km buffer is estimated at 5,229 (5,229.0) individuals in the return migration, 2,339 (2,339.0) individuals during the post-breeding migration bio-season and 2,570 (2,570.0) individuals in the migration-free winter bio-season.

10.4.189 On the basis that 3.4% of razorbills within the array area and buffer are deemed to be breeding adults from the FFC during the migration bio-seasons, and 0.9% breeding adults from the FFC during the migration-free winter (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 177 (176.7) during the return migration, 79 (79.0) during the post-breeding migration and 24 (23.5) in the migration-free winter bio-season (Table 10.26).

10.4.190 Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.9) individual return migration, less than one (0.4) during the post-breeding migration and less than one (0.1) in the migration-free winter bio-season. However, based on advice from However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.26.

10.4.191 This consequent estimated mortality equates to an increase in baseline mortality of 0.040% in the return-migration bio-season, 0.018% in the post-breeding bio-season and 0.005% in the migration-free winter bio-season based on the citation population and 0.021%, 0.009% and 0.003% respectively relative to the most recent counts.

10.4.192 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than two (1.4) breeding adult per annum. This represents an increase of 0.063% in baseline mortality of the citation population and 0.033% increase using the most recent count.

Annual Total

10.4.193 Across all bio-seasons, the number of razorbills estimated to occur in the array area and a 2km buffer is 10,138 (10,138.0) individuals, with 3,017 (3,017.4) being breeding adults from the FFC SPA. The total predicted consequent mortality from being displaced attributed to FFC SPA throughout the operational life of the Project is 15 (15.1) breeding adult from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.27.

10.4.194 The predicted mortality of 15 breeding adults from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.679% when considering the citation population or an increase of 0.355% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.195 **Therefore, the potential for an AEoI to the conservation objectives of the razorbill feature of FFC SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out, subject to natural change, razorbill will be maintained as a feature in the long-term**.

Table 10.26: Range-based displacement mortalities during the O&M phases for razorbill at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1- 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Migration–free Breeding	2,736.9	13.7	8.2 – 191.6	0.617	0.370 – 8.631	0.322	0.193 – 4.505
Post-breeding migration	79.5	0.4	0.2 – 5.5	0.018	0.011 – 0.249	0.009	0.006 – 0.130
Return-breeding migration	177.8	0.9	0.5 – 12.4	0.040	0.024 – 0.557	0.021	0.012 – 0.291
Winter	23.2	0.1	0.1 – 1.6	0.005	0.003 – 0.074	0.003	0.002 – 0.039
Annual Total	**3,017.4**	**15.1**	**9.0 – 211.1**	**0.649**	**0.408 – 9.512**	**0.355**	**0.213 – 4.964**

Table 10.27: razorbill displacement matrix at FFC SPA (array area plus 2km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	15	30	60	91	121	151	181	211	241	272	302
20	6	12	30	60	121	181	241	302	362	422	483	543	603
25	8	15	38	75	151	226	302	377	453	528	603	679	754
30	9	18	45	91	181	272	362	453	543	634	724	815	905
40	12	24	60	121	241	362	483	603	724	845	965	1,086	1,207
50	15	30	75	151	302	453	603	754	905	1,056	1,207	1,358	1,509
60	18	36	91	181	362	543	724	905	1,086	1,267	1,448	1,629	1,810
70	21	42	106	211	422	634	845	1,056	1,267	1,478	1,690	1,901	2,112
80	24	48	121	241	483	724	965	1,207	1,448	1,690	1,931	2,172	2,414
90	27	54	136	272	543	815	1,086	1,358	1,629	1,901	2,172	2,444	2,715
100	30	60	151	302	603	905	1,207	1,509	1,810	2,112	2,414	2,715	3,017

Flamborough and Filey coast SPA – puffin

10.4.196 Puffin has been screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.197 Although puffin is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on puffin as a feature, but more as an important component of the seabird assemblage. The latest population estimate is 4,279 based on the most recent 2018 colony counts.

10.4.198 The Project array area is located 92.9km from the FFC SPA which is within the mean max plus 1SD foraging distance of 265.4km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding bio-season for the months of April to July and the non-breeding bio-season defined as August to March by Furness (2015) (Appendix 7.1.4).

Breeding Bio-season

10.4.199 During the breeding bio-season, the number of puffins estimated to occur in the array area and 2km buffer is 884 (883.8) individuals. Assuming the proportion of adult birds in the array is 49%, and assuming a sabbatical rate of 7% for adult puffin, the total number of breeding adults in the array at risk of displacement is 403 (402.7) during the full breeding bio-season.

10.4.200 Of these 403 breeding adults, 43.5% are predicted to be breeding birds from FFC SPA (Appendix 7.1.4). Therefore, 175 (175.2) breeding adults at risk of displacement are attributed to FFC SPA (Table 10.28). Assuming a displacement rate of 50% and a mortality rate of 1%, the consequent mortality is estimated at less than one (0.9) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.28.

10.4.201 Based on the most recent counts of 4,279 breeding adults and annual background mortality of 261.0 individuals, the addition of less than one predicted breeding adult mortalities would represent a 0.336% increase in baseline mortality during the breeding bio-season.

Non-breeding season

10.4.202 In the non-breeding bio-season the mean-peak number of puffins estimated to occur in the array area and 2km buffer is 1,167 (1,167.0) individuals.

10.4.203 On the basis that 0.8% of these puffins within the array area are deemed to be breeding adults from the FFC during the non-breeding bio-season (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 9 (9.3) (Table 10.28). Based on 50% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.1) individual during the non-breeding bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% is also presented in Table 10.28.

10.4.204 This consequent estimated mortality equates to an increase in baseline mortality of 0.018% in the non-breeding bio-season relative to the most recent count.

Annual Total

10.4.205 Across all bio-seasons, the number of puffins estimated to occur in the array area and a 2km buffer is 2,051 (2,050.8) individuals, with 185 (184.8) being breeding adults from the FFC SPA. The total predicted consequent mortality from being displaced attributed to FFC SPA throughout the operational life of the Project is less than one (0.9) breeding adult from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (30% displacement to 70% displacement, 1 to 10% mortality) are displayed in Table 10.29.

10.4.206 The predicted mortality of one breeding adult from FFC SPA per annum across all bio-seasons represents an increase of 0.354% when considering the recent count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.207 **Therefore, the potential for an AEoI to the conservation objectives of the puffin as an assemblage feature of FFC SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, puffin will be maintained as a feature in the long-term.**

Table 10.28: Range-based displacement mortalities during the operational and maintenance phases for puffin at FFC SPA based on the values advocated by SNCBs for the most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme)

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1- 10% mortality	50% displacement, 1% mortality	30-70% displacement, 1 – 10% mortality
Breeding	175.2	0.9	0.5 – 12.3	0.336	0.201 – 4.698
Non-breeding	9.6	0.0	0.0 – 0.7	0.018	0.011 – 0.257
Annual Total	**184.8**	**0.9**	**0.5 – 12.9**	**0.379**	**0.212 – 4.955**

Table 10.29: Puffin displacement matrix at FFC SPA (array plus two km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	2	4	6	7	9	11	13	15	17	19
20	0	1	2	4	7	11	15	19	22	26	30	33	37
30	1	1	3	6	11	17	22	28	33	39	44	50	56
40	1	1	4	7	15	22	30	37	44	52	59	67	74
50	1	2	5	9	19	28	37	46	56	65	74	83	93
60	1	2	6	11	22	33	44	56	67	78	89	100	111
70	1	3	6	13	26	39	52	65	78	91	104	117	130
80	1	3	7	15	30	44	59	74	89	104	118	133	148
90	2	3	8	17	33	50	67	83	100	117	133	150	167
100	2	4	9	19	37	56	74	93	111	130	148	167	185

Flamborough and Filey Coast SPA – Gannet

10.4.208 Gannets were screened in for the O&M phase to assess the potential for an AEoI from displacement from the Project array area in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each of the qualifying features.

10.4.209 Based on the above the conservation objective for the FFC SPA the specific target for the gannet feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- To maintain the size of the breeding population at a level which is above 8,469 breeding pairs (16,938 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest count is 26,784 adults based on the 2017 survey (Aitken *et al.,* 2017).

10.4.210 The Project array area is located 92.9km from the FFC SPA, which is within the mean-maximum plus 1SD foraging distance of 315.2±194.2km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding season. In the non-breeding season, breeding gannets are not constrained by requirements to visit nests to incubate eggs or provision for chicks. It is therefore assumed that individuals will range more widely than during the breeding season, and therefore gannet has also been screened in for the non-breeding season. Gannets recorded during digital aerial surveys are therefore considered to come from a range of breeding colonies in the UK and further afield, as presented in Appendix 7.1.4.

10.4.211 The different bio-seasons for consideration of assessing potential risk from displacement on birds from FFC SPA includes the migration-free breeding season (April – August), the post-breeding migration bio-season (September to November) and the return migration bio-season (December to March), as defined by Furness (2015) (there is no migration free winter bio-season).

Migration-free Breeding Bio-season

10.4.212 During the migration-free breeding bio-season, the number of gannets estimated to occur in the array area and 2km buffer is 847 (846.8) individuals. Assuming the proportion adult birds in the array is 55% (Furness 2015), and assuming a sabbatical rate of 10% for adult gannets, the total number of breeding adults in the array at risk of displacement is 419 (419.1) during the migration-free breeding bio-season.

10.4.213 Of these 419 breeding adults, 100% are predicted to be breeding birds from FFC (Appendix 7.1.4). Therefore, 419 (419.1) breeding adults at risk of displacement are attributed to FFC SPA (Table 10.18). Assuming a displacement rate of 70% and a mortality rate of 1%, the consequent mortality is estimated at less than three (2.9) breeding adults. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented in Table 10.18.

10.4.214 Based on a citation population of 16,938 breeding adults and annual background mortality of 1,372 individuals, the addition of three predicted breeding adult mortalities would represent a 0.214% increase in baseline mortality during the migration-free breeding bio-season.

10.4.215 As the population of gannets has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 26,784 individuals and an annual background mortality of 2,170 individuals. On this basis, this would represent a 0.135% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding Bio-season

10.4.216 The mean-peak number of gannets estimated to occur in the array area and 2km buffer is estimated at 172 (171.5) and 169 (169.0) individuals during the return migration and the post-breeding migration bio-season, respectively.

10.4.217 On the basis that 6.2% of the gannets within the array area are deemed to be breeding adults from FFC SPA during the return migration and 4.8% during the post-breeding migration (Appendix 7.1.4), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 11 (10.7) during the return migration and eight (8.2) during the post-breeding migration (Table 10.18).

10.4.218 Based on 70% displacement and 1% mortality, the total predicted consequent mortality from being displaced is estimated at less than one (0.1) individual during the return migration bio-season and less than one (0.1) individual during the post-breeding migration bio-season. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented in Table 10.18.

10.4.219 This consequent estimated mortality equates to an increase in baseline mortality of 0.004% in both the return-migration bio-season and post-breeding bio-season based on the citation population and 0.003% relative to the most recent counts.

10.4.220 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.1) breeding adult per annum. This represents an increase of 0.008% in baseline mortality of the citation population and 0.005% increase using the most recent count.

Annual Total

10.4.221 Across all bio-seasons, the number of gannets estimated to occur in the array area and a 2km buffer is 1,187 (1,187.3) individuals, with 438 (438.0) being breeding adults from the FFC SPA. The total predicted consequent mortality from being displaced attributed to FFC SPA throughout the operational life of the Project is three (3.0) breeding adult from FFC SPA per annum across all bio-seasons. Displacement consequent mortalities based on the range advocated by SNCBs (60% displacement to 80% displacement, 1% mortality) are displayed in Table 10.31.

10.4.222 The predicted mortality of three breeding adults from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.222% when considering the citation population or an increase of 0.141% when considering the recent colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.223 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature of FFC SPA in relation to disturbance and displacement effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.30: Range-based displacement mortalities during the O&M phases for gannet at FFC SPA based on the values advocated by SNCBs for both citation population counts and most recent counts (Aitken *et al.,* (2017) Seabird Monitoring Programme).

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1% mortality	70% displacement, 1% mortality	60-80% displacement, 1% mortality	70% displacement, 1% mortality	60-80% displacement, 1% mortality
Migration-free breeding	419.1	2.9	2.5 – 3.4	0.214	0.183 – 0.244	0.135	0.116 – 0.155
Post-breeding migration	8.2	0.1	0.0 – 0.1	0.004	0.004 – 0.005	0.003	0.002 – 0.003
Return migration	10.7	0.1	0.0 – 0.1	0.004	0.004 – 0.005	0.003	0.002 – 0.003
Annual Total	**438.0**	**3.1**	**2.5 – 3.6**	**0.221**	**0.191 – 0.254**	**0.141**	**0.120 – 0.161**

Table 10.31: Gannet displacement matrix at FFC SPA (array plus 2km buffer), with light blue shading indicating the displacement range advocated by SNCBs, and dark blue indicating the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	4	9	13	18	22	26	31	35	39	44
20	1	2	4	9	18	26	35	44	53	61	70	79	88
30	1	3	7	13	26	39	53	66	79	92	105	118	131
40	2	4	9	18	35	53	70	88	105	123	140	158	175
50	2	4	11	22	44	66	88	110	131	153	175	197	219
60	3	5	13	26	53	79	105	131	158	184	210	237	263
70	3	6	15	31	61	92	123	153	184	215	245	276	307
80	4	7	18	35	70	105	140	175	210	245	280	315	350
90	4	8	20	39	79	118	158	197	237	276	315	355	394
100	4	9	22	44	88	131	175	219	263	307	350	394	438

Scottish SPAs – Non-breeding and Migratory Auk Species and Gannet

10.4.224 Auks (guillemot, razorbill and puffin) and gannet from Scottish SPAs have been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project alone during the non-breeding bio-season Table 10.8.

10.4.225 For ease of reading, the results of the assessments can be found for all relevant SPAs for each species in the following sections. For brevity the results have only been presented for the Projects evidenced displacement and mortality rates but the full range of potential impact can be found in the relevant tables.

Guillemot

10.4.226 Guillemot were assessed during the non-breeding bio-season at the following Scottish SPAs (Table 10.32). The non-breeding season population size for guillemot in the UK North Sea & Channel waters is predicted to be 1,617,306 birds. The predicted displacement consequent mortalities during the non-breeding season for each SPA are laid out in Table 10.32, on the basis that the Project's estimated impact can be apportioned to each relevant SPA in line with the SPA colony sizes within Furness (2015) (as set out in the apportioning Appendix 7.1.4). The level of impact at all these Scottish SPAs would be indistinguishable from natural fluctuations in the population.

10.4.227 **Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature at all of these SPAs in relation to displacement consequent mortality during the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, guillemot will be maintained as a feature in the long-term.**

Table 10.32. Guillemot displacement impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned displacement (50% Disp 1% Mort) (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
Buchan Ness to Collieston Coast	1.4	17,280	0.135
Calf of Eday	0.6	12,645	0.079
Copinsay	0.5	29,450	0.030
East Caithness Cliffs	10.3	106,700	0.158
Fair Isle	1.3	32,300	0.064
Forth Islands (UK)	1.8	32,000	0.093
Foula	1.6	37,500	0.070
Fowlsheugh	3.3	56,450	0.096
Hermaness, Saxa, Vord and Valla Field	0.4	25,000	0.029
Hoy	0.6	26,800	0.037
Marwick Head	1.1	37,700	0.046
North Caithness Cliffs	4.5	38,300	0.194
Noss	1.4	38,970	0.060
Rousay	0.6	10,600	0.092

Special Protection Area	Apportioned displacement (50% Disp 1% Mort) (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
St Abb's Head	2.7	31,750	0.141
Sumburgh Head	0.5	16,000	0.047
Troup, Pennan and Lion's Heads	1.1	44,600	0.039
West Westray	3.3	42,150	0.127

Razorbill

10.4.228 Razorbill were assessed during the migration-free winter season and the migration season at the Scottish SPAs listed in Table 10.33. The UK North Sea and English Channel razorbill population is estimated to be 218,622 during the migration-free winter season and 591,874 during the migration season. The anticipated displacement consequent mortalities for each SPA during the migration-free winter season and the migration season are outlined in Table 10.33, on the basis that the projects predicted impact can be apportioned to each relevant SPA in line with the SPA colony size within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs would be indistinguishable from natural population fluctuations.

10.4.229 **Therefore, the potential for an AEoI to the conservation objectives of the razorbill feature at all these SPAs in relation to displacement consequent mortalities during the O&M phase from the project alone can be ruled out and therefore, subject to natural change, razorbill will be maintained as a feature in the long-term.**

Table 10.33. Razorbill displacement impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned displacement (50% Disp 1% Mort) (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
St Abb's Head SPA	0.2	2,180	0.074
East Caithness Cliffs SPA	1.7	15,800	0.105
Fair Isle SPA	0.1	3,400	0.034
Forth Islands (UK) SPA	0.4	1,400	0.249
Foula SPA	0.0	6,200	0.008
Fowlsheugh SPA	0.5	5,800	0.081
North Caithness Cliffs SPA	0.2	4,000	0.054
Troup, Pennan and Lion's Heads SPA	0.2	4,800	0.048
West Westray	0.1	1,946	0.036

Puffin

10.4.230 Puffin were assessed during the non-breeding bio-seasons at the following Scottish SPAs (Table 10.34). The puffin population during the non-breeding bio-season in the UK North Sea and English Channel is predicted to be 231,975. The displacement consequent mortalities estimated for each SPA during the non-breeding season are presented in Table 10.34, on the basis that the predicted impact can be apportioned to each relevant SPA in line with the SPA colony count within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs would be indistinguishable from the natural fluctuations in populations.

10.4.231 **Therefore, the potential for an AEoI to the conservation objectives of the puffin feature at all these SPAs in relation to displacement consequent mortalities during the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, puffin will be maintained as a feature in the long-term**.

Table 10.34. Puffin displacement impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned displacement (50% Disp 1% Mort) (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
Fair Isle SPA	0.5	23,000	0.038
Forth Islands (UK) SPA	3.1	28,000	0.183
Foula SPA	1.1	48,000	0.039
Hermaness, Saxa, Vord and Valla Field SPA	1.2	55,000	0.035
Hoy SPA	0.2	7,000	0.041
North Caithness Cliffs SPA	0.0	4,160	0.019
Noss SPA	0.0	2,348	0.028

Gannet

10.4.232 Gannet were assessed during the post-breeding migratory season and the return migratory season at the Scottish SPAs listed in Table 10.35. The UK North Sea and English Channel gannet population during the post-breeding migratory season and the return migratory season are predicted to be 456,299 and 248,385, respectively. These population counts were combined and were used for non-breeding season apportioning of the displacement consequent mortalities estimated for each SPA presented in Table 10.35. The displacement consequent mortalities estimated for each SPA are presented in Table 10.35, on the basis that the predicted impact can be apportioned to each relevant SPA in line with the SPA colony counts within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs would be indistinguishable from the natural fluctuations in populations.

10.4.233 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature at all these SPAs in relation to displacement consequent mortalities during the O&M phase from the project alone can be ruled out and therefore, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.35. Gannet displacement impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned displacement (70% Disp 1% Mort) (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
Forth Islands (UK) SPA	0.5	43,200	0.015
Fair Isle SPA	0.0	2,332	0.017
Hermaness, Saxa, Vord and Valla Field SPA	0.2	32,800	0.008
Noss SPA	0.1	13,720	0.007

Collision Risk

Alde-Ore Estuary SPA – Lesser black-backed gull

10.4.234 Lesser black-backed gulls were screened in for the O&M phase to assess the potential for an AEoI from collision from the Project array in relation to the following conservation objectives for this species, as a feature of the Alde-Ore Estuary SPA (Appendix 7.1.1):

- Maintain the population of each of the qualifying features.

10.4.235 Based on the above the conservation objective for the Alde-Ore Estuary SPA the specific target for the lesser black-backed gull feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- To maintain the size of the breeding population at a level which is above 28,140 breeding adults whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest count is 3,534 adults based on the 2018/19 SMP survey.

10.4.236 The Project array area is located 147.3km from the Alde-Ore Estuary SPA, which is within the mean-maximum plus 1SD foraging distance of 236km (Woodward *et al.,* 2019) and has been screened in for the breeding season and the non-breeding season. It is important to note that although the array is within the mean-max foraging (MMF)+1SD it is outside the site-specific foraging range of 124km from Alde-Ore Estuary SPA and therefore there is unlikely to be breeding season connectivity to this site.

10.4.237 The different bio-seasons for consideration of assessing potential risk from collision on birds from Alde-Ore Estuary SPA includes the migration-free breeding season (May – July), the post-breeding migration bio-season (August – October) and the return migration bio-season (March – April) and the migration-free winter (November – February, as defined by Furness (2015).

Migration-free Breeding Bio-season

10.4.238 The predicted collision mortality during the migration-free breeding bio-season is less than two (1.5) individuals. Of these two individuals, the proportion considered to be breeding adults is 60%, and assuming a sabbatical rate of 3.5% for adult lesser black-backed gulls, the total number of breeding adults in the array area impacted by collision is less than one (0.6) per annum during the migration-free breeding bio-season.

10.4.239 Assuming 20.8% of these collisions are predicted to be breeding birds from Alde-Ore Estuary SPA (Appendix 7.1.4), then the consequent mortality during the migration-free breeding bio-season is estimated at less than one (0.1) breeding adults.

10.4.240 Based on a citation population of 28,140 breeding adults and annual background mortality of 3,236.1 individuals, the addition of less than one predicted breeding adult mortalities would represent a 0.004% increase in baseline mortality during the migration-free breeding bio-season.

10.4.241 As the population of lesser black-backed gulls has changed significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2018/9, consisting of 3,534 individuals and an annual background mortality of 406.4 individuals. On this basis, this would represent a 0.029% increase in baseline mortality during the migration-free breeding bio-season.

Non-Breeding Bio-season

10.4.242 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than one (0.9) individual, in the post-breeding migration bio-season is one (1.0) individual and during the migration-free the collision mortality is less than one (0.2) individual. On the basis that 3.3% of the lesser black-backed gulls within the array area are deemed to be breeding adults from Alde-Ore Estuary Spa during the return migration and the post-breeding migration, and 5% in the migration-free winter bio-season (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.03) individual during the return migration and post-breeding migration, and less than one (0.1) individual in the migration-free winter.

10.4.243 This consequent estimated mortality equates to an increase in baseline mortality of 0.001% in the return-migration bio-season and the post-breeding bio-season, and <0.001% in the migration-free winter based on the citation population and 0.008% relative to the most recent counts for the return-migration bio-season and the post-breeding bio-season, and 0.002% in the winter bio-season.

Annual Total

10.4.244 The total predicted consequent mortality from collision attributed to Alde-Ore Estuary SPA throughout the operational life of the Project is less than one (0.3) breeding adult from Alde-Ore Estuary SPA per annum across all bio-seasons.

10.4.245 The predicted mortality of less than one breeding adult from Alde-Ore Estuary SPA per annum across all bio-seasons represents an increase of 0.008% when considering the citation population or an increase of 0.063% when considering the recent colony count. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.246 **Therefore, the potential for an AEoI to the conservation objectives of the lesser black-backed gull feature of Alde-Ore Estuary SPA in relation to collision risk in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, lesser black-backed gull will be maintained as a feature in the long-term.**

Coquet Island SPA – Sandwich Tern

10.4.247 Sandwich tern has been screened in for the O&M phase to assess the potential for an AEoI from collision risk from the Project alone in relation to the following conservation objectives for this species, as a feature of the Coquet Islands SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.248 Based on the above the conservation objective for the Coquet Islands SPA the specific target for the sandwich tern feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 2,600 breeding adults, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 4,428 breeding adults based on the most recent 2022 colony count.

10.4.249 The Project array area is located 257km from Coquet Islands SPA which is beyond the mean max plus 1SD foraging distance of 57.5km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, including the return-migration bio-season defined as March – May and the post-breeding migration bio-season (July – September) defined by Furness (2015) (Appendix 7.1.4).

Non-breeding Bio-season

10.4.250 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than one (1.0) individual and in the post-breeding migration bio-season is less than one (0.1) individual. On the basis that 3.52% of the sandwich terns within the array area are deemed to be breeding adults from Coquet Island SPA during the return migration and the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.04) during the return migration and less than one (<0.003) during the post-breeding migration.

10.4.251 Based on a citation population of 2,600 breeding adults and an annual background mortality of 265.2 breeding adults per annum, the addition of less than one predicted breeding adult mortalities would represent an increase in baseline mortality of 0.015%.

10.4.252 As the population of sandwich tern has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2022, consisting of 4,428 individuals and an annual background mortality of 451.7 individuals. On this basis, this would represent a 0.009% increase in baseline mortality in the non-breeding bio-season. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.253 Therefore, the potential for an AEoI to the conservation objectives of the sandwich tern feature of Coquet Island SPA in relation to collision risk effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, sandwich tern will be maintained as a feature in the long-term.

Farne Islands SPA – Kittiwake

10.4.254 Kittiwake has been screened in for the O&M phase to assess the potential for an AEoI from collision risk from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the Farne Island SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.255 Although kittiwake is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on kittiwake as a feature, but more as an important component of the seabird assemblage. The citation count is 8,241 and the latest population estimate is 4,402 based on the most recent 2019 colony counts.

10.4.256 The Project array area is located 284.2km from the Farne Island SPA, which is within the mean-maximum plus 1SD foraging distance of 300.6km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding season and the non-breeding season.

10.4.257 The different bio-seasons for consideration of assessing potential risk from collision on birds from Farne Island SPA includes the migration-free breeding season (May - July), the post-breeding migration bio-season (August - December) and the return migration bio-season (January - April), as defined by Furness (2015) (there is no migration free winter bio-season).

Migration-free Breeding Bio-season

10.4.258 The predicted collision mortality during the migration-free breeding bio-season is 28 (28.1) individuals. Of these 28 individuals, the proportion considered to be breeding adults is 53%, and assuming a sabbatical rate of 10% for adult kittiwakes, the total number of breeding adults in the array impacted by collision is less than 14 (13.4) per annum during the migration-free breeding bio-season.

10.4.259 Assuming 1.3% of these collisions are predicted to be breeding birds from Farne Island SPA (Appendix 7.1.4), then the consequent mortality during the migration-free breeding bio-season is estimated at less than one (0.2) breeding adults.

10.4.260 Based on a citation population of 8,241 breeding adults and annual background mortality of 1,203.2 individuals, the addition of less than one predicted breeding adult mortality would represent a 0.015% increase in baseline mortality during the migration-free breeding bio-season.

10.4.261 As the population of kittiwakes has changed significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 4,402 individuals and an annual background mortality of 642.7 individuals. On this basis, this would represent a 0.027% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding Bio-season

10.4.262 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than 51 (50.4) individuals and in the post-breeding migration bio-season is 18 (18.1) individuals. On the basis that 0.7% of the kittiwakes within the array area are deemed to be breeding adults Farne Island SPA during the return migration and 0.5% during the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.3) during the return migration and less than one (0.1) during the post-breeding migration.

10.4.263 This consequent estimated mortality equates to an increase in baseline mortality of 0.028% in the return-migration bio-season and 0.007% in the post-breeding bio-season based on the citation population and 0.052% relative to the most recent counts for the return-migration bio-season and 0.014% for the post-breeding bio-season.

Annual Total

10.4.264 The total predicted consequent mortality from collision attributed to Farne Island SPA throughout the operational life of the Project is less than one (0.4) breeding adult from Farne Island SPA per annum across all bio-seasons.

10.4.265 The predicted mortality of less than one breeding adult from Farne Island SPA per annum across all bio-seasons represents an increase of 0.05% when considering the citation population or an increase of 0.093% when considering the recent colony count. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.266 **Therefore, the potential for an AEoI to the conservation objectives of the kittiwake feature of Farne Island SPA in relation to collision risk in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, kittiwake will be maintained as a feature in the long-term.**

Farne Islands SPA – Sandwich Tern

10.4.267 Sandwich tern has been screened in for the O&M phase to assess the potential for an AEoI from collision risk from the Project alone in relation to the following conservation objectives for this species, as a feature of the Farne Islands SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.268 Based on the above the conservation objective for the Farne Islands SPA the specific target for the sandwich tern feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 1,742 breeding adults, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 417 breeding adults based on the most recent 2019 colony count.

10.4.269 The Project array area is located 284.2km from the Farne Islands SPA which is beyond the mean max plus 1SD foraging distance of 57.5km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding connectivity, including the return-migration bio-season defined as March – May and the post-breeding migration bio-season (July – September) defined by Furness (2015) (Appendix 7.1.4).

Non-breeding Bio-season

10.4.270 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than one (1.0) individual and in the post-breeding migration bio-season is less than one (0.1) individual. On the basis that 4.3% of the sandwich terns within the array area are deemed to be breeding adults from Farne Island SPA during the return migration and the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.04) during the return migration and less than one (<0.004) during the post-breeding migration.

10.4.271 Based on a citation population of 1,724 breeding adults and an annual background mortality of 175.8 breeding adults per annum, the addition of less than one (0.04) predicted breeding adult mortalities would represent an increase in baseline mortality of 0.134%.

10.4.272 As the population of sandwich tern has changed since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, consisting of 834 individuals and an annual background mortality of 85 individuals per annum. On this basis, this would represent a 0.276% increase in baseline mortality in the non-breeding bio-season. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.273 **Therefore, the potential for an AEoI to the conservation objectives of the Sandwich tern feature of Farne Island SPA in relation to collision risk effects in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, sandwich tern will be maintained as a feature in the long-term.**

Flamborough and Filey Coast SPA – Kittiwake

10.4.274 Kittiwakes were screened in for the O&M phase to assess the potential for an AEoI from collision from the Project array in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each of the qualifying features.

10.4.275 Based on the above the conservation objective for the FFC SPA the specific target for the kittiwake feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- To maintain the size of the breeding population at a level which is above 167,400 breeding adults whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest count is 103,070 adults based on the 2017 survey (Aitken *et al.,* 2017).

10.4.276 The Project array area is located 92.9km from the FFC SPA, which is within the mean-maximum plus 1SD foraging distance of 300.6km (Woodward *et al.,* 2019) and has therefore been screened in for the breeding season and the non-breeding season.

10.4.277 The different bio-seasons for consideration of assessing potential risk from collision on birds from FFC SPA includes the migration-free breeding season (May–- July), the post-breeding migration bio-season (August–- December) and the return migration bio-season (January–- April), as defined by Furness (2015) (there is no migration free winter bio-season).

Migration-free Breeding Bio-season

10.4.278 The predicted collision mortality during the migration-free breeding bio-season is 28 (28.1) individuals. Of these 28 individuals, the proportion considered to be breeding adults is 53%, and assuming a sabbatical rate of 10% for adult kittiwakes, the total number of breeding adults in the array impacted by collision is 13 (13.4) per annum during the migration-free breeding bio-season.

10.4.279 Assuming 93.1% of these collisions are predicted to be breeding birds from FFC SPA (Appendix 7.1.4), then the consequent mortality during the migration-free breeding bio-season is estimated at 13 (12.5) breeding adults.

10.4.280 Based on a citation population of 167,400 breeding adults and annual background mortality of 24,440.4 individuals, the addition of 13 predicted breeding adult mortalities would represent a 0.051% increase in baseline mortality during the migration-free breeding bio-season.

10.4.281 As the population of kittiwakes has changed significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 103,070 individuals and an annual background mortality of 15,048.2 individuals. On this basis, this would represent a 0.083% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding Bio-season

10.4.282 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than 51 (50.4) individuals and in the post-breeding migration bio-season is 18 (18.1) individuals. On the basis that 7.2% of the kittiwakes within the array area are deemed to be breeding adults from FFC SPA during the return migration and 5.4% during the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than four (3.6) during the return migration and one (1.0) during the post-breeding migration.

10.4.283 This consequent estimated mortality equates to an increase in baseline mortality of 0.015% in the return-migration bio-season and 0.004 in the post-breeding bio-season based on the citation population and 0.024% relative to the most recent counts for the return-migration bio-season and 0.007% for the post-breeding bio-season.

Annual Total

10.4.284 The total predicted consequent mortality from collision attributed to FFC SPA throughout the operational life of the Project is 17 (17.1) breeding adult from FFC SPA per annum across all bio-seasons.

10.4.285 The predicted mortality of 17 breeding adults from FFC SPA per annum across all bio-seasons represents an increase of 0.070% when considering the citation population or an increase of 0.114% when considering the recent colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.286 **Therefore, the potential for an AEoI to the conservation objectives of the kittiwake feature of FFC SPA in relation to collision risk in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, kittiwake will be maintained as a feature in the long-term.**

North Norfolk Coast SPA – Sandwich Tern

10.4.287 Sandwich tern has been screened in for the O&M phase to assess the potential for an AEoI from collision risk from the Project alone in relation to the following conservation objectives for this species, as a feature of the North Norfolk Coast SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.288 Based on the above the conservation objective for the North Norfolk Coast SPA the specific target for the sandwich tern feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- Maintain the size of the breeding population at a level which is above 7,400 breeding adults, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest colony population estimate is 14,588 breeding adults based on the most recent 2020-2022 colony count.

10.4.289 The Project array area is located 56.4km from the North Norfolk Coast SPA which is within the mean-maximum plus 1SD foraging distance of 57.5km (Woodward *et al.,* 2019) as measured from the boundary of the SPA to the array and has therefore been screened in for the breeding and non-breeding bio-season. However, if measured from the centre of the SPA or from the largest sandwich tern colonies within the SPA, at Scolt Head Island and Blakeney Point, then the Project array area is 77km and 69.7km, respectively, beyond the mean-maximum plus 1SD foraging distance to the array area. The different bio-season for consideration of assessing potential risk from collision on birds from North Norfolk Coast SPA includes the migration-free breeding season (June), return-migration bio-season (March – May), and the post-breeding migration bio-season (July – September), as defined by Furness (2015) (Appendix 7.1.4).

Migration-free Breeding Bio-season

10.4.290 The predicted collision mortality during the migration-free breeding bio-season is less than one (0.4) individual. Based on the proportion considered to be breeding adults is 61%, the total number of breeding adults in the array area impacted by collision is less than one (0.2) per annum during the migration-free breeding bio-season.

10.4.291 Assuming 100% of these collisions are predicted to be breeding birds from North Norfolk Coast SPA (Appendix 7.1.4), then the consequent mortality during the migration-free breeding bio-season is estimated at less than one (0.2) breeding adults.

10.4.292 Based on a citation population of 7,400 breeding adults and annual background mortality of 754.8 individuals, the addition of less than one predicted breeding adult mortality would represent a 0.113% increase in baseline mortality during the migration-free breeding bio-season.

10.4.293 As the population of sandwich tern has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2020-22, consisting of 14,588 individuals and an annual background mortality of 1,488.0 individuals. On this basis, this would represent a 0.058% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding Bio-season

10.4.294 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is one (1.0) individual and in the post-breeding migration bio-season is less than one (0.1) individual. On the basis that 21.73% of the sandwich terns within the array area are deemed to be breeding adults from North Norfolk Coast SPA during the return migration and the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.2) during the return migration and less than one (0.02) during the post-breeding migration.

10.4.295 Based on a citation population of breeding adults the addition of less than one predicted breeding adult mortality would represent an increase in baseline mortality of 0.031% in the non-breeding season.

10.4.296 As the population of sandwich tern has increased since the citation population count, the potential impact on the population is more reasonably assessed against the latest population count. On this basis, this would represent a 0.016% increase in baseline mortality in the non-breeding bio-season.

Annual Total

10.4.297 The total predicted consequent mortality from collision attributed to North Norfolk Coast SPA throughout the operational life of the Project is less than one (0.5) breeding adult from North Norfolk Coast SPA per annum across all bio-seasons.

10.4.298 The predicted mortality of less than one breeding adult from North Norfolk Coast SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.145% when considering the citation population or an increase of 0.073% when considering the recent colony count. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.299 **Therefore, the potential for an AEoI to the conservation objectives of the sandwich tern feature of North Norfolk Coast SPA in relation to collision risk effects in the O&M phase from the Project alone can be ruled out and, subject to natural change, sandwich tern will be maintained as a feature in the long-term**.

Flamborough and Filey Coast SPA – Herring gull

10.4.300 Herring gull has been screened in for the O&M phase to assess the potential for an AEoI from collision risk from the Project alone in relation to the following conservation objectives for this species, as an assemblage feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each qualifying feature.

10.4.301 Although herring gull is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from the Project alone on herring gull as a feature, but more as an important component of the seabird assemblage. The latest population estimate is 702 based on the most recent 2017 colony counts.

10.4.302 The Project array area is located 92.9km from the FFC SPA, which is out with the mean-maximum plus 1SD foraging distance of 85.6km (Woodward *et al.,* 2019) and has therefore been screened out for the breeding season. Herring gull has been screened in for the non-breeding bio-season (September – February) as defined by Furness (2015).

Non-breeding Bio-season

10.4.303 The predicted collision mortality as a result of the operation of the Project in the non-breeding bio-season is less than one (0.2) individual. On the basis that 0.43% of the herring gulls within the array area are deemed to be breeding adults FFC SPA during non-breeding bio-season (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.001). This consequent estimated mortality equates to an increase in baseline mortality of 0.001% in the non-breeding bio-season based on the most recent population counts. This level of impact is considered to be *de minimis* and would be indistinguishable from natural fluctuations in the population.

10.4.304 Therefore, the potential for an AEoI to the conservation objectives of the herring gull assemblage feature of FFC SPA in relation to collision risk in the O&M phase from the Project alone can be ruled out and, subject to natural change, herring gull and the assemblage will be maintained in the long-term.

Flamborough and Filey Coast SPA – Gannet

10.4.305 Gannets were screened in for the O&M phase to assess the potential for an AEoI from collision from the Project array in relation to the following conservation objectives for this species, as a feature of the FFC SPA (Appendix 7.1.1):

- Maintain the population of each of the qualifying features.

10.4.306 Based on the above the conservation objective for the FFC SPA the specific target for the gannet feature is as follows based on Natural England's case-specific advice (Natural England 2021):

- To maintain the size of the breeding population at a level which is above 8,469 breeding pairs (16,938 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest count is 26,784 adults based on the 2017 survey (Aitken *et al.,* 2017).

10.4.307 The Project array area is located 92.9km from the FFC SPA, which is within the mean-maximum plus 1SD foraging distance of 509.4km (Woodward *et al*., 2019) and has therefore been screened in for the breeding season. In the non-breeding season, breeding gannets are not constrained by requirements to visit nests to incubate eggs or provision for chicks. It is therefore assumed that individuals will range more widely than during the breeding season, and therefore gannet has also been screened in for the non-breeding season. Gannets recorded during digital aerial surveys are therefore considered to come from a range of breeding colonies in the UK and further afield.

10.4.308 The different bio-seasons for consideration of assessing potential risk from collision on birds from FFC SPA includes the migration-free breeding season (April–- August), the post-breeding migration bio-season (September to November) and the return migration bio-season (December to March), as defined by Furness (2015) (there is no migration free winter bio-season).

10.4.309 As per Natural England guidance (Parker *et al*., 2022), a macro-avoidance rate of 70% has been applied to collision mortality estimates, with a range of 65% to 85% macro-avoidance also presented in Table 10.36 below.

Migration-free Breeding Bio-season

10.4.310 The predicted collision mortality during the migration-free breeding bio-season is three (2.9) individuals. Of these three individuals, the proportion considered to be breeding adults is 55%, and assuming a sabbatical rate of 10% for adult gannets, the total number of breeding adults in the array impacted by collision is less than two (1.4) per annum during the migration-free breeding bio-season. As presented in the apportioning annex (Appendix 7.1.4), 100% of these are predicted to be breeding birds from the FFC SPA.

10.4.311 Based on a citation population of 16,938 breeding adults and annual background mortality of 1,372 individuals, the addition of two predicted breeding adult mortalities would represent a 0.104% increase in baseline mortality during the migration-free breeding bio-season.

10.4.312 As the population of gannets has increased significantly since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2017, consisting of 26,784 individuals and an annual background mortality of 2,170 individuals. On this basis, this would represent a 0.066% increase in baseline mortality during the migration-free breeding bio-season.

Non-breeding Bio-season

10.4.313 The predicted collision mortality as a result of the operation of the Project in the return migration bio-season is less than one (0.4) individuals and in the post-breeding migration bio-season is less than one (0.4) individuals. On the basis that 6.2% of the gannets within the array area are deemed to be breeding adults from FFC SPA during the return migration and 4.8% during the post-breeding migration (Appendix 7.1.4), the consequent mortality of adult birds is less than one (0.0) during the return migration and less than one (0.0) during the post-breeding migration.

10.4.314 This consequent estimated mortality equates to an increase in baseline mortality of 0.005% in the return-migration bio-season and 0.004% in the post-breeding bio-season based on the citation population and 0.003% relative to the most recent counts for both bio-seasons.

Annual Total

10.4.315 The total predicted consequent mortality from collision attributed to FFC SPA throughout the operational life of the Project is less than two (1.6) breeding adults from FFC SPA per annum across all bio-seasons.

10.4.316 The predicted mortality of three breeding adults from FFC SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.114% when considering the citation population or an increase of 0.072% when considering the recent colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

10.4.317 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature of FFC SPA in relation to collision risk in the O&M phase from the Project alone can be ruled out and, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.36: Collision mortality based on 65%, 70% and 85% macro-avoidance for gannets at the FFC SPA.

Bio-season	70% macro-avoidance			65% to 85% macro-avoidance		
	Mortality estimate	% increase citation population	% increase SMP population	Mortality estimate	% increase citation population	% increase SMP population
Migration-free breeding	1.4	0.104	0.066	0.7 – 1.7	0.052 – 0.122	0.033 – 0.077
Post-breeding migration	0.0	0.001	0.001	0.0 – 0.0	0.001 – 0.001	0.000 – 0.001
Return migration	0.0	0.001	0.001	0.0 – 0.0	0.001 – 0.002	0.000 – 0.001
Annual Total	**1.5**	**0.107**	**0.068**	**0.7 – 1.7**	**0.053 – 0.125**	**0.033 – 0.079**

FFC – Assemblage Features

10.4.318 The breeding seabird assemblage feature for FFC SPA has been screened in for the assessment of the O&M phase, comprised of 216,730 individual seabirds at classification, and 298,544 individuals in 2017 (Natural England, 2020). The assemblage comprises the following nine species;

- Gannet;
- Kittiwake;

- Guillemot;
- Razorbill;
- Fulmar;
- Puffin;
- Herring gull;
- Cormorant; and
- Shag.

10.4.319 Of these, gannet, kittiwake, guillemot and razorbill are qualifying species of FFC SPA in their own right, and effects on these species have therefore been considered separately. Though they are assemblage features only, puffin and herring gull have also been assessed for impacts alone in the impact section above.

10.4.320 Potential impacts on fulmar, cormorant and shag have been screened out of the assessment, owing to their low sensitivity to displacement and collision impacts, alongside low numbers recorded within the Project survey area.

10.4.321 As set out in assessments on screened in assemblage species, no significant changes to either their abundance or diversity is expected as a result of the Project. **Therefore, the potential for an AEoI to the conservation objectives of the assemblage features of FFC SPA in relation to collision and displacement risks in the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, both seabird abundance and diversity will be maintained as a feature in the long-term.**

Scottish SPAs – Kittiwake and Gannet

10.4.322 Kittiwake and gannet from Scottish SPAs have been screened in for the assessment of the O&M phase to assess the impacts from collision from the Project alone during the non-breeding bio-season.

10.4.323 For ease of reading, the results of the assessments can be found for all relevant SPAs for each species in the following sections.

Kittiwake

10.4.324 Kittiwake were assessed during the post-breeding migratory season and the return migratory season at the Scottish SPAs listed in Table 10.37. The kittiwake population in the UK North Sea and English Channel, is estimated to be 829,937 during the post-breeding migratory season and 627,816 during the return migratory season. These population counts were combined and were used for non-breeding season apportioning of the displacement consequent mortalities estimated for each SPA presented in Table 10.37. The displacement consequent mortalities estimated for each SPA are presented in Table 10.37, on the basis that the predicted impact can be apportioned to each relevant SPA in line with the SPA colony counts within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs is considered *de minimis* and would be indistinguishable from the natural population fluctuations.

10.4.325 **Therefore, the potential for an AEoI to the conservation objectives of the kittiwake feature at all these SPAs in relation to displacement consequent mortalities during the O&M phase from the Project alone can be ruled out and therefore, subject to natural change, kittiwake will be maintained as a feature in the long-term**.

Table 10.37. Kittiwake collision impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned collisions	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
Buchan Ness to Collieston Coast SPA	1.5	60,904	0.017
Calf of Eday SPA	0.2	3,434	0.030
Copinsay SPA	0.1	19,100	0.003
East Caithness Cliffs SPA	4.9	65,000	0.052
Fair Isle SPA	0.1	36,320	0.002
Forth Islands (UK) SPA	0.4	16,800	0.015
Foula SPA	0.0	7,680	0.004
Fowlsheugh SPA	1.1	73,300	0.011
Hermaness, Saxa, Vord and Valla Field SPA	0.0	1,844	0.018
Hoy SPA	0.0	6,000	0.006
Marwick Head SPA	0.1	15,400	0.003
North Caithness Cliffs SPA	1.2	26,200	0.032
Noss SPA	0.1	14,040	0.003
Rousay SPA	0.2	9,800	0.015
St Abb's Head SPA	0.4	42,340	0.007
Sumburgh Head SPA	0.0	2,732	0.006
Troup, Pennan and Lion's Heads SPA	1.8	63,200	0.020
West Westray	1.5	47,800	0.021

Gannet

10.4.326 Gannet were assessed during the post-breeding migratory season and the return migratory season at the Scottish SPAs listed in Table 10-4. The UK North Sea and English Channel gannet population during the post-breeding migratory season and the return migratory season are predicted to be 456,299 and 248,385, respectively. These population counts were combined and were used for non-breeding season apportioning of the displacement consequent mortalities estimated for each SPA presented in Table 10.38. The displacement consequent mortalities estimated for each SPA are presented in Table 10.38, on the basis that the predicted impact can be apportioned to each relevant SPA in line with the SPA colony counts within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs is considered to be *de minimis* and would be indistinguishable from the natural fluctuations in populations.

10.4.327 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature at all these SPAs in relation to displacement consequent mortalities during the O&M phase from the project alone can be ruled out, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.38. Gannet collision impacts apportioned to Scottish SPAs.

Special Protection Area	Apportioned collisions (breeding adults per annum)	SPA citation population (breeding adults)	SPA citation population increase in baseline mortality rate (%)
Forth Islands (UK) SPA	0.1	43,200	0.001
Fair Isle SPA	0.0	2,332	0.006
Hermaness, Saxa, Vord and Valla Field SPA	0.0	32,800	0.000
Noss SPA	0.0	13,720	0.002

Migratory Terns and Waterbirds (UK SPAs)

10.4.1 Migratory tern and waterbird species have been screened in for the assessment of O&M phase to assess the potential impact from collision during migration for sites within 100km of the Project. A migratory bird collision assessment will be undertaken post-PEIR and will be presented in the final RIAA to accompany the DCO application and will consider the species presented in Table 10.39.

Table 10.39: SPAs designated for migratory terns and waterbirds relevant to the Project (within 100km)

Designated site	Distance to Array (km)	Features screened in for collision risk
Greater wash SPA	23.4	Little gull, Sandwich tern, Little tern, Common tern
Humber Estuary SPA	52.7	Marsh harrier; Redshank; Ruff; Shelduck; Pink-footed goose; Wigeon; Ringed plover; Curlew; Sanderling; Oystercatcher; Dark-bellied brent goose; Mallard; Pochard; Goldeneye; and Scaup.
North Norfolk Coast SPA	56.3	Sandwich tern, Common tern, Dark-bellied brent goose; Eurasian marsh harrier; Eurasian wigeon; Great bittern; Pied avocet; Pink-footed goose; Red knot; and Assemblage features.
Gibraltar Point SPA	62.1	Bar-tailed godwit; Grey plover; and Eurasian oystercatcher; Grey plover; Red knot; Sanderling; Eurasian curlew; Common redshank; Ruddy turnstone; Pink-footed goose; Dark-bellied brent goose; Common shelduck; Northern pintail; Dunlin; and Bar-tailed godwit
The Wash SPA	65.5	Bar-tailed godwit; Common scoter; Black-tailed godwit; Common goldeneye; Common redshank; Common shelduck; Dark-bellied brent goose; Dunlin; Eurasian curlew; Eurasian oystercatcher;

Designated site	Distance to Array (km)	Features screened in for collision risk
		Eurasian wigeon; Gadwall; Grey plover; Northern pintail; Pink-footed goose; Red knot; Ruddy turnstone; Sanderling; Tundra swan; and Assemblage features.
Great Yarmouth North Denes SPA	84.5	Little tern

10.4.2 The 18 months of digital aerial survey analysed to date has not recorded any of these migratory waterbirds. However, migratory collision risk modelling will be undertaken post-PEIR as a precautionary approach.

Combined Collision and Displacement Risk

FFC SPA - Gannet

10.4.3 As gannet has been assessed for the impacts of both displacement and collision, consideration is also given to the combined total of these impacts in relation to the conservation objectives of the gannet feature of the FFC SPA (Appendix 7.1.4).

10.4.4 Impacts resulting from displacement, collision, and the impacts combined are presented in Table 10.40 below.

Table 10.40: Combined collision and displacement impacts for gannet at the FFC SPA.

Bio-season	Displacement mortality (based on 70% displacement and 1% mortality)	Collision mortality	Combined mortality
Breeding	2.9	1.4	4.4
Post-breeding migration	0.0	0.1	0.1
Return migration	0.1	0.1	0.1
Annual total	**3.0**	**1.6**	**4.5**

10.4.5 The annual mortality of breeding adult gannets from the FFC SPA as a result of combined displacement and collision mortality is five (4.5). Based on a citation population of 28,000 breeding adults and an annual background mortality of 2,268 individuals per annum, the addition of five mortalities as a result of the Project would represent a 0.201% increase in baseline mortality. Considering the more recent 2017 SMP population count of 124,462 breeding adults and an annual background mortality of 10,081 individuals per annum, the addition of five mortalities would represent a 0.045% increase in baseline mortality based on the latest SMP count. This level of increase is considered *de minimis* and indistinguishable from the natural fluctuations in the population.

10.4.6 **There is, therefore, no potential for an AEoI to the conservation objectives of the gannet features of the FFC SPA in relation to combined displacement and collision risk effects in the O&M phase from the Project alone and therefore, subject to natural change, this species will be maintained as features in the long-term.**

Scottish SPAs – Gannet

10.4.7 Gannet were assessed for both displacement and collision impacts during the post-breeding migratory season and the return migratory season at the Scottish SPAs listed in Table 10.8. Impacts resulting from displacement and collision are presented in Table 10.35 and Table 10.38 respectively. Impacts resulting from the combination of both these impacts on Scottish SPAs are presented in Table 10.41 below, on the basis that the predicted impact can be apportioned to each relevant SPA in line with the SPA colony counts within Furness (2015) (Appendix 7.1.4). The level of impact at all these Scottish SPAs is considered to be *de minimis* and would be indistinguishable from the natural fluctuations in populations.

10.4.8 **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature at all these SPAs in relation to combined collision and displacement consequent mortalities during the O&M phase from the project alone can be ruled out, subject to natural change, gannet will be maintained as a feature in the long-term.**

Table 10.41: Gannet combined displacement and collision mortalities at Scottish SPAs

Special Protection Area	Apportioned collisions	Displacement mortality (based on 70% displacement and 1% mortality)	Combined mortality	SPA citation population increase in baseline mortality rate (%)
Forth Islands (UK) SPA	0.2	0.5	0.7	0.020
Fair Isle SPA	0.0	0.0	0.0	0.023
Hermaness, Saxa, Vord and Valla Field SPA	0.1	0.2	0.3	0.011
Noss SPA	0.0	0.1	0.1	0.010

10.5 Migratory Fish

Assessment criteria

10.5.1 The approach taken to the assessment of migratory fish is based upon the following:

- The distance between the array boundary, ORCP search area and the relevant designated sites;
- Sensitivity of the receptors (including consideration of the vulnerability, recoverability, value and importance of the receptors);
- Magnitude of impact (drawing on the spatial extent of any interaction, the likelihood, duration, frequency and reversibility of a potential impact); and
- The effects screened in for LSE.

10.5.2 For the draft RIAA, the assessment of potential for adverse effect draws on the conclusions of Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology but specifically in the context of the designated fish features (or supporting habitats), in light of the relevant conservation objectives, site-based advice and feature condition.

Maximum Design Scenario

10.5.3 Table 10.42 below provides the Maximum Design Scenario(s) considered for fish and shellfish in relation to underwater noise impacts, as described in Table 4.7 within Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology. The full project description is provided in Part 6, Volume 1, Chapter 3: Project Description for full reference.

Table 10.42: Maximum design scenario for fish and shellfish ecology for the Project alone.

Potential effect	Maximum design scenario assessed	Justification
Construction		
Mortality, injury and behavioural changes resulting from underwater noise arising from construction activity.	<u>Array Area (temporal MDS for fleeing receptors):</u> ▪ 93 jacket foundations (5 m diameter, 4 piles per foundation) with a maximum of four foundations installed sequentially; ▪ Four offshore transformer substations (5 m diameter, 24 piles per foundation) ▪ One offshore accommodation platform (5 m diameter jacket foundation, 24 piles per foundation); ▪ Total of 516 pin piles ▪ Maximum hammer energy 3,500 kJ; ▪ Six-hour piling duration; ▪ 3,096 hours piling ▪ Maximum separation distance between piling events will be the maximum extent of the array area. <u>Array Area (spatial MDS for fleeing receptors):</u> ▪ 93 monopile foundations (13 m diameter) with a maximum of two foundations installed sequentially; ▪ Four offshore transformer substations on monopile foundations (14 m diameter) ▪ One offshore accommodation platform (14 m diameter monopile); ▪ Total installation of 99 monopiles ▪ Maximum hammer energy 6,600 kJ; ▪ Eight-hour piling duration; ▪ 792 hours piling; ▪ Maximum separation distance between piling events will be the maximum extent of the array area.	For the array area, the temporal MDS results from the sequential piling of up to four jacket foundations for 93 WTGs, four OSS and one accommodation platform using 3,500 kJ hammer energy. Total of 3,240 hours of piling across the whole project within a seven-year construction window. This scenario would result in the largest spatial noise impact at any given time, and the longest duration of piling. The spatial MDS for fleeing receptors results from the piling of monopiles for 93 WTGs and four OSSs, using 6,600 KJ hammer energy. This would result in the largest spatial noise impact at any given

Potential effect	Maximum design scenario assessed	Justification
	ECC - ORCP Search Area (spatial MDS): ▪ Two ORCPs on 14 m diameter monopile foundations; ▪ Maximum hammer energy 5,000 kJ; ▪ Eight-hour piling duration per pile; ▪ 16 hours piling. ECC – ORCP Search Area (temporal MDS): ▪ Two ORCPs on piled jacket (small OSS) foundations (six legs per jacket and four 5 m diameter pin piles per leg) – 48 pin piles; ▪ Six-hour piling duration per pile; ▪ 288 hours piling UXO Clearance: ▪ Max charge size: 800kg + donor	time when considering impacts to fleeing receptors.
O&M		
Underwater noise as a result of operational turbines.	Underwater noise during the operational phase from 93 WTGs and maintenance vessel operations over the design lifetime of the project (i.e., anticipated to be approximately 35 years).	Maximum number of operational WTGs and related O&M visits by vessels during the lifetime of the project.
Decommissioning		
Mortality, injury and behavioural changes resulting from underwater noise arising from decommissioning activity.	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 1m below the seabed	This would result in the maximum potential disturbance associated with noise associated with decommissioning activities including foundation decommissioning.

Description of significance

10.5.4 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.

10.5.5 As described in Table 8.1, there are two sites which have the potential for LSE for migratory fish features, the Humber Estuary SAC and the River Derwent SAC. The sites are discussed below in relation to the potential for LSE from underwater noise from construction, operation and maintenance, and decommissioning of the Project.

Construction and decommissioning

Underwater noise

10.5.6 This section addresses the potential for AEoI from effects associated with underwater noise impacts arising from foundations installation during the construction phase and the decommissioning of foundations within the array area and the ECC.

10.5.7 The potential for an AEoI as a result of underwater noise on migratory fish relates to the following designated sites and the relevant features (i.e. those features screened in for potential LSE):

- Humber Estuary SAC:
  - Sea lamprey (*Petromyzon marinus*), (qualifying feature but not a primary reason for site selection); and
  - River lamprey (*Lampetra fluviatilis*) (qualifying feature but not a primary reason for site selection).
- River Derwent SAC:
  - River lamprey (*Lampetra fluviatilis*) (primary reason for selection of the site).

10.5.8 The conservation objectives of the Humber Estuary SAC 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.

10.5.9 The conservation objectives for the River Derwent SAC 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 supporting processes on which the feature and/or its supporting habitat relies;
  - the extent and distribution of the supporting habitat;

- the supporting processes on which the feature and/or its supporting habitat relies;
- the structure/ function of the supporting habitat; and
- the population of the qualifying species within the site.

10.5.10 The Screening Report (Outer Dowsing Offshore Wind, 2022) 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 the 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. Therefore the main focus of this assessment is in relation to the potential for effects during the construction phase of the Project only.

10.5.11 There are a number of sources of underwater noise associated with the Project alone during construction, with these identified within Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology. General construction noise (including that arising from vessel movements, dredging and seabed preparation works) has been screened out of the assessment, as it will generate low levels of continuous sounds (i.e., from the vessels themselves and/or the sounds from dredging tools) throughout the construction phase. The study area around the Project as defined for PEIR is subject to relatively high levels of shipping activity currently, and it is expected that the vessel activity would be no greater than the baseline during construction activities (due to construction exclusion zones reducing current shipping activity and the number of construction vessels expected to be much lower than that which currently transit the area). The underwater noise impacts from vessel noise are generally spatially limited to the immediate area around the vessel rather than having impacts over a wide area (e.g., Mitson, 1993). All general construction noise (including that arising from vessel movements, dredging and seabed preparation works) is considered to have a much smaller impact range than that of the piling and UXO noise considered below. Therefore, due to the high baseline activity and tolerance of receptors, these noise sources are screened out. The sources screened in for potential LSE here (in line with Section 8 of the current report) being:

- Underwater noise from percussive piling within the array area and the ORCP Search Area and decommissioning works;
- Underwater noise during UXO clearance; and
- Underwater noise from operational turbines

10.5.12 The approach taken by this draft RIAA is to assess these effects individually, with a conclusion of the effect from underwater noise drawn based on these effects. The importance of underwater noise for migratory fish is discussed in Part 6, Volume 1, Chapter 10: Fish and Shellfish and Volume 2, Annex 3.2: Underwater noise assessment. 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 migratory fish, is drawn on here in the context of the conservation objectives for each of the relevant designated sites. Each of these effects are discussed in turn below, including the relevance for the features identified.

Project level underwater noise

10.5.13 Underwater noise during construction of the Project has been studied specifically through the following, including that of direct relevance to migratory fish:

- Part 6, Volume 1, Chapter 10: Fish and Shellfish; and
- Part 6, Volume 2, Appendix 3.2: Underwater Noise Report.

10.5.14 Volume 2, Appendix 3.2: Underwater Noise Report provides the technical evidence base for underwater noise, with Volume 1, Chapter 10: Fish and Shellfish providing the context for migratory fish, in relation to the potential for effects from underwater noise. Underwater noise can potentially have a negative impact on fish species ranging from physical injury/mortality to behavioural impacts to masking of communication. In general, biological damage as a result of underwater noise is either related to a large pressure change (barotrauma) or to the total quantity of sound energy received by a receptor. Barotrauma injury can result from exposure to a high intensity sound even if the sound is of short duration (i.e. UXO clearance or a single strike of a piling hammer). However, when considering injury due to the energy of an exposure, the duration of the exposure and total energy received by the receptor becomes important. Fish are also considered to be sensitive to the particle motion element of underwater noise.

10.5.15 Fish receptors can be grouped into the Popper *et al.,* (2014) categories (see Volume 2, Appendix 3.2: Underwater Noise Report.) based on their hearing system:

- Group 1: Fish with no swim bladder or other gas chamber–- which include sea and river lamprey and are sensitive only to particle motion and show sensitivity only to a narrow band of frequencies.
- Group 2: Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume–- which includes salmonids, such as Atlantic salmon, and are more sensitive to particle motion than sound pressure.
- Group 3: Fish in which hearing involves a swim bladder or other gas volume–- e.g. clupeids such as shad species are primarily sensitive to sound pressure, although they also detect particle motion (Hawkins and Popper, 2016).

10.5.16 It is worth noting that the only species considered in this assessment (sea and river lamprey) are classed as a Group 1 receptors (Popper *et al.,* 2014). The extent to which intense underwater sound might cause an adverse environmental impact in a particular fish species is dependent upon the level of sound pressure or particle motion, its frequency, duration and/or repetition (Hastings and Popper, 2005). The range of potential effects from intense sound sources, such as pile driving and explosions, includes immediate death, permanent or temporary tissue damage and hearing loss, behavioural changes and masking effects (Popper *et al.,* 2014). Tissue damage can result in eventual death or may make the fish less fit until healing occurs, resulting in lower survival rates. Hearing loss can also lower fitness until hearing recovers. Specifically, when considering migratory fish features such as sea and river lamprey, underwater noise can cause barriers to migration, and therefore due consideration to this impact is given in this assessment.

10.5.17 The potential for mortality or mortal injury is likely to only occur in close proximity to the sound source, although for impact piling the risk of this occurring will be reduced by use of soft start techniques at the start of the piling sequence (Table 7.1). This means that fish near to piling operations will likely move outside of the impact range, before noise levels reach a level likely to cause irreversible injury. There is also a potential for mortality or mortal injury from UXO detonations, although it is worth noting that the Applicant is not currently intending to apply for consent for UXO clearance works as part of the DCO application (as at this stage it is not clear if it will be required, or indeed if required to what extent and location, and a separate Marine Licence will be sought for such works once these factors have been established). With that said, it is anticipated that ADDs would be used prior to a UXO detonation (to be determined in the UXO-specific MMMP as part of the Marine Licence application). The reaction of free-swimming fish to ADDs is unknown and based on anecdotal evidence from UXO campaigns where records have been made of fish floating at the surface after an explosion, it is possible that some fish will experience these mortality and injurious impacts.

10.5.18 Recoverable injury is defined as a survivable injury with full recovery occurring after exposure, although decreased fitness during this recovery period may result in increased susceptibility to predation or disease (Popper *et al.,* 2014). The impact ranges for recoverable injury and mortality/potential mortal injury are more or less the same due to the thresholds used. The impact thresholds for Group 1 species (including both sea and river lamprey) are presented in Table 10.24:.

10.5.19 Temporary threshold shift (TTS) is a temporary reduction in hearing sensitivity caused by exposure to intense sound. TTS results from temporary changes in sensory hair cells of the inner ear and/or damage to auditory nerves. However, sensory hair cells are constantly added to fish and are replaced when damaged and therefore the extent of TTS is of variable duration and magnitude, with no potential for this to lead to permanent effects. Normal hearing ability returns following cessation of the noise causing TTS. When experiencing TTS, fish may have decreased fitness due to a reduced ability to communicate, detect predators or prey, and/or assess their environment. Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology presents the ranges at which TTS in fish may occur as a result of piling operations during the Project construction phase. There are no available thresholds for TTS effects from other noise sources, however, any impacts are likely to be localised, and for single sound sources such as that from UXO explosions, effects are likely to be within that from cumulative piling exposure.

10.5.20 Behavioural effects in response to construction related underwater noise include a wide variety of responses including startle responses (C-turn), strong avoidance behaviour, changes in swimming or schooling behaviour, or changes of position in the water column (e.g. Hawkins *et al.,* 2014). Depending on the strength of the response and the duration of the impact, there is the potential for some of these responses to lead to significant effects at an individual level (e.g. reduced fitness, increased susceptibility to predation) or at a population level (e.g. avoidance or delayed migration to key spawning grounds). There are no quantitative thresholds advised for behavioural impacts assessment, however, Popper *et al.*, (2014) provide qualitative behavioural criteria for fish from a range of sources. These categorise the risks of effects in relative terms as ''high, moderate or low'' at three distances from the source: near (10s of metres), intermediate (100s of metres), and far (1000s of metres), respectively.

Table 10.43. Impact threshold criteria from Popper *et al*. (2014).

Impact threshold noise level (dB re. 1µPa sound pressure level (SPL)/dB re. 1 µPa^{2}s sound exposure level (SEL))			
	Mortality and potential injury	Recoverable injury	TTS
Group 1	219dB SEL_{cum} 213dB SPL_{peak}	216dB SEL_{cum} 213dB SPL_{peak}	>>186dB SEL_{cum}

10.5.21 Table 10.44 and Table 10.45 below summarise the maximum predicted impact ranges for mortality and potential mortal injury, recoverable injury and TTS from piing activities in the array area and the ORCP search area within the ECC. The impact ranges from piling within the array area and the ORCP search area are also presented in Figure 10.3 UXO detonations are considered to have a low likelihood of triggering a population level effect, due to the limited temporal footprint that would arise from UXO operations, therefore effects are likely to be no greater than those from cumulative piling exposure. Behavioural impacts are discussed qualitatively below with respect to each species.

Table 10.44. Noise modelling results for injury ranges for fleeing receptors from the sequential piling of WTG foundations in the array area

Criteria	Noise Level (dB re 1µPa Sound Exposure Level (SEL)/dB re 1µPa^2 Sound Exposure Level (SEL))	Monopile Foundation Impact Ranges			Jacket Foundation Impact Ranges		
		Northwest	Northeast	Southwest	Northwest	Northeast	Southwest
Mortality and Potentially Mortal Injury							
SPL_{peak}	213	100m	110m	80m	90m	100m	70m
SEL_{cum} (fleeing)	219	<100m	<100m	<100m	<100m	<100m	<100m
Recoverable Injury							
SPL_{peak}	213	100m	110m	80m	90m	100m	70m
SEL_{cum} (fleeing)	216	<100m	<100m	<100m	<100m	<100m	<100m
TTS							
SEL_{cum} (fleeing)	186	6.8km	10km	4.8km	5.4km	8.4km	3.4km

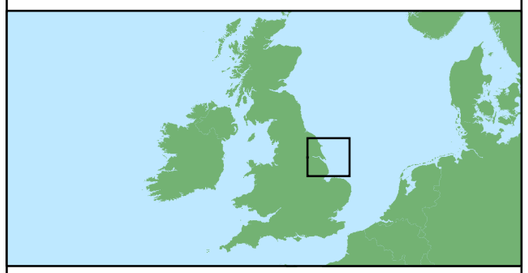
Table 10.45: Noise modelling results for injury ranges for fleeing receptors from the single and sequential piling of ORCP foundations in the ECC

Criteria	Noise Level (dB re 1µPA Sound Exposure Level (SEL)/dB re 1µPA^2 Sound Exposure Level (SEL))	Monopile Foundations		Jacket Foundations			
		Single piling at the NE and SW locations		Single piling at the NE and SW locations		Sequential piling of four pin piles at the NE and SW locations	
		NE	SW	NE	SW	NE	SW
Mortality and Potentially Mortal Injury							
SPL_{peak}	213	80	70	70	60	70	60
SEL_{cum} (fleeing)	219	<100m	<100m	<100m	<100m	<100m	<100m
Recoverable Injury							
SPL_{peak}	213	80	70	70	60	70	60
SEL_{cum} (fleeing)	216	<100m	<100m	<100m	<100m	<100m	<100m
TTS							
SEL_{cum} (fleeing)	186	5.8km	1.9km	4.0km	1.1km	4.0km	1.1km

250000
300000
350000
400000
6000000
5950000
5900000
N
River Derwent
Humber Estuary

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Special Areas of Conservation
- Monopile Foundations, Single Piling (6,600 kJ)
- Monopile Foundations, Sequential Piling (6,600 kJ)



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:550,000

Underwater Noise Impact Ranges from Piling within the Array Area and ECC relative to the Humber Estuary SAC and the River Derwent SAC

Figure 10.3

OUTER DOWSING OFFSHORE WIND

Date: 09/05/2023
Produced By: BPHB
Revision: 0.1

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Underwater noise from piling within the array area and ECC ORCP search area

10.5.22 As summarised in Table 10.44, the maximum design scenario in relation to underwater noise impacts from piling of foundations within the array area, when considering the worst case impacts on migratory fish species is the following:

- The sequential piling of monopiles foundations within the array area (two piles per 24 hours).

10.5.23 As summarised in Table 10.45 the maximum design scenario in relation to underwater noise impacts from piling of foundations within ORCP search area, when considering the worst case impacts on migratory fish species is the following:

- The piling of monopile foundations within the ORCP search area (one pile per 24 hours).

Consideration of sea lamprey and river lamprey

10.5.24 The Humber Estuary, to the north of the study area, is known to host several key diadromous species. Specifically, river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus)* are known to migrate through the Humber estuary to freshwater spawning habitats within tributaries that flow into the estuary. The River Derwent SAC which flows into the Humber Estuary is designated for river lamprey as a primary reason for the selection of the site, and sea lamprey which are present as a qualifying feature, but not the primary reason for site selection. The Humber Estuary SAC also has both sea and river lamprey present as a qualifying features, but not as a primary reasons for site selection.

10.5.25 Sea lamprey is classed as a Group 1 species (Popper *et al.,* 2014), Group 1 species lack a swim bladder and are therefore considered less sensitive to underwater noise (than other species). Sea lampreys are of mobile nature and are therefore able to flee from noise disturbance. Sea lamprey are also considered transient receptors across the Project during migration. Sea lamprey are widely distributed species when out of the natal rivers and have been found within shallow coastal waters and deep offshore waters (Maitland, 2003). Sea lamprey are not thought to specifically migrate back to their natal rivers (Bergstedt and Seelye, 1995; Waldman *et al.,* 2008); instead, they are thought to return to rivers within the regional area, navigating primarily by detection of larval pheromones to identify suitable rivers (i.e. those with pre-existing larvae) (reviewed in Hansen *et al.,* 2016). This flexibility in homing behaviour of this anadromous fish, combined with the low sensitivity of this species to underwater noise suggests that noise effects would only have a very localised effect.

10.5.26 Based on their low vulnerability to noise impacts, and their transient nature across the site during migration, sea lamprey are expected to recover quickly, returning to normal behaviours, and recolonising areas shortly after disturbance. Taking this into account, the receptors are deemed to be of low vulnerability, high recoverability and are of national importance. The sensitivity of these receptors to underwater noise impacts is therefore considered to be low.

10.5.27 River lamprey is classed as a Group 1 species (Popper et al., 2014), without a swim bladder and are, therefore, considered less sensitive to underwater noise (than other species). River lampreys are of mobile nature and are considered transient across the Project during migration and are therefore able to flee from noise disturbance. River lamprey typically remain within estuarine environments during their adult life stages (Maitland, 2003) and therefore are unlikely to be present close to any noisy activities from the Project, within no potential barrier to migration from noise between the fish and the river. Based on their low vulnerability to noise impacts, and their mobile nature, these receptors are expected to recover quickly, returning to normal behaviours, and recolonising areas shortly after disturbance. Taking this into account, the receptors are deemed to be of low vulnerability, high recoverability and are of national importance. The sensitivity of these receptors to underwater noise impacts is therefore considered to be low.

10.5.28 Given the nature of noise effects and the transient nature of sea lamprey and river lamprey across the Project during migration, it is anticipated that sea lamprey and river lamprey would display a fleeing response to noise, and therefore will experience less exposure to underwater noise. In the context of the assessment, fleeing receptors are anticipated to flee from the source at a consistent rate of 1.5 ms^{-1}. Based on the worst case scenarios for underwater noise from piling of foundations within the array area, which results from the sequential piling of monopile foundations, injurious effects on fleeing fish receptors will only occur in the immediate vicinity (<100m) of the piling activity. TTS effects have the potential to occur up to 10 km from the array area (Figure 10.3). Taking into consideration the distance of the array area from the Humber Estuary SAC (53.1 km), and the River Derwent SAC (130km) there are not anticipated to be any effects from underwater noise on the sea lamprey and river lamprey features within the designated sites.

10.5.29 Based on the worst case piling scenario for underwater noise from the piling of ORCP foundations within the ECC, which results from the piling of monopile foundations, injurious effects on fleeing fish receptors will only occur in the immediate vicinity (<100m) of the piling activity. TTS effects have the potential to occur up to 5.8 km from the ORCP search area (Figure 10.3). Taking into consideration the distance of the ORCP search area from the Humber Estuary SAC (14.4km) and the River Derwent SAC (100km), there are not anticipated to be any effects from underwater noise on the sea lamprey or river lamprey features within the designated sites.

10.5.30 As defined above, there are no quantitative thresholds advised to be used to assess behavioural impacts, however, Popper et al., (2014) provide qualitative behavioural criteria for fish from a range of sources. When considering these criteria, the risk of behavioural effects or auditory masking for sea lamprey and river lamprey is low and within the immediate field (100s of meters). Near field impacts are considered likely to be contained within the TTS effects described above. Therefore, there are not considered to be any significantly behavioural impacts on sea or river lamprey.

10.5.31 Considering the localised nature of underwater noise from piling within the array area and the ORCP search area, and the transient nature of the migratory receptors and the low sensitivity of the receptors to underwater noise, there will be no direct impacts from underwater noise from piling activities on migratory fish features within the designated sites, and consequently no barriers to migratory behaviours. Any impacts from underwater noise from piling activities on sea and river lamprey within the vicinity of the array area that may be attributed as features of the designated sites will be of localised nature, with no population level effects anticipated.

10.5.32 As stated in paragraph 10.5.10, the potential for effects during decommissioning will likely 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. Therefore, there are no adverse effects on migratory fish features of the Humber Estuary SAC or the River Derwent SAC anticipated to occur during the decommissioning phase of the Project.

10.5.33 Due to the transient nature of sea lamprey and river lamprey across the site, the low sensitivity of the features, and the localised impact ranges from underwater noise it is considered that there is**, therefore, no AEoI to the sea lamprey and river lamprey features of the Humber Estuary SAC and River Derwent SAC from the Project alone during construction and decommissioning and therefore, subject to natural change, the population of sea lamprey will be maintained in the long-term with respect to underwater noise from construction and decommissioning within the array area and ECC.**

Underwater noise from UXO clearance

10.5.34 Prior to the start of construction UXO investigation works will be required which may require clearance of UXO through in-situ detonation, resulting in the emission of underwater noise. The Applicant is not currently intending to apply for consent for UXO clearance works as part of this DCO application (as at this stage it is not clear if it will be required, or indeed if required to what extent and location, and a separate Marine Licence will be sought for such works once these factors have been established). However, it is acknowledged that such UXO clearance could occur and therefore, it is appropriate to consider the potential impacts of this additional source of underwater noise on migratory fish receptors. 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 within the pre-construction phase (broadly 2026), with the proposed date for piling being 2027 - 2029. Therefore, the earliest any such clearance may occur is anticipated to be in 2026.

10.5.35 Consideration of impacts from UXO is made on a risk of injury basis and a disturbance element. Part 6, Volume 1, Chapter 10: Fish and Shellfish considers that UXO clearance activities are one of the loudest anthropogenic noise sources that occur underwater, with source levels that can be higher than those from piling (depending on the methodology used). UXO clearance has the potential to result in mortality, potential mortal injury, recoverable injury, TTS and disturbance to fish and shellfish species, depending on the proximity of the individuals to the UXO location and the size of the UXO. Small scale mortality of fish as a result of UXO detonation are evidenced (Dahl *et al.,* 2020), with dead fish recorded floating at the surface following detonation, typically within the immediate vicinity of the detonation and as such this is expected to be a localised impact. However, recoverable injury and disturbance effects will impact a progressively larger area, with TTS and behavioural effects potentially occurring 10's of kilometres from the UXO location.

10.5.36 Due to the potential impacts from underwater noise from UXO clearance, bubble curtains are on occasion used to mitigate the noise from high-order UXO clearance works thereby reducing the sound level received by marine animals (specifically marine mammal species) from the detonation. Additionally, deflagration or "low order" detonation clearance methods may sometimes be used. Evidence to date (e.g., Cheong *et al.,* 2020) suggests these methods give rise to a much quieter, standard source level (regardless of UXO charge size, with the sound level emitted only relating to the donor charge size) which may result in reduced impacts on the marine environment.

10.5.37 Section 4.7 of Part 6, Volume 1, Chapter 10: Fish and Shellfish concluded that while individual UXO detonations have the potential to result in impact ranges comparable to piling events (as described above) the short-term (seconds) and discrete nature of a UXO detonation is considered to result in a lesser effect. This is because UXO detonation is a discrete event, and while this may result in some temporary disturbance to migratory fish, it is unlikely to result in any significant disturbance compared to more continuous noise sources such as piling that may occur intermittently over a longer period. Furthermore, river lamprey and sea lamprey are considered transient receptors across the site during migration, and are considered to be able to flee from noise disturbance, and consequently will have less exposure to underwater noise. Taking the above into consideration, there are not anticipated to be any impacts on sea lamprey or river lamprey within the Humber Estuary SAC or the River Derwent SAC. Furthermore, there are not anticipated to be any population level effects on sea lamprey or river lamprey outside of the Humber Estuary SAC and River Derwent SAC that may be attributed as features of the designated sites.

10.5.38 Therefore, based on the transitory nature of sea and river lamprey, short-term and spatially limited nature of the impact, and the separate UXO Marine Licence application with subsequent assessments, it is concluded that **there is no AEoI to the sea lamprey or river lamprey for the Humber Estuary SAC and River Derwent SAC from the Project alone during construction and decommissioning and therefore, subject to natural change, the populations of sea and river lamprey will be maintained in the long-term with respect to underwater noise associated with UXO clearance.**

Operation &Maintenance

Underwater noise from operational WTGs

10.5.39 The potential for an AEoI as a result of underwater noise on migratory fish during O&M relates to the following designated sites and relevant features (i.e. those features screened in for potential LSE):

- Humber Estuary SAC:
  - Sea lamprey (*Petromyzon marinus*), (qualifying feature but not a primary reason for site selection); and
  - River lamprey (*Lampetra fluviatilis*) (qualifying feature but not a primary reason for site selection).
- River Derwent SAC:
  - River lamprey (*Lampetra fluviatilis*) (primary reason for selection of the site).

10.5.40 The conservation objectives at the Humber Estuary SAC and the River Derwent SAC are listed in paragraph 10.5.8 *et seq*.

10.5.41 Operational WTGs will produce underwater noise as a result of vibration from the rotating machinery in the turbines, which is transmitted through the structure of the pile and foundations. The MMO (2014) review of post-consent monitoring at OWFs found that available data on the operational WTG noise, from the UK and abroad, in general showed that noise levels from operational WTGs are low and the spatial extent of the potential impact of the operational WTG noise on marine receptors is generally estimated to be small. This is supported by several published studies which provide evidence that while detectable, behavioural and/or physiological (stress) responses are restricted to very-close ranges (Thomsen *et al.,* 2006).

10.5.42 The potential for operational noise to affect migratory fish is noted in Part 6, Volume 1, Chapter 10: Fish and Shellfish, where it is concluded that there is no significant effect on fish receptors. Specifically, it is considered that the source of noise from an operational turbine mainly originates from the gearbox and the generator, and has tonal characteristics (Madsen *et al.,* 2005; Tougaard *et al.,* 2009). The radiated levels are low and the spatial extent of the potential impact of the operational windfarm noise on marine receptors is generally estimated to be small and thus unlikely to result in any injurious effects on fish. Previous studies show that behavioural responses of fish are only likely to occur at close ranges from the turbine, (i.e., a few metres) (Wahlberg and Westerberg, 2005).

10.5.43 There is evidence to suggest that fish species are unlikely to show significant avoidance to the noise levels generated by turbines, with the presence of continuous noise that is not significantly above the hearing threshold of fish not thought to cause any significant movement of fish away from the source (Mitson, 1993). Studies of very low frequency sound have indicated that consistent deterrence from the source is only likely to occur at particle accelerations equivalent to a free-field sound pressure level of 160dB re 1µPa (RMS) (Sand *et al.,* 2001). This is higher than the noise levels reported in the open literature for operational windfarms measured at a number of ranges, all within a few hundred metres of the turbine (Edwards *et al.,* 2007; see also Wahlberg and Westerberg, 2005 and Madsen *et al.,* 2006).

10.5.44 The particle acceleration resulting from an operational wind turbine has also been measured by Sigray *et al.,* (2011) with the resultant levels being considered too low to be of concern for behavioural reactions from fish. Furthermore, the particle acceleration levels measured at 10m from the turbine were comparable with hearing thresholds. Whilst limited, the available data provides an indicator that operational wind turbines are unlikely to result in disturbance of fish except within very close proximity of the turbine structure, as postulated by Wahlberg and Westerberg (2005). However, the available measurement data is mostly for smaller turbines (up to 1.5MW), and it would be expected that larger wind turbines would result in different acoustic characteristics, with foundation type also having an influence on the acoustic characteristics of the noise radiated from the structure.

10.5.45 Noise would also result from surface vessels servicing the windfarm. However, noise levels reported by Malme *et al*. (1989) and Richardson *et al*. (1995) for large surface vessels indicate that physiological damage to Group 1 fish, such as sea and river lamprey, is unlikely due to their low sensitivity. Considering the operational turbine noise of the windfarm and any associated service vessels, the ambient noise levels within the site would be expected to be lower than those present in the vicinity of nearby shipping lanes.

10.5.46 With respect to the potential for disturbance to result in displacement of individuals, and given existing evidence which demonstrates the migratory fish are not displaced from offshore windfarms 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.

10.5.47 As regards the conservation objectives for the Humber Estuary SAC and River Derwent SAC it is considered that while the noise generated is long-term and continuous throughout the lifetime of the Project, the potential effects are negligible (especially in comparison to the construction phase effects). Furthermore, considering the distance of the array area from the Humber Estuary SAC and the River Derwent SAC and the localised nature of the impact, there will be no direct impacts from operation noise from turbines on migratory fish features within the designated sites. Any impacts from underwater noise from operational turbines on sea and river lamprey within the vicinity of the array area that may be attributed as features of the designated sites will be of a very small scale nature with negligible population level effects. The risk of effects to sea lamprey and river lamprey at these sites is therefore negligible and there is no adverse effect on the extent, distribution, structure and function of the species, structure and function of the supporting habitats and processes, and the population and distribution of the species within the site. Therefore, it is concluded that there is **no AEoI to the sea lamprey or river lamprey for the Humber Estuary SAC and River Derwent SAC from the Project alone and therefore, subject to natural change, the populations of sea and river lamprey will be maintained in the long-term with respect to underwater noise associated with the O&M phase.**

10.6 Onshore Ecology

Assessment criteria

10.6.1 At the time of writing, the baseline for onshore birds has not been fully characterised and therefore for some species, sufficient information to determine the importance of populations which may be present within the Study Area is not available. Such valuations will be informed by data generated during further surveys, such as breeding birds and a second season of non-breeding bird surveys, and will be presented within a subsequent version of the RIAA.

10.6.2 Winter bird surveys were completed at the end of March 2023 and there has been very limited time to include the results from those surveys in the RIAA. The methods and results are presented in PEIR Volume 2, Appendix 22.3, however only an initial analysis of the dataset has been undertaken due to the time constraints and therefore the assessment presented herein is preliminary and indicative, with further analysis and assessment to be undertaken at a later stage.

10.6.3 The Maximum Design Scenario (MDS) for onshore infrastructure is detailed in Table 10.45.

Table 10-45: Maximum Design Scenario for Onshore Ecology from the Project Alone

Potential effect	Maximum design scenario assessed	Justification
Construction		
Damage to international designated sites	There are no SPAs, Ramsars or SACs within the onshore ECC boundary, however, the Greater Wash SPA is located immediately adjacent to the onshore PEIR boundary at the Landfall and includes the inter-tidal zone. The route may affect areas that are functionally linked to designated sites. Construction activities may also have indirect impacts on the designated sites e.g. alterations in hydrological conditions, pollution or air quality impacts.	Parameters are based on those stated within the Onshore Project Description (6.1.3). The MDS includes the maximum development footprint (temporary and permanent) and therefore the largest possible area of damage and disturbance to ecological receptors. It also assumes use of the technologies likely to cause most damage where the technology to be used is still uncertain, e.g. trenched crossing of smaller watercourses.
Permanent habitat loss	Permanent habitat loss associated with the onshore ECC (not including the OnSS) is limited to the transition joint bays (TJBs). Permanent loss of habitat due to the construction footprint of the substation. The following assumptions have been made: ▪ Maximum of one substation; ▪ Indicative permanent site area for substation of 18 ha (up to the permanent fencing); and ▪ Indicative temporary working area for construction of substation of up to 27 ha.	
Temporary habitat loss AND Pollution of waterbodies and watercourses, especially via suspended solids	Currently, the onshore ECC is an approximately 300 m wide cable corridor. Following consultation on the PEIR, it is the intention to select an onshore ECC that is approximately 80 m wide (located within the current 300 m corridor), informed by ongoing assessment work, consultee feedback and advancement of project design. Where trenchless techniques such as HDD are used along the ECC the width will need to increase to approximately 120 m. The number of trenchless crossings, and the area of temporary habitat loss, are unknown at this stage and will be confirmed in a subsequent update of the RIAA.	

Potential effect	Maximum design scenario assessed	Justification
	Trenching and the associated c. 80 m (or 120m) construction corridor will result in temporary habitat loss along the onshore ECC. Temporary construction compounds (TCCs) and access roads will also result in temporary habitat loss. TCCs at the chosen substation zone may also be required and would result in temporary habitat loss. The duration of temporary habitat loss is habitat, location and species specific. The construction period is expected to last for up to 36 months. Post-construction, it may last for a maximum period of five years; this being the approximate duration for recovery of a hedgerow or drainage ditch to ecological function for use by most species. The majority of the habitat loss within the PEIR boundary will be temporary, occurring only during construction, with permanent habitat loss largely limited to the footprint of the OnSS. Habitats will be reinstated on completion of works. The TJBs and JBs will largely be restored, with some manhole cover type access retained. Trenchless crossing techniques are required for the landfall, larger surface watercourses, key roads, railways and some utilities crossings. Construction compounds would be located at each end of the crossing, requiring an associated compound with permeable surfacing. Trenched crossing of smaller watercourses, which may result in hydrological changes, is assumed for this assessment.	
Disturbance to birds and otter	The potential exists for qualifying interest or Annex 1 species to be impacted by disturbance via noise, human presence and presence of plant and machinery.	

Potential effect	Maximum design scenario assessed	Justification
Air quality impacts on all ecological receptors	Effects from air quality are largely associated with nutrient nitrogen deposition caused by construction traffic and equipment. The assessment will focus on areas within and close to the construction zone, temporary site compounds and along access roads where the Critical Load could exceed 1%.	
Operation and Maintenance		
Disturbance of birds and otter during planned and unplanned maintenance works when the proposed development is operational.	Planned maintenance of the ECC requires visits to cable joint pits. Planned maintenance at the substation is likely to be highly localised with a minimal likelihood of disturbance expected to the adjacent habitats and species. Unplanned maintenance may involve the repair of onshore cable faults. This is extremely rare (indicatively one-two events during the life of the Project). Typically, this involves excavating the two adjacent joint bays, pulling the cable back through the ducting and pulling a new cable through. Alternatively, the area of the fault may be excavated, and two new joints installed within this area. Methods for excavation and reburial will be similar to the original installation. For unplanned major maintenance, vehicles similar to those used for construction may also be required (rigid lorries delivering materials, low loaders delivering plant and individual vehicles for personnel). In the event of a transformer replacement or failure, an AIL similar to that used during construction would be required. Any unplanned corrective maintenance required would be subject to any necessary consents and consultation with the relevant nature conservation bodies at the time.	Parameters are based on those stated within the Onshore Project Description (6.1.3).
Decommissioning		
Impacts during decommissioning are likely to be similar to construction, but	Removal of the substation including areas of hardstanding. Buried cables would be de-energized with the ends sealed and left in place to avoid ground disturbance.	The MDS includes the maximum footprint and therefore the largest possible area of

Potential effect	Maximum design scenario assessed	Justification
more limited in geographical extent and timescale and there would be no permanent habitat loss.	Transition Joint Bays to be left in place.	disturbance to ecological receptors.

10.6.4 The onshore PEIR boundary is shown in Figure 1.1.

Information on European sites

10.6.5 Following the Screening exercise, LSE could not be excluded for the following designated sites: Humber Estuary SPA, Ramsar and SAC, The Wash SPA and Ramsar, The Wash and North Norfolk Coast SAC, Gibraltar Point SPA and Ramsar, Satltfeeltby to Theddlethorpe Dunes and Gibraltar Point SAC and Greater Wash SPA. The broad conservation objectives for these sites are provided below.

10.6.6 The conservation objectives for the Wash and North Norfolk Coast and Humber Estuary SACs are:

- 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 qualifying species;
  - The structure and function (including typical species) of qualifying natural habitats;
  - The structure and function of the habitats of 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.

10.6.7 The conservation objectives for the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC only include the following three points:

- 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 the qualifying natural habitats;
  - The structure and function (including typical species) of the qualifying natural habitats; and
  - The supporting processes on which the qualifying natural habitats rely.

10.6.8 The conservation objectives for the SPAs are generic:

- 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.

10.6.9 For The Wash and Humber Estuary SPAs, Natural England has published Supplementary Advice on Conservation Objectives (SACO) (Natural England, 2023), which provide a series of 'attributes' and 'targets' for each qualifying feature, which underpin the conservation objectives. These have been used to determine the conservation condition for the relevant features and to inform the assessment of potential connectivity between the Project and the designated sites and therefore which features require further assessment. It is not appropriate at this stage to undertake a detailed assessment of the implications for each attribute and target for each designated site, as that will be done in a subsequent draft, once the Project design details have been refined (particularly areas of habitat loss and locations for construction infrastructure such as HDD pits and construction compounds). The assessment is therefore indicative at this stage and confirmation of the assessment of adverse effect on integrity (AEoI) will be provided once the design has been refined.

10.6.10 For the other European sites where supplementary information was not available, no 'restore' or 'maintain' objectives were available. In order to determine the conservation condition of the qualifying features of the relevant SPAs and Ramsar sites, and therefore whether the objective is to maintain or restore the feature, the citation populations were compared against the most recently available population estimates for the designated sites, and are presented for each relevant qualifying feature. Population size is only one of a series of attributes which define conservation condition. The use of population size alone is therefore a proxy. This is considered adequate because populations size is determined by the other attributes and the Project is outside any of the designated sites. Understanding the conservation condition, and the relevant conservation objective, enables an assessment of whether there would be an adverse effect on the integrity of the relevant designated sites, which would occur should any of the conservation objectives be undermined.

Feature 1: Avocet

Distribution and Abundance

Project Site

10.6.11 The winter bird survey (see PEIR document: 6:1:22.3) yielded one record of avocet from within the survey area, comprising a group of five birds on 20 March 2023 at Anderby Marsh. These may be passage birds or birds prospecting for nest sites. [redacted] There are also breeding records from [redacted], which is at the edge of the 100m buffer but the suitable habitat is >300m from the PEIR boundary. Whilst the desk study records are generally at low resolution, no further records of breeding avocet are thought to be from areas within 100m of the PEIR boundary. Breeding bird surveys have not yet been undertaken to confirm the breeding population and distribution in relation to the PEIR boundary. The assessment will be updated once those surveys are complete.

10.6.12 The single count of avocet at Anderby Marsh is equivalent to 0.2% of the most recent non-breeding population estimate for the Humber Estuary SPA.

Designated Sites

10.6.13 Avocet is a non-breeding and breeding qualifying feature of the Humber Estuary SPA. The non-breeding population was estimated to be 59 individuals at designation (1996/97-2000/01, from Natural England Designated Sites View) and the most recently available five-year average from British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) counts for the Humber Estuary is 2,479 individuals (Frost *et al.,* 2021). For the attribute 'abundance' the target is to "Maintain the size of the non-breeding population at a level which is above 1,213 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

10.6.14 The breeding population of the Humber Estuary SPA was estimated to be 64 pairs at the time of designation (1998/2002 data). For the attribute 'abundance' the target is to "Maintain the size of the breeding population at a level which is above 233 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

10.6.15 The Humber Estuary SSSI citation states "breeding avocets were first recorded here in 1992. The numbers of avocets in particular have increased substantially in recent years". The five-year mean for Great Britain (GB) for the period 2015–2019 reported by the Rare Breeding Birds Panel (RBBP) was 2,138 pairs, an increase of more than 300% in the 25 years to 2019 (Eaton *et al.,* 2021).

Connectivity

10.6.16 The attributes that define conservation condition are provided in the Natural England SACO (Natural England webpage, 2023). Winter core commuting distances are unclear. Given the distance between the Humber Estuary and the Project, and the small numbers recorded at the Project site, there would be no pathways for direct impacts on the non-breeding avocet within the designated site. The Humber Estuary non-breeding population is in favourable condition and the maintenance of the supporting habitats listed in the targets would not be directly affected by the Project.

10.6.17 Breeding avocet forage between 0.3-5.9 km from nest sites mainly during the daytime (Enners *et al.,* 2019). The Humber Estuary is located 10.7 km from the PEIR boundary at the closest point. Breeding avocet of the Humber Estuary SPA are therefore only considered for potential hydrological and water quality impacts and potential effects on a possible supporting population. This is because the Humber Estuary SPA breeding colonies are too distant from the PEIR boundary to be affected by disturbance or habitat loss when at the colonies and the PEIR boundary is located beyond their foraging range.

10.6.18 Breeding avocet at [redacted] (and elsewhere within the breeding bird survey area to be confirmed following completion of surveys in 2023) could be a supporting population for the Humber Estuary SPA, through exchange of individuals. Avocet have been observed not to have high site fidelity (Lengyel, 2006), and therefore avocet fledged at [redacted] could go on to breed at the Humber Estuary SPA.

Feature 2: Golden Plover

Distribution and Abundance

Project Site

10.6.19 There were four, nine, 25 and 72 observations of golden plover from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 950 individuals. Observations were of birds feeding and loafing within fields across the survey area.

10.6.20 Golden plover breeds in the uplands in Britain (i.e. the Project is located outside of the breeding range).

Designated Sites

10.6.21 Golden plover is a non-breeding qualifying feature of Humber Estuary SPA and Ramsar and The Wash Ramsar. Table 10.46 details the population estimates for the designated sites and their conservation status.

Table 10.46: Population data and conservation status for golden plover

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Humber Estuary SPA	30,709	31,237	51	Y	"Maintain the size of the non-breeding population at a level which is above 30,709 wintering individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	3.09%	3.04%
Humber Estuary Ramsar	30,709	31,237	51	Y	Maintain	3.09%	3.04%
The Wash Ramsar	22,033	15,212	-6,821	N	Restore	4.31%	6.25%

Connectivity

10.6.22 Patterns of golden plover movements and occupancy outside of the breeding season can be complex, especially in response to cold weather, as described in Gillings & Fuller 1999. Given the close proximity of The Wash to parts of the onshore ECC however, golden plovers recorded utilising farmland habitats within the winter bird survey area are very likely to be connected with The Wash non-breeding population. The Humber Estuary is 10.7 km away from the onshore ECC at the closest point, and may also have connectivity with the golden plover population utilising farmland within the zone of influence of the Project.

Feature 3: Lapwing

Distribution and Abundance

Project Site

10.6.23 There were zero, 20, 72 and 190 observations of lapwing within from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 2,500 individuals.

10.6.24 Lapwing is a widespread breeding species in Great Britain.

10.6.25 Breeding bird surveys of the onshore PEIR Boundary will be undertaken in 2023 to determine the population and distribution of breeding lapwing within the onshore zone of influence of the Project.

Designated Sites

10.6.26 Lapwing is a non-breeding qualifying feature of The Wash Ramsar. Table 10.47 details the population estimates for the designated sites and their conservation status.

Table 10.47: Population data and conservation status for lapwing

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash Ramsar	46,422	12,976	-33,446	N	Restore	5.39%	19.27%

Connectivity

10.6.27 Lapwing utilises lowland farmland and estuarine habitats in winter and given the proximity of The Wash to the onshore PEIR boundary, it is considered that the non-breeding lapwings occurring within the onshore zone of influence of the Project will be connected with The Wash Ramsar population.

10.6.28 Patterns of lapwing movements and occupancy outside of the breeding season can be complex, especially in response to cold weather, as described in Gillings & Fuller 1999. Some GB breeding lapwings are sedentary and stay within the same region following breeding, some migrate to winter elsewhere within GB, however some migrate to Ireland and others to France or Spain. Therefore, a large proportion of the breeding population within the zone of influence of the Project is likely to winter further afield than The Wash, although some of the population is likely to spend at least part of the non-breeding season within The Wash.

Feature 4: Curlew

Distribution and Abundance

Project Site

10.6.29 There were 17, 30, 95 and 194 observations of curlew from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 77 individuals.

10.6.30 Curlew is a widespread breeding species in GB.

Designated Sites

Curlew is a non-breeding qualifying feature of The Wash SPA and Ramsar.

10.6.31 details the population estimates for the designated sites and their conservation status.

Table 10.48: Population data and conservation status for curlew

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	3,700	6,061	2,361	Y	"Maintain the size of the non-breeding population to a level which is above 3,700 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	2.08%	1.27%
The Wash Ramsar (passage)	9,438	No information	-	-	-	0.82%	-

Connectivity

10.6.32 Curlew utilises estuarine habitats and nearby farmland in winter and given the proximity of The Wash to the onshore PEIR boundary, it is considered that the non-breeding curlews occurring within the onshore zone of influence of the Project will be connected with The Wash SPA and Ramsar.

10.6.33 Most British breeding curlews migrate south-west and hence any breeding population within the zone of influence of the project is unlikely to be a supporting population for The Wash SPA and Ramsar non-breeding populations.

Feature 5: Oystercatcher

Distribution and Abundance

Project Site

10.6.34 There were 15, 17, 35 and two observations of oystercatcher within from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 23 individuals.

10.6.35 Oystercatcher is a widespread breeding species in GB.

Designated Sites

10.6.36 Oystercatcher is a non-breeding qualifying feature of The Wash SPA and Ramsar. Table 10.49 details the population estimates for the designated sites and their conservation status.

Table 10.49: Population data and conservation status for oystercatcher

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	24,000	22,175	-1,825	N	"Restore the size of the non-breeding population at a level which is above 24,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.1%	0.1%
The Wash Ramsar	15,616	22,175	6,559	Y	Maintain	0.15%	0.1%

Connectivity

10.6.37 Oystercatchers utilise estuarine habitats and nearby farmland in winter and given the proximity of The Wash to the onshore PEIR boundary, it is considered that the non-breeding oystercatcher occurring within the onshore zone of influence of the Project will be connected with The Wash SPA and Ramsar.

10.6.38 Some breeding oystercatchers are resident whereas others migrate, so any breeding population at the Project site could act as a supporting population for The Wash SPA and Ramsar non-breeding populations.

Feature 6: Redshank

Distribution and Abundance

Project Site

10.6.39 There were two, six, 28 and 24 observations of redshank from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 35 individuals. The records were clustered at the River Welland, The Haven and Anderby Marsh.

10.6.40 The species breeds in saltmarshes, freshwater marsh and wet grasslands in the lowlands.

Designated sites

10.6.41 Redshank is a non-breeding qualifying feature of The Wash SPA and Ramsar, and Humber Estuary SPA and Ramsar and a passage feature of the Humber Estuary Ramsar. Table 10.50 details the population estimates for the designated sites and their conservation status.

Table 10.50: Population data and conservation status for redshank

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	4,331	5,087	756	Y	"Maintain the size of the population at a level which is above 4,331 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.8%	0.69%
The Wash Ramsar	6,373	5,087	-1,286	N	Restore	0.55%	0.69%
Humber Estuary SPA	4,632	2,881	-1,751	N	"Restore the size of the non-breeding population to a level which is at or above 4,632 wintering individuals and 7,462 individuals during passage, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.76%	1.21%
Humber Estuary Ramsar (winter)	4,632	2,881	-1,751	N	Restore	0.76%	1.21%

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Humber Estuary Ramsar (passage)	7,462	No information				0.47%	-

Connectivity

10.6.42 Given the proximity to The Wash and the potential for inter-change between sites during the non-breeding season, there is potential connectivity between the non-breeding redshank recorded within the survey area and the designated sites listed above. Breeding populations in the south of Britain tend to be more sedentary, whereas northerly populations are more migratory. Therefore, any breeding population within the onshore zone of influence of the Project may be a supporting population (but not a qualifying population) of The Wash and Humber Estuaries.

Feature 7: Dunlin

Distribution and Abundance

Project Site

10.6.43 There were five, nine, ten and zero observations of dunlin from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 46 individuals. Nine records were from the Landfall, in the inter-tidal area and within Anderby Marsh, with one from The Haven.

10.6.44 The species breeds in upland areas in GB (i.e. breeding range does not encompass the Project site).

Designated Sites

10.6.45 Dunlin is a non-breeding qualifying feature of The Wash SPA and Ramsar, and Humber Estuary SPA and Ramsar and a passage feature of the Humber Estuary Ramsar. Table 10.51 details the population estimates for the designated sites and their conservation status.

Table 10.51: Population data and conservation status for dunlin

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	29,000	26,150	-2,850	N	"Restore the size of the non-breeding population at a level which is above 29,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.16%	0.18%
The Wash Ramsar	36,600	26,150	-10,450	N	Restore	0.13%	0.18%
Humber Estuary SPA	22,222	15,954	-6,268	N	"Restore the size of the non-breeding population to a level which is above 22,222 wintering individuals and 20,269 individuals during passage, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.2%	0.29%
Humber Estuary Ramsar (winter)	22,222	15,954	-6,268	N	Restore	0.2%	0.29%

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Humber Estuary Ramsar (passage)	20,269	No information	-	-	-	0.23%	-

Connectivity

10.6.46 Given the close proximity of The Wash to parts of the onshore PEIR Boundary, dunlins recorded within the winter bird survey area are very likely to be connected with The Wash non-breeding population. The Humber Estuary is 10.7 km away from the onshore ECC at the closest point, and may also have connectivity with the dunlin population utilising areas within the onshore zone of influence of the Project.

Feature 8: Sanderling

Distribution and Abundance

Project Site

10.6.47 There were 29, 28, 28 and zero observations of sanderling from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak count of 19 individuals. All records were from the beach at the Landfall.

10.6.48 The species is a non-breeding bird in GB.

Designated Sites

10.6.49 Sanderling is a non-breeding qualifying feature of The Wash SPA and Ramsar, and Gibraltar Point SPA and Ramsar. Table 10.52 details the population estimates for the designates sites and their conservation status.

Table 10.52: Population data and conservation status for sanderling

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	500	10,079	9,579	Y	"Maintain the size of the population at a level which is above 500 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	3.8%	0.19%
The Wash Ramsar	3,505	10,079	6,574	Y	Maintain	0.54%	0.19%
Gibraltar Point Ramsar	971	No information	-26% (from Woodward et al 2019 – medium term change; long term is positive)	N	Restore	1.96%	-
Gibraltar Point SPA	1,140	No information	-26% (from Woodward et al 2019 – medium term change; long term is positive)	N	Restore	1.67%	-

Connectivity

10.6.50 The sanderlings recorded within the survey area may be connected with The Wash and Gibraltar Point SPA and Ramsar sites given the proximity.

Feature 9: Ruff

Distribution and Abundance

Project Site

10.6.51 Winter bird surveys in 2022/23 recorded ruff on three occasions, with flocks of 11, 31 and 39 birds in October, November and March. Each of these records was of birds using habitats located >400m away from the PEIR boundary. There were no records of ruff utilising land from within the PEIR boundary plus 400m buffer, with a single record of two birds in flight.

10.6.52 Ruff is a very rare breeding bird in GB, occurring at a very small number of sites, and is not expected to breed within the zone of influence of the Project.

Designated sites

10.6.53 Ruff is a non-breeding qualifying feature of the Humber Estuary SPA. The non-breeding population was estimated to be 128 individuals at designation (1996-2000, from Natural England Designated Sites View) and the most recently available five-year average from BTO WeBS counts for the Humber Estuary is 80 individuals (Frost *et al.,* 2021). Natural England SACO states in relation to attribute 'abundance' that the target is to "Restore the size of the non-breeding population to a level which is above 128 individuals during passage, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

Connectivity

10.6.54 Based on the absence of records of ruff from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is no connectivity between the Project site and the Humber Estuary SPA in relation to non-breeding ruff. The important areas for Ruff in and around the Humber Estuary, as detailed within the Natural England Conservation Advice (Natural England webpage, 2023) would not be impacted by the Project. Ruff is a very rare breeding bird in the UK and not considered likely to breed within the zone of influence of the Project. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 10: Bar-tailed Godwit

Distribution and Abundance

Project Site

10.6.55 No observations of bar-tailed godwit were recorded during the extensive winter bird surveys in 2022-23. It is a non-breeding species in GB.

Designated sites

10.6.56 Bar-tailed godwit is a non-breeding qualifying feature of The Wash SPA and Ramsar, Gibraltar Point SPA, and Humber Estuary SPA and Ramsar. Table 10.53 details the population estimates for the designated sites and their conservation status.

Table 10.53: Population data and conservation status for bar-tailed godwit

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	7,396	17,509	10,113	Y	"Maintain the size of the population at a level which is above 8,200 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0	0
The Wash Ramsar	16,546	17,509	963	Y	Maintain	0	0
Gibraltar Point SPA	8,800	Unavailable	71% long-term increase (Woodward et al., 2019)	Y	Maintain	0	0
Gibraltar Point Ramsar	3,468	Not available	71% long-term increase (Woodward et al., 2019)	Y	Maintain	0	0
Humber Estuary SPA	2,752	1,561	-1,191	N	"Restore the size of the non-breeding population to a level which is above 2,752, whilst avoiding deterioration from its current level as indicated by	0	0

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
					the latest mean peak count or equivalent".		
Humber Estuary Ramsar	2,752	1,561	-1,191	N	Restore	0	0

Connectivity

10.6.57 Based on the absence of records of bar-tailed godwit from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is no current connectivity between the Project site and the SPA and Ramsar sites listed above in relation to non-breeding bar-tailed godwit. The important areas for bar-tailed godwit in and around the Humber Estuary (which has a restore objective) as detailed within the Natural England Conservation Advice (Natural England webpage, 2023), would not be impacted by the Project. The Wash and Gibraltar Point populations are in favourable condition and the maintenance of the supporting habitats listed in the targets would not be affected by the Project. This species is a non-breeding bird in the UK. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 11: Black-tailed Godwit

Distribution and Abundance

Project Site

10.6.58 There were only two observations of black-tailed godwit within the PEIR boundary plus 400m survey area during the winter 2022-23 bird surveys, with a peak count of 16 individuals. Both records were of feeding birds at The Haven, in December and January. The species is primarily a non-breeding bird in GB, with a few regular breeding sites in England, mainly in East Anglia, and does not breed within the zone of influence of the project.

Designated Sites

10.6.59 Black-tailed godwit is a non-breeding qualifying feature of The Wash SPA and Ramsar, Gibraltar Point SPA, and Humber Estuary SPA and Ramsar. Table 10.54 details the population estimates for the designates sites and their conservation status.

Table 10.54: Population data and conservation status for black-tailed godwit

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	260	8,597	8,337	Y	"Maintain the size of the non-breeding population at a level which is above 260 individuals whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	6%	0.18%
The Wash Ramsar	6,849	8,597	1,748	Y	Maintain	0.2%	0.18%
Humber Estuary SPA	1,113	4,545	3,432	Y	"Maintain the size of the non-breeding population at a level which is above 2951, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	1.4%	0.35%
Humber Estuary Ramsar (winter)	1,113	4,545	3,432	Y	Maintain	1.4%	0.35%

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Humber Estuary Ramsar (passage)	915	Not available	-	-	-	0% (recorded during core winter only)	-

Connectivity

10.6.60 Based on the low number of observations and low abundance of black-tailed godwit from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible current connectivity between the Project site and the relevant SPA and Ramsar sites in relation to non-breeding black-tailed godwit. The designated sites populations are in favourable condition and the maintenance of the supporting habitats listed in the target would not be affected by the Project. The species is primarily a non-breeding bird in GB and therefore there will not be a potentially supporting breeding population within the ZoI of the Project. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 12: Knot

Distribution and Abundance

Project Site

10.6.61 No observations of knots were recorded during the extensive winter bird surveys conducted in winter 2022-23. It is a non-breeding species in GB.

Designated Sites

10.6.62 Knot is a non-breeding qualifying feature of The Wash SPA and Ramsar, and Humber Estuary SPA and Ramsar and a passage feature of the Humber Estuary Ramsar. Table 10.55 details the population estimates for the designated sites and their conservation status.

Table 10.55: Population data and conservation status for knot

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	75,000	188,838	113,838	Y	"Maintain the size of the non-breeding population at a level which is above 75,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0	0
The Wash Ramsar	68,978	188,838	113,838	Y	Maintain	0	0
Humber Estuary SPA	28,165	22,500	-5,665	N	"Maintain the size of the non-breeding population at a level which is above 18,500 individuals on passage and 28,165 wintering individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0	0

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Humber Estuary Ramsar	28,165	22,500	-5,665	N	Restore	0	0
Humber Estuary Ramsar (passage)	18,500	N/A	Unknown	-	-	0	0

Connectivity

10.6.63 Based on the absence of records of knot from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is no connectivity between the Project site and the relevant SPA and Ramsar sites in relation to non-breeding and passage knot. The maintenance or restoration of the habitats listed in the targets would not be affected by the Project. This species is a non-breeding bird in the UK. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 13: Turnstone

Distribution and Abundance

Project Site

10.6.64 There was a single observation of turnstone, of two individuals, during the extensive winter bird surveys undertaken in winter 2022-23. The species does not normally breed in GB.

Designated Sites

10.6.65 Turnstone is a non-breeding qualifying feature of The Wash SPA. Table 10.56 details the population estimates for the designated site and conservation status.

Table 10.56: Population data and conservation status for turnstone

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	980	755	-224	N	"Restore the size of the population at a level which is above 980 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.2%	-

Connectivity

10.6.66 Based on a single observation of turnstone of two birds from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible current or past connectivity between the Project site and The Wash SPA in relation to non-breeding turnstone. Potential supporting habitats for The Wash SPA turnstone population are listed as: salt-marsh and other inter-tidal habitats (Natural England webpage, 2023). Such habitats are scarce within the ZoI of the Project (onshore) and therefore past connectivity is also likely to be negligible. This species is a non-breeding bird in the UK. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 14: Ringed Plover

Distribution and Abundance

Project Site

10.6.67 There were only six records of ringed plover during the extensive winter bird surveys in winter 2022-23, with a peak count of four individuals. The landfall area is considered unsuitable for breeding due to recreational disturbance along the beach.

Designated Sites

10.6.68 Ringed plover is a non-breeding qualifying feature of The Wash Ramsar. Table 10.57 details the population estimates for the designated site and conservation status.

Table 10.57: Population data and conservation status for ringed plover

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash Ramsar	1,500	1,315	-185	N	Restore	0.3%	0.3%

Connectivity

10.6.69 Based on the low number of observations and very low abundance of ringed plover from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible current connectivity between the Project site and The Wash Ramsar in relation to non-breeding ringed plover. Habitats within the ZoI of the Project are considered to be of low suitability for non-breeding ringed plover and therefore past connectivity is also concluded to be negligible. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 15: Grey Plover

Distribution and Abundance

Project Site

10.6.70 There were nine observations of grey plover within the onshore PEIR boundary plus 400m survey area during the winter 2022-23 bird surveys, with a peak count of seven individuals. Three records were from The Haven and three records from the Landfall. The species is a non-breeding bird in GB.

Designated Sites

10.6.71 Grey plover is a non-breeding qualifying feature of The Wash SPA and Ramsar, and Gibraltar Point SPA and Ramsar. Table 10.58 details the population estimates for the designated sites and their conservation status.

Table 10.58: Population data and conservation status for grey plover

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	5,500	8,313	2,813	Y	"Maintain the size of the non-breeding population at a level which is above 5,500 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.13%	0.08%
The Wash Ramsar	13,129	8,313	-4,816	N	Restore	0.05%	0.08%
Gibraltar Point Ramsar	2,793	No information	-50% (from Woodward et al 2019)	N	Restore	0.25%	-
Gibraltar Point SPA	3,980	No information	-50% (from Woodward et al 2019)	N	Restore	0.18%	-

Connectivity

10.6.72 Based on the low number of observations and low abundance of grey plover from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the Project site and the relevant SPA and Ramsar sites in relation to non-breeding grey plover. The Wash SPA population is in favourable condition and the maintenance of the supporting habitats listed in the targets would not be directly affected by the Project. Potential supporting habitats for the other designated sites listed in Table 10.58 are scarce within the ZoI of the Project and therefore past connectivity is also likely to be negligible. The areas of suitable habitat within the ZoI of the Project are considered not to be important to the maintenance of The Wash SPA population or restoration of the other designated sites populations. It is a non-breeding bird in GB. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 16: Bewick's Swan

Distribution and Abundance

Project Site

10.6.73 There were no records of Bewick's swan during the extensive winter bird surveys in winter 2022-23. It is a non-breeding species in GB.

Designated Sites

10.6.74 Bewick's swan is a non-breeding qualifying feature of The Wash SPA. Table 10.59 details the population estimates for the designated site and conservation status.

Table 10.59: Population data and conservation status for Bewick's swan

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	130	4	-126	N	"Restore the size of the population to a level which is above 130 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0	0

Connectivity

10.6.75 Based on the absence of observations of Bewick's swan from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the Project site and the Wash SPA in relation to non-breeding Bewick's swan. The Natural England Marine Site Details lists potential supporting habitats as: freshwater and coastal grazing marsh and the water column. Those habitats are scarce within the ZoI of the Project (onshore) and therefore past connectivity is also likely to be negligible. It is a non-breeding bird in GB. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 17: Dark-bellied Brent Goose

Distribution and Abundance

Project Site

10.6.76 There were two, two, 19 and zero observations of dark-bellied brent goose from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022-23 bird surveys, with a peak count of 1,100 individuals. Thirteen observations were from The Haven and adjacent fields, mainly of feeding birds. There were also three flights recorded offshore.

10.6.77 Dark-bellied brent goose is a non-breeding bird in GB.

Designated Sites

10.6.78 Dark-bellied brent goose is a non-breeding qualifying feature of The Wash SPA and Ramsar and Gibraltar Point Ramsar. Table 10.60 details the population estimates for the designated sites and their conservation status.

Table 10.60: Population data and conservation status for dark-bellied brent goose

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	17,000	11,221	-5,779	Y – Maintain objective	"Maintain the size of the non-breeding population at a level which is above 17,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	6.47%	9.8%
The Wash Ramsar	20,861	11,221	-9,460	N	Restore	5.27%	9.8%
Gibraltar Point Ramsar	682	No information	-19% (from Woodward et al 2019, long-term change)	N	Restore	161%	-

Potential Connectivity

10.6.79 Brent geese typically commute up to 5km inland from roost sites to feed (McKay *et al.*, 2001). The Solent Waders and Brent Goose Strategy (SWBGS 2010) report that sites which are closer to the mean high-water mark are more likely to be used. Summers & Critchley (1990) recorded flights between roost and feeding sites of 8 +/- 2 km. The study by Rowell & Robinson (2004) documents a general pattern across the SPA suite in England of feeding on intertidal habitats in autumn (Sep-Nov), then moving inland to feed (Dec-Feb), before returning to estuarine areas in spring (Mar-May). The concentration of birds at The Haven are within and adjacent to the Wash SPA and Ramsar however there could be interchange with Gibraltar Point Ramsar.

Feature 18: Pink-footed Goose

Distribution and Abundance

Project Site

10.6.80 There were zero, six, 20 and 18 observations of pink-footed goose on the ground from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022-23 bird surveys, with a peak flock count of 610 individuals. Six observations, including the peak count, were from fields on the outskirts of Skegness. There were an additional four observations of birds in flight, three of which comprised of one-two birds offshore.

10.6.81 Pink-footed goose is a non-breeding bird in GB.

Designated Sites

10.6.82 Pink-footed goose is a non-breeding qualifying feature of The Wash SPA and Ramsar, and North Norfolk SPA and Ramsar. Table 10.61 details the population estimates for the designated sites and their conservation condition.

Table 10.61: Population data and conservation status for pink-footed goose

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation condition (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	7,300	34,300	+27,000	Y	"Maintain the size of the non-breeding population at a level which is above 7,300 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	8.35%	1.78%
The Wash Ramsar	29,099	34,300	+5,201	Y	Maintain	2.10%	1.78%
North Norfolk SPA	6,000	47,832	+41,832	Y	Maintain	10.17%	1.28%
North Norfolk Ramsar	9,576	47,832	+38,256	Y	Maintain	6.37%	1.28%

Potential Connectivity

10.6.83 Scottish Natural Heritage (now NatureScot) (2016) estimates the foraging range of pink-footed goose from night roosts to be a core range of 15-20km. The Wash SPA and Ramsar is located 0.1 km from the PEIR boundary at the closest point and hence is within the core foraging range. The North Norfolk SPA and Ramsar is 22 km from the PEIR boundary at the closest point and is outwith the core foraging range, however Natural England have advised that there have been observations in recent winters of birds commuting between the North Norfolk sites and Lincolnshire to feed, hence birds recorded within the survey area may also be associated with the North Norfolk SPA and Ramsar.

Feature 19: Gadwall

Distribution and Abundance

Project Site

10.6.84 There were zero, eight, eight and seven observations of gadwall from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022-23 bird surveys, with a peak flock count of 87 individuals. Five of the records were from Anderby Marsh and two from Wolla Bank Pit.

10.6.85 Gadwall is a widespread breeding species in England.

Designated Sites

10.6.86 Gadwall is a non-breeding qualifying feature of The Wash SPA. Table 10.62 details the population estimates for the designated sites and their conservation status.

Table 10.62: Population data and conservation status for gadwall

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	130	122	-8	Y – Maintain objective	"Maintain the size of the non-breeding population at a level which is above 130 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	66.9%	71.3%

Connectivity

10.6.87 Given the proximity of The Wash SPA, non-breeding gadwall recorded within the survey area could be connected to the designated site population. Some British breeding birds appear to be sedentary whereas others migrate to Europe in the autumn. Any breeding population within the zone of influence of the Project may therefore be connected with The Wash SPA non-breeding population.

Feature 20: Wigeon

Distribution and Abundance

Project Site

10.6.88 There were two, 12, 25 and three observations of wigeon from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 500 individuals. Ten observations were from Anderby Marsh, four from a waterbody near Rookery Farm and a single record on the sea.

10.6.89 Wigeon is a rare breeding bird in GB, typically restricted to the uplands and therefore not expected to breed within the zone of influence of the Project.

Designated Sites

10.6.90 Wigeon is a non-breeding qualifying feature of The Wash SPA. Table 10.63 details the population estimates for the designated sites and their conservation status.

Table 10.63: Population data and conservation status for wigeon

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	3,900	12,226	8,326	Y	"Maintain the size of the population at a level which is above 3,900 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	12.82%	4.09%

Connectivity

10.6.91 Given the proximity to The Wash SPA, wigeon recorded within the survey area are potentially connected to that designated site.

Feature 21: Shelduck

Distribution and Abundance

Project Site

10.6.92 There were one, six, eight and one observations of shelduck from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022-23 bird surveys, with a peak flock count of 15 individuals (otherwise between two to six individuals). Five records were from Anderby Marsh, in February and March, of roosting and loafing birds, with a single record near Lamming's Marsh Farm.

10.6.93 The species breeds around the coast of GB.

Designated Sites

10.6.94 Shelduck is a non-breeding qualifying feature of The Wash SPA. Table 10.64 details the population estimates for the designated sites and their conservation status.

Table 10.64: Population data and conservation status for shelduck

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	16,000	2,374	-13,626	N	"Restore the size of the population to a level which is above 16,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.09%	0.63%
The Wash Ramsar	9,746	2,374	-7,373	N	Restore	0.15%	0.63%
Humber Estuary SPA	4,464	4,515	51	Y	"Maintain the size of the non-breeding population at a level which is above 4464, whilst avoiding	0.34%	0.33%

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
					deterioration from its current level as indicated by the latest mean peak count or equivalent".		
Humber Estuary Ramsar	4,464	4,515	51	Y	Maintain	0.34%	0.33%

Connectivity

10.6.95 Based on the low number of observations and low abundance of shelduck from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the Project site and the relevant SPA and Ramsar sites in relation to non-breeding shelduck. The Humber Estuary populations are in favourable condition and the maintenance of the supporting habitats listed in the targets would not be directly affected by the Project. Potential supporting habitats for The Wash SPA shelduck population are listed as: salt-marsh, other inter-tidal habitats, coastal lagoons, freshwater and coastal grazing marsh and halophilous scrub (Natural England webpage, 2023). Such habitats are scarce within the ZoI of the Project and therefore past connectivity is also likely to be negligible. This species (non-breeding) is therefore only included for assessment of potential impacts from pollution and hydrological changes. Suitable breeding habitat for shelduck is likely to be restricted to the Landfall area, and therefore there is only likely to be a small breeding population, however that will be confirmed by breeding bird surveys in 2023.

Feature 22: Pintail

Distribution and Abundance

Project Site

10.6.96 There was a single observation of pintail within the PEIR boundary plus 400m survey area during the winter 2022-23 bird surveys, of two individuals. The record was approximately 200m offshore of the Landfall area. The species is a very rare breeding bird in GB.

Designated Sites

10.6.97 Pintail is a non-breeding qualifying feature of The Wash SPA. Table 10.65 details the population estimates for the designated sites and their conservation status.

Table 10.65: Population data and conservation status for pintail

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	1,700	376	-1,324	N	"Restore the size of the non-breeding population to a level which is above 1,700 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0.12%	0.53%

Connectivity

10.6.98 Based on the single observation and very low abundance of pintail from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the Project site and the Wash SPA in relation to pintail. Potential supporting habitats for The Wash SPA pintail population are listed as: salt-marsh, other inter-tidal habitats, coastal lagoons and freshwater and coastal grazing marsh (Natural England webpage, 2023). Such habitats are scarce within the ZoI of the Project and therefore past connectivity is also likely to be negligible. It is a very rare breeding bird in GB. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 23: Goldeneye

Distribution and Abundance

Project Site

10.6.99 There were no observations of goldeneye within the PEIR boundary plus 400m survey area during the winter 2022-23 bird surveys. The species is a very rare breeding bird in GB, largely restricted to the Scottish Highlands.

Designated Sites

10.6.100 Goldeneye is a non-breeding qualifying feature of The Wash SPA. Table 10.66 details the population estimates for the designated sites and their conservation status.

Table 10.66: Population data and conservation status for goldeneye

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	220	69	-151	N	"Restore the size of the non-breeding population at a level which is above 220 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	0%	0%

Connectivity

10.6.101 Based on the absence of observations of goldeneye from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the onshore Project site and The Wash SPA in relation to goldeneye. Potential supporting habitats for The Wash SPA goldeneye population are listed as: circalittoral rock, inter-tidal habitats, sub-tidal habitats, coastal lagoons and the water column (Natural England webpage, 2023). Such habitats are scarce within the ZoI of the Project (onshore) and therefore past connectivity is also likely to be negligible. The breeding population in the UK is largely restricted to Scotland. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature 24: Common scoter

Distribution and Abundance

Project Site

10.6.102 There were 12 observations of common scoter from the Landfall surveys and ten from the ECC surveys, during the winter 2022/23 bird surveys, with a peak count of 40 individuals. All records were offshore of the Landfall area, with five flocks feeding, four swimming and one loafing. All records were >350m offshore from MHWS, ranging to 590m offshore.

10.6.103 The species is a very rare breeding bird in the UK, restricted to northern Scotland.

Designated Sites

10.6.104 Common scoter is a non-breeding qualifying feature of The Wash SPA and Greater Wash SPA. Table 10.67 details the population estimates for the designated sites and their conservation status.

Table 10.67: Population data and conservation status for common scoter

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash SPA	830	1,195	364	Y	"Maintain the size of the population at a level which is above 830 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	4.82%	3.35%
Greater Wash SPA	3,449 (Mean of Peak)	Not available	-	Y	"Maintain the size of the non-breeding population at a level which is above 3,449, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	1.16%	-

Connectivity

10.6.105 The landfall survey area overlaps with the Greater Wash SPA and therefore common scoter recorded in the area offshore of the landfall are considered to be part of that designated site.

Feature 25: Eider

Distribution and Abundance

Project Site

10.6.106 There was a single record of eider during the extensive winter bird surveys in winter 2022-23, of a single individual. Habitats within the zone of influence of the Project are considered unsuitable for nesting eider.

Designated Sites

10.6.107 Eider is a non-breeding qualifying feature of The Wash Ramsar. Table 10.68 details the population estimates for the designated site and conservation status.

Table 10.68: Population data and conservation status for eider

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash Ramsar	1,109	1,049	-60	N	Restore	0.09%	0.09%

Connectivity

10.6.108 Based on the low number of observations and very low abundance of eider from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is negligible connectivity between the onshore Project site and The Wash Ramsar in relation to non-breeding eider. Potential supporting habitats for The Wash Ramsar eider population are scarce within the ZoI of the Project (onshore) and therefore past connectivity is also likely to be negligible. Habitats within the ZoI of the project are considered unsuitable for nesting eider. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature Group 26: Terns

Distribution and Abundance

Project Site

10.6.109 There were no observations of common tern, sandwich tern or little tern during the October 2022 to March 2023 winter bird surveys; these are migratory species, which over-winter in Africa. Terns are breeding birds in GB, with a small number of sandwich terns wintering around GB coasts.

10.6.110 Mitchell *et al*., 2004 indicates that breeding colonies of these three tern species in the vicinity of the Project are at:

- Little tern – Gibraltar Point.
- Sandwich tern – none in Lincolnshire.
- Common tern – none on the Lincolnshire coast. It is noted from Wilson *et al*., 2014 that there is a colony at Freiston Shore and a smaller colony at Frampton Marsh.

Designated Sites

10.6.111 Table 10.69 details the population estimates for the designated sites and their conservation status for sandwich tern, common tern and little tern.

Table 10.69: Population data and conservation status for breeding terns

Designated site	Citation population	Best current population estimate (breeding pairs)	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain		Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Little tern								
Greater Wash SPA	798 pairs (2009-2013)	568 confirmed pairs in Lincolnshire and Norfolk from 2017 (RBBP online)	903 confirmed pairs in 2013 in Lincolnshire and Norfolk (RBBP online), which suggests a decline	Y – Maintain objective	"Maintain the size of the breeding population at a level which is above 798 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	-	-	
Wash SPA	30 pairs		-	Y	"Maintain the size of the breeding population at a level which is above 30 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	-	-	

Designated site	Citation population	Best current population estimate (breeding pairs)	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
Gibraltar Point SPA	40 pairs	Not available. 11 pairs at Gib Point (Lincs Birds Report 2020)	-29	N	Restore	-	-
Humber Estuary SPA	51 pairs	Not available	-	-	"Restore the size of the breeding population to a level which is above 51 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	-	-
Sandwich tern							
Greater Wash SPA	3,852 pairs	Not available at this stage	-	Y	"Maintain the size of the breeding population at a level which is above 3,852 breeding pairs, whilst avoiding deterioration from its current level as	-	-

Designated site	Citation population	Best current population estimate (breeding pairs)	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
					indicated by the latest mean peak count or equivalent".		
Common tern							
Greater Wash SPA	510 pairs	Not available at this stage	-	Y	"Maintain the size of the breeding population at a level which is above 510 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".	-	-
Wash SPA	220 pairs	Not available at this stage	-	Y	"Maintain the size of the population at a level which is above 220 pairs whilst avoiding deterioration from its current level as indicated by the latest	-	-

Designated site	Citation population	Best current population estimate (breeding pairs)	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
					mean peak count or equivalent".		

Connectivity

10.6.112 Little tern and sandwich tern are almost exclusively marine species nesting close to the shore and feeding over the sea. Common tern will utilise marine habitats, but also breed inland at wetland sites and feed on lakes and rivers. All three species may therefore forage offshore of the Landfall area and common tern may utilise wetland habitats elsewhere within the ZoI of the onshore Project.

Feature 27: Black-headed Gull

Distribution and Abundance

Project Site

10.6.113 There were 46, 54, 98 and 29 observations of black-headed gull from the Landfall surveys and survey areas for the Lincolnshire Node ECC and OnSS, Weston Marsh South of the A52 and Weston Marsh North of the A52 (segments A1-A5 only) respectively, during the winter 2022/23 bird surveys, with a peak flock count of 137 individuals. Black-headed gull were widespread throughout the survey area, utilising agricultural fields, with a concentration of records, albeit in low numbers, at the beach and inter-tidal zone.

10.6.114 Black-headed gull is a widespread breeding species in Britain.

Designated Sites

10.6.115 Black-headed gull is a non-breeding qualifying feature of The Wash Ramsar. Table 10.70 details the population estimates for the designated sites and their conservation status.

Table 10.70: Population data and conservation status for black-headed gull

Designated site	Citation population	BTO WeBS count 15/16-19/20 for the relevant area	Population change	Favourable conservation status (Y/N)	Conservation objective restore or maintain	Survey peak count as a % of citation population	Survey peak count as a % of current WeBS population
The Wash Ramsar	31,403	14,541	-16,862	N	Restore	0.44%	0.94%

Connectivity

10.6.116 Black-headed gulls recorded within the survey area may be connected with the Wash Ramsar, given the proximity to the designated site. Most black-headed gulls stay in Britain over winter, although may range widely across the country, and therefore it is unlikely that any breeding colony within the ZoI of the Project would be a supporting population for The Wash Ramsar.

Feature 28: Bittern

Distribution and Abundance

Project Site

10.6.117 No records of bittern were obtained during the winter bird surveys at the Landfall or onshore ECC and OnSS in winter 2022-23. Desk study searches identified non-breeding records from Wolla Bank, Wolla Bank Pit and Wolla Bank Reedbed.

10.6.118 The desk study search also identified breeding season records from [redacted] but it is not stated whether these relate to non-breeding observations or breeding records. Breeding bird surveys will be conducted in 2023 to determine the distribution and population of breeding bittern within and adjacent to the PEIR boundary.

Designated Sites

10.6.119 Bittern is a non-breeding and breeding qualifying feature of the Humber Estuary SPA. The non-breeding population was estimated to be four individuals at designation (1996/97-2000/01, from Natural England Designated Sites View) and the most recently available five-year average from BTO WeBS counts for the Humber Estuary is two individuals (Frost et al., 2021). The Natural England target for attribute 'abundance' is to "Maintain the size of the non-breeding population at a level which is above four wintering individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

10.6.120 The breeding population was estimated to be two males at the time of designation (2000-02 data). The Natural England target for attribute 'abundance' is to "Maintain the size of the breeding population at a level which is at or above seven booming males, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

10.6.121 The GB breeding population has been rising consistently over the last ten years, with a new record total of 227 pairs counted in 2019 (Eaton *et al.,* 2021).

Connectivity

10.6.122 The average territory size of male bitterns in GB is 0.2 km^2 (RSPB Online [2023]). A radiotracking study found their median home-range sizes were 14.6, 19.3 and 33.1 ha during the booming, moult and winter periods respectively (Gilbert *et al*., 2005). The Humber Estuary is located 10.7 km from the PEIR boundary at the closest point and therefore the PEIR boundary is well outwith the core foraging range of bitterns from the Humber SPA. Combined with the absence of records of non-breeding bittern during the winter bird surveys, it is considered that connectivity is negligible and this non-breeding feature is therefore only assessed in relation to potential pollution and hydrological impacts. Breeding bird surveys are on-going and are required to determine whether there are any breeding bitterns within the ZoI of the onshore Project.

Feature 29: Marsh harrier

Distribution and abundance

Project Site

10.6.123 The desk study search identified records of marsh harrier during the breeding season from multiple locations within the 2 km search area, indicating that the species will likely be present as a breeding species within the zone of influence of the Project. Distribution and population data for breeding marsh harrier will be obtained through Schedule 1 bird surveys in 2023. Winter bird surveys recorded courtship behaviour of a pair of marsh harriers at the Landfall area in March 2023, as well as at Frampton Marsh just outwith the survey area.

10.6.124 Winter bird surveys recorded marsh harrier on 11 occasions, spread throughout the winter period. Five of these were from agricultural habitats and six were from the coastal strip (Anderby Marsh, Wolla Bank and Chapel Pit).

Designated sites

10.6.125 Marsh harrier is a breeding qualifying feature of the Humber Estuary SPA. The breeding population was estimated to be ten females at designation (1998-2002, from Natural England Designated Sites View). The Natural England target for attribute 'abundance' is to "Maintain the size of the non-breeding population at a level which is above 21 breeding females, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent". The GB population has increased since the 1970s from a low of one pair to a mean of just over 400 breeding pairs reported to the RBBP over the five years 2015–2019 (Eaton *et al.,* 2021).

Connectivity

10.6.126 Hardey *et al*. (2013) states that "In East Anglia, the home range of males varied with the stage of the breeding cycle from 569 ha during courtship to 1,407 ha during the post-fledging period (Underhill-Day, 1990). Males may hunt up to 7 km from their nesting territory. Females have smaller home ranges, but these increase in size when they start to feed young (from 100–1,300 ha)". The Humber Estuary is located 10.7 km from the PEIR boundary at the closest point and therefore the PEIR boundary is well outside the core foraging range of marsh harriers from the Humber SPA.

10.6.127 Breeding marsh harrier of the Humber Estuary SPA are only considered in relation to potential effects on a possible supporting population of breeding and non-breeding birds at the Project site. This is because the Humber Estuary SPA breeding sites are too distant from the PEIR boundary to be affected by disturbance or habitat loss and the PEIR boundary is located beyond their foraging range.

Feature 30: Hen harrier

Distribution and abundance

Project Site

10.6.128 There were three observations of hen harrier during the winter bird surveys in 2022-23, each of a single bird in flight, from November and December. These were however each from the inter-tidal habitats of The Wash located >1km from the PEIR boundary. There were no records obtained from within the winter birds survey area comprising the PEIR boundary plus 400m buffer. The desk study search identified some records of hen harrier from within the 2km search area, with limited details, but presumably sightings of non-breeding birds.

10.6.129 Hen harrier primarily breeds in the uplands in Britain, and is therefore not expected to be present as a breeding species within the ZoI of the Project.

Designated sites

10.6.130 Hen harrier is a non-breeding qualifying feature of the Humber Estuary SPA. The non-breeding population was estimated to be eight individuals at designation (1997/98-2001/02, from Natural England Designated Sites View). The Natural England target for attribute 'abundance' is to "Maintain the size of the non-breeding population at a level which is above eight wintering individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".

Connectivity

10.6.131 Based on the absence of records of hen harrier from within the winter birds survey area during extensive winter bird surveys in 2022-23, it is concluded that there is no connectivity between the Project site and the Humber Estuary SPA in relation to non-breeding hen harrier. Potential supporting habitats for The Humber Estuary SPA hen harrier population are listed as: saltmarsh, other inter-tidal habitats, coastal lagoons and reedbeds and freshwater and coastal grazing marsh (Natural England webpage, 2023). Such habitats are scarce within the ZoI of the Project (onshore) and therefore past connectivity is also likely to be negligible. Hen harrier is very unlikely to occur as a breeding species within the zone of influence of the Project. This species is therefore only included for assessment of potential impacts from pollution and hydrological changes.

Feature Group 31: Waterbird assemblage

Designated sites

Project Site

10.6.132 Table 10.71 details the population estimates for the waterbird assemblages for the designated sites and their conservation status.

Table 10.71: Population data and conservation status for waterbird assemblage

Designated site	Citation population	BTO WeBS alerts for waterbird assesmblages (Woodward et al., 2019)	BTO WeBS alerts for waterbird assemblages % change since baseline	Favourable conservation status (Y/N)	Conservation objective restore or maintain
Humber Estuary SPA	153,934	No alerts	-24%	N	"Restore the overall abundance of the assemblage to a level which is above 153,934 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent".
Humber Estuary Ramsar	153,934			N	Restore
The Wash SPA	203,829	No alerts	+359%	Y	"Maintain the overall abundance of the assemblage at a level which is above 214,000 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent".
The Wash Ramsar	292,541			Y	Maintain
Gibraltar Point Ramsar	53,072	No alerts	+92% (long term change)	Y	Maintain

Feature Group 32: Habitat features of designated sites

Table 10.72 lists the habitat features that were screened in for LSE.

Table 10.72: Conservation status of screened in habitat features

Habitat features	Designated sites	Favourable conservation status Y/N (from NE SSSI Condition of Features)	Conservation Objective Restore or Maintain
Dune systems and humid dune slacks.	Humber Estuary Ramsar	N	Restore
	Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC	Y	Maintain
Sandbanks which are slightly covered by sea water all the time; Sub-tidal sandbanks	Humber Estuary SAC	N	Restore The Natural England SACO indicates that all relevant attributes have a 'maintain' target.
	The Wash & North Norfolk Coast SAC	Y	Maintain
Estuaries	Humber Estuary SAC	Y	Maintain The Natural England SACO indicates that some attributes have a 'restore' target.
Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats	Humber Estuary SAC	Y	Maintain The Natural England SACO indicates that some attributes have a 'restore' target.
	The Wash & North Norfolk Coast SAC	N	Restore
Coastal lagoons	Humber Estuary SAC	Y	Maintain The Natural England SACO indicates that all relevant attributes have a 'maintain' target, other than to 'reduce aqueous contaminants'.

Habitat features	Designated sites	Favourable conservation status Y/N (from NE SSSI Condition of Features)	Conservation Objective Restore or Maintain
	The Wash & North Norfolk Coast SAC	Y	Maintain
Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	The Wash & North Norfolk Coast SAC	Y	Maintain
	Humber Estuary SAC	Y	Maintain The Natural England SACO indicates that some attributes have a 'restore' target.
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);	Humber Estuary SAC	N	Restore The Natural England SACO indicates that some attributes have a 'restore' target.
	The Wash & North Norfolk Coast SAC	Y	Maintain
Embryonic shifting dunes	Humber Estuary SAC	N	Restore The Natural England SACO indicates that some attributes have a 'restore' target.
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes); *Shifting dunes with marram*	Humber Estuary SAC	N	Restore The Natural England SACO indicates that some attributes have a 'restore' target.
	Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC	Y	Maintain
Fixed dunes with herbaceous vegetation (grey dunes); Dune grassland;	Humber Estuary SAC	N	Restore The Natural England SACO indicates that some attributes have a 'restore' target.

Habitat features	Designated sites	Favourable conservation status Y/N (from NE SSSI Condition of Features)	Conservation Objective Restore or Maintain
	Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC	Y	Maintain
Dunes with *Hippophae rhamnoides*; Dunes with sea-buckthorn.	Humber Estuary SAC	N	Restore The Natural England SACO indicates that all relevant attributes have a 'maintain' target, other than a 'restore' target for air quality.
	Saltfleetby-Theddlethorpe Dunes & Gibraltar Point SAC	Y	Maintain
Saltmarshes, major intertidal banks of sand and mud, shallow water, and deep channels; inter-relationship between saltmarshes, intertidal sand, mudflats, and estuarine waters;	The Wash Ramsar	Y	Maintain
Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*);	The Wash & North Norfolk Coast SAC	Y	Maintain

Feature Group 33: Red Data Book Invertebrates

10.6.133 The following red data book invertebrates which are a feature of the Gibraltar Point Ramsar site were screened in for LSE:

- *Haliplus mucronatus* (a water beetle, aquatic)
- *Brachytron pratense* (hairy dragonfly, aquatic)

10.6.134 No information on the conservation condition and therefore conservation objectives (restore or maintain) were identified.

Feature 34: Otter

10.6.135 Otter is a qualifying feature of The Wash and North Norfolk SAC but is not a primary reason for selection. No population is given in the site citation and the feature is not included in the marine condition assessment. No recent population estimate was identified. The Standard Data Form indicates that the 'degree of conservation' is 'average or reduced' indicating that it may be in unfavourable condition and therefore the conservation objective may be to restore the population. However, the date of this assessment is unclear. The otter population in the Anglian Region appears to be in favourable condition, as there were lots of new positive records in the 2009-10 survey and fewer sites which were positive in 2000-02 and negative in 2009-10 (Environment Agency, 2010).

10.6.136 A total of 18 records of otter were returned by GLNP within the Lincolnshire Node Study Area, two of which were located within the PEIR boundary. A total of 59 records were returned of otter within the Study Area for the Weston Marsh ECC south of the A52 and 108 from within the Study Area for the Weston Marsh ECC north of the A52. Of these, 12 were from within the PEIR boundary for the Weston Marsh ECC south of the A52 and 13 from within the PEIR boundary for the Weston Marsh ECC north of the A52 .

10.6.137 Otters are likely to utilise the pond and ditch network present within the area, particularly during the amphibian breeding season when frog, toad and newt prey would be abundant.

10.6.138 An assessment of potential otter habitat within the PEIR Boundary and within ponds and watercourses 250 m upstream/downstream of the PEIR Boundary is currently ongoing. Further otter surveys will be undertaken for those watercourses offering suitable habitat for otter. The results of otter surveys undertaken will be provided in an otter survey report at the ES stage. Given the proximity of The Wash and North Norfolk SAC, it is likely that otters utilising areas within the ZoI of the onshore Project will be connected with the designated site population.

Construction and Decommissioning

Pathway 1 - Habitat Loss

10.6.139 There will be no habitat loss from the Humber Estuary SPA, or any other SPA, SAC or Ramsar site within the onshore zone of the Project (i.e. above MHWS). The majority of the habitat loss within the PEIR boundary will be temporary, occurring only during construction, with permanent habitat loss largely limited to the footprint of the OnSS (indicative permanent site area of 18 ha). Construction will occur for up to 36 months, and habitats will be reinstated on completion of works. The TJBs and JBs will largely be restored, with some manhole cover type access retained. The working corridor will be contained within the PEIR boundary and is expected to be 80m wide. At the decommissioning stage it is currently planned to leave the onshore cables in the ground.

Feature 1: Avocet

Implication for Conservation Objectives Unmitigated

10.6.140 Habitats at the three potential substation locations appear unsuitable for use by breeding avocet and no breeding records were identified through the desk study from those areas. [redacted], the cable will be installed using trenchless techniques and therefore there would be no habitat loss at [redacted], where avocet may breed. Elsewhere along the onshore ECC, habitats are unsuitable for breeding avocet and there have been no further desk study records of breeding avocet potentially within the PEIR boundary.

10.6.141 For breeding avocet of the Humber Estuary SPA, the SACO targets relevant to habitat loss are:

- "Maintain the size of the breeding population at a level which is above 233 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent".
- "Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised".
- "Restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) to: an unspecified extent, based on restoring natural estuarine functioning".

Integrity Test (Alone) – Unmitigated

10.6.142 The national avocet breeding population has increased by 300% over the past 25 years (Eaton *et al*., 2019). Given the relatively small area of permanent habitat loss, the largely arable habitats present, the small number of avocet recorded within the PEIR boundary plus 400m, and the favourable condition of the avocet population, temporary and permanent habitat loss would:

- not reduce the breeding population below its current level;
- not affect the management or protection of habitat for avocet; and
- not affect the restoration of intertidal sand and mudflats, coastal lagoons and saltmarsh habitats.

10.6.143 Habitat loss would therefore not undermine the conservation objectives for the Humber Estuary SPA. **It is concluded that there will be no adverse effect on integrity of the Humber Estuary SPA in relation to habitat loss and avocet (breeding and non-breeding), in the absence of mitigation, for the project alone.**

Feature 2: Golden plover

Implication for Conservation Objectives Unmitigated

10.6.144 The details of permanent and temporary habitat loss as a result of the Project are as described under Pathway 1 – Habitat Loss and in the MDS table. There was only a single record of golden plover from the winter bird surveys from the vicinity of the three substation option areas, which once selected, will be the main area for permanent habitat loss. These three areas comprise of arable fields and do not include the habitats listed within the SACO targets for golden plover at the Humber Estuary SPA (noting that it is stated that for inland habitats, grassland is the most important feeding habitat, rather than arable). This comprised of a group of 19 birds in proximity to Weston Marsh South OnSS.

10.6.145 During construction, temporary habitat loss within the onshore PEIR Boundary would result in the temporary loss of some agricultural foraging, loafing and roosting habitat, however there will be other similar habitat available nearby. Golden plover utilise a range of agricultural fields, and will commute several kilometres to foraging grounds, and there is an abundance of similar agricultural land surrounding the Project.

10.6.146 For non-breeding golden plover of the Humber Estuary SPA, the SACO targets relevant to habitat loss are:

- "Maintain the size of the non-breeding population at a level which is above 30,709 wintering individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent"; and
- "Restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) [to] [an unspecified extent, based on restoring natural estuarine functioning]".

10.6.147 The following habitats support this feature:

- Intertidal sand and mudflats;
- Coastal lagoons;
- Saltmarsh; and

- Inland areas of wet grassland and agricultural land (both arable land and permanent pasture). Grassland is the most important feeding habitat, with earthworm-rich permanent pastures preferred over leys and arable.

10.6.148 The Wash Ramsar golden plover population is in unfavourable condition. Natural England and RSPB (2019) indicates that the breeding population is facing high level threats from climate change and non-climatic threats, whereas the wintering populations may benefit from climate change and face low level non-climatic threats. This indicates that it is not local factors that are limiting the Wash Ramsar population.

Integrity Test (Alone) – Unmitigated

10.6.149 Given the temporary nature of the majority of the habitat loss, the small area of permanent habitat loss (of low suitability habitat), and the availability of alternative agricultural land in the surrounding area, it is considered that habitat loss arising from the Project (taking account of the mitigation detailed in Section 7) would (in relation to the European sites):

- not reduce the non-breeding population below its current level or prevent the restoration of the population; and
- not affect the restoration of intertidal sand and mudflats, coastal lagoons, saltmarsh and wet grassland habitats.

10.6.150 It is therefore expected that the Project would not undermine any of the conservation objectives, **and would not have an adverse effect on integrity (AEoI) of The Wash Ramsar and Humber Estuary SPA and Ramsar in relation to non-breeding golden plover. This will however need to be confirmed following further design information, notably the areas of habitat loss for suitable grassland feeding areas.**

10.6.151 The assessments for the features that follow do not go into detail in relation to the SACO attributes and targets, as that will be provided in a subsequent version of the RIAA when further design information is available for the Project.

Feature 3: Lapwing

Implication for Conservation Objectives Unmitigated

10.6.152 The details of permanent and temporary habitat loss as a result of the Project are as described for avocet. There were no records of lapwing from the winter bird surveys from the vicinity of Weston Marsh North (WMN) OnSS, one record (of 56 birds) from the vicinity of Weston Marsh South (WMS) OnSS and three records (peak of 31 birds) from the vicinity of Lincolnshire Node OnSS. The OnSS to be selected from the three substation options, will be the main area for permanent habitat loss.

10.6.153 During construction, temporary habitat loss within the PEIR Boundary would result in the temporary loss of some agricultural foraging, loafing and roosting habitat for non-breeding birds, however there will be other similar habitat available nearby. Lapwing utilise arable fields within the survey area, and there is an abundance of similar agricultural land surrounding the Project. The population size is limited by breeding success and not the availability of over-winter arable farmland habitat (Sheldon *et al*., 2004). Given the availability of alternative foraging habitat, the small scale of habitat loss relative to the foraging range and the temporary nature of the loss, the assumed conservation objective to restore the population of The Wash Ramsar would likely not be undermined as a result of habitat loss for non-breeding lapwing from the project alone.

10.6.154 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of temporary habitat loss to a potentially connected population of breeding lapwing. This includes breeding bird survey population and distribution data.

10.6.155 Integrity Test (Alone) – UnmitigatedFor the reasons outlined above, it is expected that the permanent and temporary habitat loss for non-breeding lapwing arising from the Project (taking account of embedded mitigation detailed in Section 7) would not undermine any of the conservation objectives and therefore **would not have an AEoI of The Wash Ramsar in relation to non-breeding lapwing. This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

10.6.156 Further information is required to make an assessment of the impacts on the potentially connected breeding population of lapwing and therefore an adverse effect on integrity cannot be excluded at this stage.

Features 4, 5 and 6: Curlew, Oystercatcher and Redshank

Implication for Conservation Objectives Unmitigated

10.6.157 There were no records of curlew from winter bird surveys in the vicinity of WMS OnSS, two records from the vicinity of WMN OnSS (peak count of six) and two records from Lincolnshire Node OnSS (peak count of nine). The OnSS selected from the three substation option areas, will be the main area for permanent habitat loss. There were no records of oystercatcher from winter bird surveys in the vicinity of any of the three OnSS option areas. There were no records of redshank from winter bird surveys in the vicinity of any of the three OnSS option areas.

10.6.158 Curlew utilise a range of agricultural fields, and there is an abundance of similar agricultural land surrounding the Project. Curlew also utilise the inter-tidal area and wetland features within the zone of influence of the onshore Project. Low numbers of oystercatcher were recorded utilising farmland habitat within the winter bird survey area, with concentrations of records at The Haven (inter-tidal habitats) and the Landfall (low numbers using Anderby Marsh and inter-tidal habitats). Low numbers of redshank were recorded utilising farmland habitat within the winter bird survey area, with concentrations of records at The Haven (inter-tidal habitats) and the Landfall (low numbers using Anderby Marsh).

10.6.159 During construction, temporary habitat loss within the onshore PEIR Boundary would result in the temporary loss of some agricultural foraging, loafing and roosting habitat, however there will be other similar habitat available nearby. Wetland habitats at the landfall and The Haven will be protected from loss of habitat through the use of trenchless techniques.

10.6.160 Given the availability of alternative farmland foraging habitat, the small scale of habitat loss relative to the foraging range and the temporary nature of the loss, it is expected that the conservation objectives of the relevant European sites would not be undermined as a result of habitat loss impacting these non-breeding species from the project alone.

10.6.161 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of temporary habitat loss to potentially connected populations of breeding curlew, oystercatcher and redshank. This includes breeding bird survey population and distribution data.

Integrity test (alone) – unmitigated

10.6.162 For the reasons outlined above, it is expected that the permanent and temporary habitat loss arising from the Project (including embedded mitigation) would not undermine any of the conservation objectives, and **therefore would not have an adverse effect on the intergrity of relevant designated sites in relation to non-breeding curlew, oystercatcher and redshank. This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

10.6.163 Further information is required to make an assessment of the impacts on the potentially connected breeding populations of curlew, oystercatcher and redshank and therefore an adverse effect on integrity cannot be excluded at this stage.

Features 7 and 8: Dunlin and Sanderling

Implication for Conservation Objectives Unmitigated

10.6.164 There were no records of dunlin from winter bird surveys in the vicinity of any of the three OnSS option areas. There were no records of sanderling from winter bird surveys (and no suitable habitat) in the vicinity of any of the three OnSS option areas.

10.6.165 At the Landfall, and at The Haven, the cable will be installed using trenchless techniques and therefore there would be no habitat loss at Anderby Marsh or of inter-tidal areas, where dunlin and sanderling have been recorded. Elsewhere within the onshore PEIR Boundary, habitats are unsuitable for dunlin and sanderling. On that basis, it is expected that conservation objective four of The Wash and Humber Estuary SPAs and the assumed conservation objectives for the Ramsar sites would not be undermined as a result of habitat loss for non-breeding dunlin and sanderling from the project alone.

Integrity test (alone) – unmitigated

10.6.166 For the reasons outlined above, the permanent and temporary habitat loss arising from the Project (taking account of the embedded mitigation) would not undermine any of the conservation objectives, and **therefore would not have an AEoI of The Wash SPA and Ramsar or Humber Estuary SPA and Ramsar in relation to non-breeding dunlin and sanderling.**

Feature 17: Dark-bellied brent goose

Implication for Conservation Objectives Unmitigated

10.6.167 During the construction phase, there will be loss of farmland within an 80m wide route corridor, which will result in the loss of some foraging habitat for dark-bellied brent goose, however there will be other alternative habitat available nearby. Potential displacement of brent geese from land adjacent to the corridor is discussed in the 'Pathway 2 – Disturbance' section.

10.6.168 The majority of the habitat loss will be arable land, and the SACO targets for dark-bellied brent geese of The Wash SPA do not refer to arable land as an important supporting habitat. Given the availability of alternative habitat and the small scale of habitat loss relative to the foraging range of this species and the large amount of suitable foraging habitat available, it is expected that conservation objective four for the identified designated sites, maintaining/ restoring the population of qualifying features, would not be undermined by habitat loss during construction or decommissioning of the project alone.

Integrity Test (Alone) – Unmitigated

10.6.169 The impact of habitat loss alone (including embedded mitigation) would not be likely to undermine any of the conservation objectives and **therefore would not have an AEoI of the Wash SPA and Ramsar or Gibraltar Point Ramsar in relation to non-breeding dark-bellied brent goose. This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

Feature 18: Pink-footed goose

Implication for Conservation Objectives Unmitigated

10.6.170 There were no records of pink-footed goose from the winter bird surveys from the vicinity of the three substation option areas. During construction, temporary habitat loss within the onshore PEIR Boundary would result in the temporary loss of some agricultural foraging habitat, however there will be other similar habitat available nearby. Pink-footed geese feed on a range of agricultural crops and grassland, and will commute large distances to foraging grounds, and there is an abundance of similar agricultural land surrounding the Project. Given the temporary nature of the loss, the availability of alternative foraging habitat and the small scale of habitat loss relative to the foraging range, conservation objectives for the Wash SPA and Ramsar and North Norfolk SPA and Ramsar would not be likely to be undermined as a result of habitat loss from the project alone.

Integrity Test (Alone) – Unmitigated

10.6.171 For the reasons outlined above, the permanent and temporary habitat loss arising from the Project (including embedded mitigation) would not be likely to undermine any of the conservation objectives and therefore would not have an adverse effect on the integrity of The Wash SPA and Ramsar or North Norfolk SPA and Ramsar in relation to non-breeding pink-footed goose. **This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

Feature 19: Gadwall

Implication for Conservation Objectives Unmitigated

10.6.172 There were no records of gadwall from winter bird surveys (and no suitable habitat) in the vicinity of any of the three OnSS option areas. At the Landfall, the cable will be installed using trenchless techniques and therefore there would be no loss of wetland features such as at Anderby Marsh or Wolla Bank, where gadwall have been recorded. Elsewhere within the onshore PEIR Boundary, habitats are largely unsuitable for gadwall. On that basis, conservation objective four for The Wash SPA would not be likely to be undermined as a result of habitat loss for non-breeding gadwall from the project alone.

Integrity Test (Alone) – Unmitigated

10.6.173 For the reasons outlined above, the permanent and temporary habitat loss arising from the Project (taking account embedded mitigation) would not undermine any of the conservation objectives, and **therefore would not have an AEoI of The Wash SPA in relation to non-breeding gadwall.**

Feature 20: Wigeon

Implication for Conservation Objectives Unmitigated

10.6.174 There were no records of wigeon from winter bird surveys (and no suitable habitat) in the vicinity of any of the three OnSS option areas. At the Landfall, the cable will be installed using trenchless techniques and therefore there would be no loss of wetland features such as at Anderby Marsh, where most wigeon were observed. The wetland near Rookery Farm is outwith the PEIR boundary so will not be subject to habitat loss. On that basis, conservation objective four to maintain the population of wigeon for The Wash SPA would not be undermined as a result of habitat loss from the project alone.

Integrity Test (Alone) – Unmitigated

10.6.175 For the reasons outlined above, the permanent and temporary habitat loss arising from the Project (taking into account embedded mitigation) would not undermine any of the conservation objectives and **therefore would not have an AEoI of The Wash SPA in relation to non-breeding wigeon.**

Feature 24: Common Scoter

10.6.176 This section assesses the impacts on common scoter from onshore works only (i.e. above MHWS). As non-breeding common scoters have only been recorded offshore, there will be no loss of habitat for this species resulting from the onshore element of the works. Therefore there is no risk of undermining the conservation objectives for the non-breeding common scoter feature of the relevant designated sites and **there will be no AEoI of The Wash SPA or Greater Wash SPA as a result of habitat loss from onshore works in relation to common scoter.**

Feature Group 26: Terns

10.6.177 Cable installation at the Landfall area and crossings of other significant wetland features, such as The Haven, will be undertaken by trenchless techniques and will not be subject to habitat loss. Little tern and sandwich tern are almost exclusively marine species nesting close to the shore and feeding over the sea. Common tern will utilise marine habitats, but also breed inland at wetland sites and feed on lakes and rivers. **There will be no loss of suitable habitat for tern species and therefore no possibility to undermine the conservation objectives of the relevant designated sites and there will be no AEoI of those sites in relation to breeding terns from the onshore elements of the project alone.**

Feature 27: Black-headed Gull

Implication for Conservation Objectives Unmitigated

10.6.178 The OnSS areas comprise of agricultural fields which are abundant in the wider area and therefore permanent loss of a small amount of arable land relative to the wider resource would not undermine the conservation objectives of The Wash Ramsar. During construction, temporary habitat loss along the onshore ECC would result in the temporary loss of some agricultural foraging and loafing habitat, however there will be other similar habitat available nearby. There will be no habitat loss at the coastal wetlands such as at Anderby Marsh. Given the availability of alternative farmland foraging habitat, and the temporary nature of the loss, the assumed conservation objective to restore the population of The Wash Ramsar would not be undermined as a result of habitat loss for non-breeding black-headed gull from the project alone.

10.6.179 Further information is required in order to make an assessment of the implications for the conservation objectives of The Wash Ramsar as a result of temporary habitat loss to a potentially connected population of breeding black-headed gull. This includes breeding bird survey population and distribution data.

Integrity Test (Alone) – Unmitigated

10.6.180 For the reasons outlined above, the permanent and temporary habitat loss arising from the Project (taking account of embedded mitigation) would not undermine any of the conservation objectives, and **therefore would not have an AEoI of The Wash Ramsar in relation to non-breeding black-headed gull.**

10.6.181 Further information is required to make an assessment of the impacts on the potentially connected breeding population of black-headed gull and therefore an AEoI cannot be excluded at this stage.

Feature 28: Bittern

10.6.182 Bittern would not be impacted by temporary or permanent habitat loss resulting from the Project, as they utilise reedbed habitat and notable wetland features, such as Anderby Marsh, which will be avoided through the use of trenchless techniques. **Therefore there is no possibility that the conservation objectives of the Humber Estuary SPA would be undermined as a result of habitat loss for breeding or non-breeding bitterns, and therefore there would be no AEoI of that site.**

Feature 29: Marsh Harrier

10.6.183 Given that the majority of habitats to be lost during the construction phase will be agricultural fields, which are abundant in wider area, and that there was no concentration of foraging activity within the winter bird survey area, habitat loss would not undermine the conservation objectives of the Humber Estuary SPA. **There would therefore be no AEoI of the designated site as a result of the impact of habitat loss to a possibly connected (but not a qualifying) non-breeding population of marsh harrier.**

10.6.184 Further information is required to make an assessment of the impacts on a potentially connected breeding population of marsh harrier and therefore an adverse effect on integrity cannot be excluded at this stage.

Feature Group 31: Waterbird Assemblage

10.6.185 For the reasons outlined from the assessment of features already undertaken, the conservation objective would not be likely to be undermined as a result of habitat loss from the Project alone. **This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

Feature Group 32 and 33: Habitat Features of SACs and Ramsar sites and Red Data Book Invertebrates

10.6.186 Trenchless techniques will be employed to ensure no temporary or permanent loss of habitats within any SAC or Ramsar site. There is therefore no means by which habitat loss from the Project could undermine the conservation objectives of the screened in SACs and Ramsar sites in relation to the qualifying habitat features and the associated red data book invertebrates. **There would therefore not be an AEoI for the Humber Estuary SAC and Ramsar, Satltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC, The Wash and North Norfolk SAC and The Wash Ramsar.**

Feature 34: Otter

10.6.187 Habitat loss could potentially impact otters directly by impacting holts, through temporary and permanent loss and fragmentation of foraging routes and areas and/or accidental killing and injury. All sizeable water bodies and those with significant flow will however be avoided or trenchless techniques will be used at their crossing,

10.6.188 Reasonable avoidance measures would be used to reduce the risk of committing an offence under the protecting legislation. These may include micro-siting certain elements and/or installing protective fencing to minimise disturbance to any holts and ensuring excavations remain closed overnight or contain ramps such that otters cannot become trapped. A licence from Natural England may be required depending on the nature of any impact.

10.6.189 Taking account of the embedded mitigation measures, the conservation objectives of The Wash and North Norfolk SAC would not be undermined by habitat loss and therefore there would be no AEoI of that designated site in relation to otter.

Pathway 2 – Disturbance of Birds and Mammals Outside The SPA

10.6.190 Section 7 of the Project Description chapter (PEIR Volume 1 Chapter 3) states that trenchless techniques will be used to install the cables beneath the intertidal and near shore area. It states that *"Landfall installation will be undertaken from the TJB site on the west side of Roman Bank, however some form of beach access may also be required for construction vehicles, depending on the preferred method of installation identified. A number of potential access options have been identified via existing access points. Some improvement works to the access points may be required to enable construction works access"*. In addition, *"There may be temporary closures to parts of the beach and intertidal area during activities such as cable pulling or excavation, but wherever possible access will be maintained across the beach and public diversions established"*.

10.6.191 It describes that the TJB will be located a minimum of 80m to the west of Roman Bank. A landfall logistics compound will be located within the Landfall area. The trenchless techniques exit pits will be located below mean low water springs (MLWS). The Landfall works are anticipated to take up to a maximum of 36 months to complete. For decommissioning, it is expected that the onshore cable would be left in situ to avoid adverse effects on the environment and communities.

10.6.192 The Institute of Estuarine and Coastal Studies (IECS) report (Cutts *et al*., 2009) provides a review of the evidence relating to construction disturbance impacts on waterfowl and was used to develop a Waterbird Disturbance Mitigation Toolkit (Cutts *et al*., 2013). The Toolkit summarises the following general waterbird disturbance levels from visual stimuli:

- High level disturbance stimuli: close proximity of works (<100m); works or 3rd parties on foreshore; workers on foot; large/fast moving machinery.
- Moderate level disturbance stimuli: high level activities for which birds are habituated; and small/slow moving plant.
- Low level disturbance stimuli: moderate level activities for which birds are habituated; works out of sight; high level works >500m away from birds (or 300m with habituation); moderate level works >300m away (or 250m with habituation).

10.6.193 The study summarises the waterbird responses to construction noise disturbance as:

- High noise level effects – sudden noise of > 60 dB (at the bird) or prolonged noise of > 72 dB.
- Moderate noise level effects – occasional noise > 55 dB, regular noise 60-72 dB and long-term regular noise >72 dB.
- Low noise level effects – noise < 55 dB and noise between 55-72 dB in some highly disturbed areas.

10.6.194 The Toolkit provides a table presenting standard distance decay rates for noise and states *"Acceptable dose levels (e.g. up to 70 dB) are shaded green with dark green unlikely to have any effect whilst the pale green might occasionally induce a low level behavioural response such as heads-up"*. Above the acceptable 70 dB dose threshold *"yellow to orange shading is where a response is likely but mitigation may be effective in reducing disturbance risk; pale red where mitigation is necessary and might be of value, but with remaining risk of effect; dark red where a flight response is almost certain to occur and would be increasingly difficult to mitigate through simple screening etc and may require the cessation of works during high sensitivity periods".*

10.6.195 The noise assessment for the Project is detailed in Volume 1 Chapter 26 of the PEIR. The noise generated by construction operations and the operational noise from the OnSS on International or National ecological sites situated near the Landfall, ECC and OnSS have been predicted and assessed in accordance with the limits contained in AQTAG09 (Air Quality Technical Advisory Group 09). This guidance is intended to be used to assess the potential adverse impact of sound, of an industrial and/or commercial nature on wildlife.

10.6.196 The noise assessment (PEIR Volume 1, Chapter 26) acknowledges that a detailed list of construction plant, operational noise levels and associated on-times for all the construction activities/operations is not yet available. Estimates of the combined sound power levels are however provided for each construction activity, as detailed in Table 10.73.

Table 10.73: Estimated combined sound power levels – construction plant for Landfall and onshore ECC, dB

Activity	Combined Sound Power Level (SWL)
1. Establish Access and TCC (including trenchless drilling compounds)	120
2. Site Preparation, Including Fencing, Haul Road Construction and Topsoil Strip	120
3. Transition Bay Excavation	116
4. Transition Bay Wall and Base Construction	114
5. Connection of Cables in Transition Bays	115
6. Roof and Backfill over Transition Bay	118
7. Trench Excavation and duct installation	118
8. Trench Backfill	119
9. Jointing Bay Excavation	116
10. Jointing Bay Base Construction	114
11. Pulling and Connection of Cables	114
12. Backfill over Jointing Bay	118
13. TCC Operations	109
14. Trenchless Drilling Compound Operations (including piling)	116
15. Night-time Trenchless Drilling Operations (excluding piling)	114

Table 10.74: Estimated combined sound power levels – construction plant for OnSS options, dB

Activity	Combined Sound Power Level (SWL)
1. Ground Works	123
2. Building Foundation	115
3. Access Road and Carparks	116
4. Building Fabric and High Voltage Plant	118

10.6.197 The construction work for the installation of export cables involves a number of discrete activities undertaken along the length of the cable route, the duration of each activity at any location being dependent on the nature of construction activity being undertaken. The works at any location would therefore be intermittent and not continuous for the 36 month construction period.

Feature 1: Avocet

Implication for Conservation Objectives Unmitigated

10.6.198 It is understood from desk study searches that there is a breeding population of avocet [redacted] There are also records of breeding from [redacted], however suitable wetland habitat is located >300m from the PEIR Boundary. Breeding bird surveys will be carried out in 2023 to confirm precise breeding locations and population size.

10.6.199 During construction activities there is a risk of disturbing avocet, and other bird species. Disturbance of birds during construction (and de-commissioning of the OnSS), through noise or the presence of site workers/machinery may displace birds using intertidal habitat or land used for breeding or foraging with knock-on effects on survival. Disturbance can lead to effective habitat loss, should birds not utilise the habitat impacted by the noise or visual disturbance. Natural England have previously recommended a 300m safe working distance (for non-construction operations such as human presence and shooting) around avocet nest sites (Natural England, 2021).

10.6.200 There is a grassy bank adjacent, which separates the potential breeding location from the trenchless techniques pit, and is approximately 2 m high and therefore provides visual and acoustic screening. The dunes and associated vegetation including scrub provide a further complete screen between the potential breeding area and the beach. The intertidal zone within the Landfall area is considered to be largely unsuitable for avocet foraging during the breeding season.

10.6.201 Further information is required in order to make an assessment of the effect on the integrity of the Humber Estuary SPA as a result of potential construction disturbance to breeding avocet. This includes breeding bird survey population and distribution data for the Landfall and onshore ECC, as well as further details of the planned locations of construction infrastructure such as TJBs, exit pits, access roads and compounds.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity test (alone) – Mitigated

10.6.202 Further information is required in order to make an assessment of the effect on the integrity of the Humber Estuary SPA as a result of potential construction disturbance to breeding avocet.

Feature 2: Golden Plover

Implication for Conservation Objectives Unmitigated

10.6.203 Golden plover is classified as a species of moderate sensitivity to disturbance in the Disturbance Toolkit (Cutts *et al*., 2013), although it is noted that research into disturbance to wintering birds is limited. In relation to visual disturbance, a distance of 200m is cited at which 'high level' stimuli could cause disturbance. The Toolkit considers that noise levels up to 72dB at the receptor would be acceptable, with caution above 55dB. It states that golden plover will roost to within 300m of plant and considers a source noise generation of 120-115dB at 300m from golden plover may be acceptable, with caution above 107-112dB. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to golden plover utilising farmland habitats at a distance of up to 300m.

10.6.204 Disturbance, in the absence of mitigation, has the potential to limit foraging activity and displace birds to potentially sub-optimal roosting locations and therefore has the potential to impact survival of golden plover within the vicinity. This would undermine the population/abundance conservation objective for The Wash Ramsar and Humber Estuary SPA and Ramsar, and the SACO target of The Humber Estuary SPA to reduce disturbance, leading to an adverse effect on integrity of that designated site. The relevant SACO target is to *"Reduce the frequency, duration and/or intensity of disturbance affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed"*. It clarifies that *"Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*

- *changed local distribution on a continuing basis; and/or*
- *changed local abundance on a sustained basis; and/or*
- *the reduction of ability of any significant group of birds to survive, breed, or rear their young."*

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.205 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the project alone and **there will be no likely adverse effect on integrity of those designated sites in relation to non-breeding golden plover for the Project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

10.6.206 The assessments for the features that follow do not go into detail in relation to the SACO attributes and targets, as that will be provided in a subsequent version of the RIAA when further design information is available for the Project.

Features 3, 4, 5 and 6: Lapwing, Curlew, Oystercatcher and Redshank

Implication for Conservation Objectives Unmitigated

10.6.207 Lapwing is classified as a species of moderate sensitivity to disturbance in the Disturbance Toolkit, although it is noted that research into disturbance to wintering birds is limited. In relation to visual disturbance, a distance of 300m is cited at which 'high level' disturbance stimuli could elicit a disturbance response. The Toolkit considers that noise levels of up to 72dB at the receptor would be acceptable, with caution above 55dB. It states that lapwing will roost to within 200m of plant and therefore a source noise generation of 115-120dB at 200m from lapwing may be acceptable, with caution above 87-92dB at 200m range. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding lapwing utilising farmland habitats at a distance of up to 300m.

10.6.208 Curlew is classified as a species of moderate sensitivity to disturbance in the Disturbance Toolkit. In relation to visual disturbance, a distance of 300m is cited at which 'moderate' and 'high level' disturbance stimuli could cause disturbance. The Toolkit considers that noise levels up to 117-122dB at source would be acceptable when birds are at 300m range. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding curlew utilising farmland habitats at a distance of up to 300m.

10.6.209 Oystercatcher is classified as a species of moderate sensitivity to disturbance in the Disturbance Toolkit. In relation to visual disturbance, a distance of 200m is cited at which 'moderate' and 'high level' disturbance stimuli could be elicit a disturbance response. The Toolkit considers that noise levels up to 72dB at the receptor, with caution applied at levels above 55dB. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding oystercatcher utilising farmland habitats at a distance of up to 300m.

10.6.210 Redshank is classified as a species of high sensitivity to noise disturbance but which is tolerant of visual disturbance in the Disturbance Toolkit. In relation to visual disturbance, a distance of 100m is cited at which 'high level' stimuli could cause disturbance. The Toolkit considers that noise levels up to 70dB at the receptor are acceptable, with caution applied at levels above 55dB. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding redshank at a distance of up to 300m.

10.6.211 A study of non-breeding waders at Cardiff Bay (Burton et al., 2002) found that densities of curlew, oystercatcher and redshank were significantly reduced adjacent to construction work. Disturbance, in the absence of mitigation, has the potential to limit foraging and displace birds to potentially sub-optimal roosting locations and therefore has the potential to impact survival of these waders within the vicinity. This could undermine the population/abundance conservation objective for the designated sites, and the SACO target of the SPAs to reduce disturbance, leading to an AEoI of those designated sites.

10.6.212 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of disturbance to potentially connected breeding populations. This includes breeding bird survey population and distribution data.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.213 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the project alone and **there will be no likely adverse effect on integrity of the designated sites in relation to non-breeding lapwing, curlew, oystercatcher and redshank for the project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

10.6.214 Further information is required to make an assessment of the impacts on the potentially connected breeding populations of lapwing, curlew, oystercatcher and redshank and therefore an adverse effect on integrity cannot be excluded at this stage.

Features 7 and 8: Dunlin and Sanderling

Implication for Conservation Objectives Unmitigated

10.6.215 Dunlin is classified as a species of low sensitivity to disturbance in the Disturbance Toolkit. In relation to visual disturbance, a distance of 75m is cited at which 'high level' stimuli could cause disturbance. The Toolkit considers that noise levels up to 72dB at the receptor are acceptable, with caution applied at levels above 60dB. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding dunlin at a distance of up to 200m.

10.6.216 Sanderling is classified as a species of low sensitivity to disturbance in the Disturbance Toolkit. In relation to visual disturbance, a distance of 50m is cited at which 'high level' stimuli could cause disturbance. The Toolkit considers that noise levels up to 75B at the receptor are acceptable, with caution applied at levels above 60dB. In the absence of specific mitigation and on a precautionary basis, the onshore Project works may cause disturbance to non-breeding sanderling at a distance of up to 200m.

10.6.217 Disturbance, in the absence of mitigation, has the potential to limit foraging and displace birds to potential sub-optimal roosting locations and therefore has the potential to impact survival of dunlin and sanderling within the vicinity. Whilst both species were only recorded at low abundances during the winter bird surveys, the conservation objectives for the relevant designated sites are to restore the populations. On a precautionary basis, there is a risk that the population/abundance conservation objective for the designated sites, and the SACO target of the SPAs to reduce disturbance, would be undermined, leading to an adverse effect on integrity of those designated sites.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.218 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the project alone and **there will be no likely adverse effect on integrity of the designated sites in relation to non-breeding dunlin and sanderling for the project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

Features 17 and 18: Dark-bellied Brent Goose and pink-footed goose

10.6.219 Brent geese were concentrated within the study area at The Haven, both in fields and saltmarsh. The cable crossing of The Haven will be by trenchless technique and the entry and exit drilling locations, and associated TCC, will be set back from the river, however the locations and details are yet to be confirmed.

10.6.220 The construction disturbance toolkit (Cutts *et al*., 2013) classifies brent goose as a species of high sensitivity to visual and noise disturbance and advises that for any visible construction works planned within 400m of brent geese then consideration should be given to mitigation options.

10.6.221 Owens (1977) states: *"Brent Geese quickly become habituated to most sounds. Unexpected ones, such as nearby gun shots from wildfowlers, usually put the geese to flight. Similarly, the first shots of the day at the Colne Army ranges caused geese to leave the saltings for the mudflats. They quickly returned however, and ignored all subsequent firing that day. At Foulness, the extremely loud but regular bangs made during weapon testing caused little reaction after the first weeks. Brent Geese fed undisturbed 50m from passing trains at Leigh Marsh."*

10.6.222 Dark-bellied brent geese at The Haven within 400m of the PEIR boundary would be at risk of disturbance, depending on where within the PEIR Boundary the construction works take place. Disturbance has the potential to limit foraging and therefore has the potential to impact survival of brent geese within the vicinity. This would potentially undermine the population/abundance conservation objective for the designated sites, and the SACO target of the SPAs to reduce disturbance, leading to an adverse effect on integrity of the identified designated sites.

10.6.223 Pink-footed goose are not included in the Disturbance Toolkit, but are likely to have a similar sensitivity to construction disturbance to that described for brent goose and may be impacted by visual and noise disturbance at a distance of up to 400m from the source. Pink-footed geese were recorded during winter bird surveys utilising various fields within the onshore PEIR Boundary, at relatively low frequency and mainly in low numbers but occasionally in larger flocks, including some which constitute a significant proportion of the SPA populations. For the rationale given in relation to temporary habitat loss, including the temporary nature of the works, the large foraging area of the species and the alternative available habitat, the impact of construction disturbance would not undermine the population/abundance conservation objective for the designated sites, and the SACO target of the SPAs to reduce disturbance. This is particularly the case given the significant increases in the designated sites populations.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.224 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the project alone and **there will be no likely AEoI of the designated sites in relation to non-breeding dark-bellied brent goose and pink-footed goose for the project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

Features 19 and 20: Gadwall and Wigeon

Implication for Conservation Objectives Unmitigated

10.6.225 The recommended buffer for gadwall and wigeon from construction activity is 200m (Wallis *et al*., 2019). Disturbance, in the absence of mitigation, has the potential to limit foraging and displace birds to potentially sub-optimal foraging and loafing locations and therefore has the potential to impact survival of gadwall within the vicinity. High numbers of non-breeding gadwall and wigeon were recorded at Anderby Marsh, relative to The Wash SPA populations. In the absence of mitigation there is a risk that the population/abundance conservation objective for The Wash SPA, and the SACO target of the SPAs to reduce disturbance, would be undermined, leading to an adverse effect on integrity of that site.

10.6.226 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of disturbance to a potentially connected population of breeding gadwall. This includes breeding bird survey population and distribution data.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.227 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the Project alone and **there will be no likely adverse effect on integrity of the designated sites in relation to non-breeding gadwall and wigeon for the project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

10.6.228 Further information is required to make an assessment of the impacts on the potentially connected breeding population of gadwall and therefore an adverse effect on integrity cannot be excluded at this stage.

Feature 24: Common Scoter

10.6.229 Studies of disturbance to non-breeding common scoter have focussed on impacts from marine activities such as shipping and the species has been recorded flushing from boats at a distance of >3km (Schwemmer *et al*., 2011). They have been found to show a weak avoidance of operational offshore windfarms (Dierschke *et al*. 2016) and are considered to be particularly sensitive to human activities in the marine environment such as shipping and helicopter traffic (see summary in Goodship &Furness, 2022). The potential for human recreational disturbance to this species is limited due to their distance from the shore (Goodship & Furness, 2022). Typically, vehicles elicit less of a disturbance response than people on foot (see Cutts *et al*., 2013).

10.6.230 For the onshore element of works, given that Landfall installation will primarily occur from the TJB which is inland and screened from the shore, the distance at which common scoter have been recorded offshore and that they are likely to be impacted less by plant and vehicles onshore than by vessel activity, it is concluded that the Landfall works (above MHWS) would not undermine the conservation objectives of The Wash SPA or Greater Wash SPA in relation to non-breeding common scoter. **Therefore, there would be no adverse effect on the integrity of The Wash SPA or Greater Wash SPA as a result of onshore construction disturbance to non-breeding common scoter.**

Feature Group 26: Terns

10.6.231 Little tern and sandwich tern are marine species and the beach area within and adjacent to the Landfall is considered unsuitable for nesting terns due to human recreational disturbance. The only pathway by which disturbance may be caused to little tern and sandwich tern would be in relation to birds foraging inshore adjacent to the onshore PEIR Boundary.

10.6.232 A study by Parsons *et al*., 2015 estimated a mean maximum little tern foraging range of 2.4km (for seaward extent) and 3.9km (for along-shore extent). Eglington (2013) reviewed several studies and concluded that most reported a foraging range of <4km from the colony. The Landfall is approximately 13km from Gibraltar Point at the closest point and 11km from the Humber Estuary and therefore beyond the typical foraging range for this species. **Therefore, there is no risk that construction disturbance would undermine the conservation objectives of The Wash or Greater Wash SPA, Gibraltar Point or Humber Estuary SPA little tern populations and there would be no AEoI of those sites.**

10.6.233 Eglington & Perrow (2014) state that sandwich terns often fly >30km between their colony and foraging areas. Thaxter *et al*., 2012 state a mean maximum foraging range of 49km and a mean range of 11.5km. The nearest colonies are likely to be at the North Norfolk SPA and the tracking and modelling presented by Wilson *et al*., 2014 indicates that the Landfall area is outwith the core range but within the maximum range. Given the large foraging range of this species and the relatively small area of sea falling within the zone of influence of the Landfall area (above MHWS), and the nature of the works on the beach above MHWS, it is concluded that such works would not undermine the conservation objectives of the Greater Wash SPA for sandwich tern. **There would therefore be no AEoI of the Greater Wash SPA as a result of construction disturbance.**

10.6.234 Wilson *et al*., 2014 states that the only two notable common tern colonies in the Wash SPA are at Freiston Shore and Snettisham, with the only other colony being Frampton Marsh with a mean of 10 apparently occupied nests between 2009-13. This study modelled the foraging area around those two colonies and indicates that the Landfall area is well away from their core foraging range. It is considered unlikely that there would be any common tern colonies within the ZoI of the Project, however breeding bird surveys are being undertaken in 2023 and will confirm that. **Further information is therefore required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of disturbance to a potentially connected population of breeding common tern.** This comprises of breeding bird survey population and distribution data.

Feature 27: Black-headed gull

Implication for Conservation Objectives Unmitigated

10.6.235 Black-headed gull is a species of low sensitivity to human disturbance and is tolerant of construction activities in proximity to foraging areas. **It is therefore concluded that significant disturbance to non-breeding black-headed gulls would not occur (mitigation is not required) and would not undermine the conservation objectives of The Wash Ramsar and there would be no AEoI of the site.**

10.6.236 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated site as a result of disturbance to a potentially connected population of breeding black-headed gull. This includes breeding bird survey population and distribution data.

Integrity Test (Alone) – Un-Mitigated

10.6.237 Further information is required to make an assessment of the impacts on the potentially connected breeding population of black-headed gull and therefore an AEoI cannot be excluded at this stage.

Feature 28: Bittern

10.6.238 Non-breeding bittern may utilise reedbed habitats at Wolla Bank, although no records were obtained from extensive winter bird surveys in 2022/23, indicating that this may be occasional use only. Wolla Bank reedbeds are located adjacent to the agricultural fields at the Landfall, with the TJB and associated construction compound to be located somewhere within the 300m wide PEIR boundary, set back at least 80m from Roman Bank. Disturbance, in the absence of mitigation, has the potential to limit foraging and displace birds to potentially sub-optimal foraging and roosting locations and therefore has the potential to impact survival of bittern within the vicinity. Bittern will be screened from disturbance at least partially by the reed vegetation of the marsh habitat that they occupy. At this stage it has not been determined where the Landfall TJBs and other infrastructure will be located, and therefore the proximity to Wolla Bank reedbeds. On a precautionary basis, in the absence of mitigation, there is a risk that Landfall works could undermine the conservation objectives (population/abundance objective and target to reduce disturbance) of the Humber Estuary SPA, should non-breeding bittern be present at Wolla Bank and connected with the Humber Estuary population.

10.6.239 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of disturbance to a potentially connected population of breeding bittern. This includes breeding bird survey population and distribution data.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.240 With the mitigation in place, disturbance will be minimised, localised and temporary, not enough to change the local distribution or abundance for any more than a short period or reduce the ability of a significant group to survive. Therefore, birds will not be likely to be significantly disturbed by the project alone and **there will be no likely AEoI of the designated sites in relation to non-breeding bittern for the project alone during construction and decommissioning. This will however need to be confirmed following further design information and further details of the mitigation.**

10.6.241 Further information is required to make an assessment of the impacts on the potentially connected breeding population of bittern and therefore an AEoI cannot be excluded at this stage.

Feature 29: Marsh Harrier

Implication for Conservation Objectives Unmitigated

10.6.242 Goodship & Furness (2022) classify marsh harrier as of medium sensitivity to human disturbance and suggest a buffer zone of 300-500m during the breeding and non-breeding seasons. Disturbance, in the absence of mitigation, has the potential to limit foraging and displace birds to potentially sub-optimal foraging locations and therefore has the potential to impact survival of marsh harrier within the vicinity. However, there is similar agricultural habitat available in the wider area and no concentrated foraging activity was recorded during the non-breeding season. The conservation status of the Humber Estuary breeding marsh harrier population is favourable.

10.6.243 Further information is required in order to make an assessment of the implications for the conservation objectives of the relevant designated sites as a result of disturbance to a potentially connected population of breeding marsh harrier. This includes breeding bird survey population and distribution data.

Integrity Test (Alone) – Un-Mitigated

10.6.244 For the reasons outlined above, disturbance would not undermine the conservation objective (population/abundance objective and target to reduce disturbance) of the designated site (mitigation is not required) and therefore there would be no AEoI of the site.

10.6.245 Further information is required to make an assessment of the impacts on the potentially connected breeding population of marsh harrier and therefore an AEoI cannot be excluded at this stage.

Feature Group 31: Waterbird Assemblage

Implication for Conservation Objectives Unmitigated

10.6.246 For those designated sites in favourable condition, from the assessment of features already undertaken, the Project would not be likely to undermine the conservation objective to maintain the populations of waterfowl for The Wash SPA or Ramsar and Gibraltar Point Ramsar. The Project could however affect the SACO target to reduce disturbance. For The Humber Estuary SPA and Ramsar site, due to the conservation status being unfavourable and the conservation objective being to restore, the Project could undermine the conservation objectives.

Mitigation

Refer to the onshore ecology mitigation detailed in Section 7.

Integrity Test (Alone) – Mitigated

10.6.247 With mitigation in place conservation objective for the waterfowl assemblage would not be likely to be undermined for the identified designated sites. **Therefore, the project alone during construction and decommissioning, with mitigation, would have no likely AEoI of the designated sites identified via disturbance of waterfowl outside the SPA or Ramsar site boundaries during the non-breeding season. This will however need to be confirmed following further design information, notably the areas of loss of suitable feeding habitat.**

Feature Group 32 and 33: Habitat Features of SACs and Ramsar Sites Red Data Book Invertebrates

10.6.248 LSE for these features from this impact pathway has been screened out.

Feature 34: Otter

10.6.249 Surveys are ongoing during 2023 in respect of otter. The proposed mitigation and compensation will be refined once the development proposals are finalised and the field survey data have been evaluated. Disturbance could impact on otters utilising any holts or resting sites within the ZoI of the Project. Disturbance to foraging or commuting otter is unlikely as riverine otters are largely nocturnal.

10.6.250 Reasonable avoidance measures would be used to reduce the risk of committing an offence under the protecting legislation. These may include micro-siting certain elements and/or installing protective fencing to minimise disturbance to any holts and ensuring excavations remain closed overnight or contain ramps such that otters cannot become trapped. A licence from Natural England may be required depending on the nature of any impact.

10.6.251 Further information is required to make an assessment of the impacts on the conservation objectives of The Wash and North Norfolk SAC and therefore an AEoI cannot be excluded at this stage.

Pathway 3 – Decrease in Water Quality and Quantity (Impacting Prey Availability)

Features 1-34: All Avian Features

10.6.252 The water quality targets for The Wash and Humber Estuary SPA's are:

- *"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 and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is < 12 µM for coastal waters), avoiding deterioration from existing levels".*
- *"Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat".*

10.6.253 The water quality targets for The Wash and North Norfolk SAC are:

- *"Where the feature is dependent on estuarine water, ensure water quality and quantity is maintained to a standard that provides the necessary conditions to support the feature: maintain dissolved oxygen (DO) at ≥ 5.7mg l-1 standardised to a salinity of 35".*
- *"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".*
- *"Restrict surface sediment contaminants (<1cm from the surface) to below the OSPAR Environment Assessment Criteria (EAC) or Effects Range Low (ERL) threshold. For example, mean cadmium levels should be maintained below the ERL of 1.2 mg per kg".*
- *"Maintain the natural nutrient status, dissolved oxygen (DO), phytoplankton levels and opportunistic algae, so that they do not have an adverse impact on the species and communities of the lagoon, which are subject to natural fluctuation".*
- *"Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) across the habitat".*

10.6.254 Measures to minimise the risk of a pollution event will be contained within the PPEIRP, a draft of which will be provided with the ES. A detailed assessment of this impact is provided within Volume 1, Chapter 24: Hydrology, Hydrogeology and Flood Risk. To summarise, it concludes that with embedded mitigation measures in place, the impact to water quality as a result of direct spills would be negligible to minor adverse. **Further refinement to the Project design is required to make an assessment of the impacts on the conservation objectives of the hydrologically connected European sites and therefore an AEoI cannot be excluded at this stage.**

Pathway 4 – Decrease in Air Quality

10.6.255 The air quality assessment in Volume 1 Chapter 19 of the PEIR identified four pathways that could impact designated sites during construction and decommissioning:

- Dust/PM10 emissions generated from temporary onshore construction works;
- Road traffic emissions generated from temporary construction vehicle movements;

- Emissions generated from temporary construction NRMM; and
- Emissions generated from temporary offshore vessel movements.

10.6.256 The assessment of construction phase road traffic emissions will be undertaken for the ES.

10.6.257 Assessment of the impacts from the other three pathways does not consider potential impacts on the Humber Estuary SPA as it is beyond the ZoI.

10.6.258 In relation to dust impacts, the chapter considers a 20m impact zone from worst case construction areas, which includes some Local Wildlife Sites (LWS) and Lincolnshire Wildlife Trust (LWT) sites, potentially including Anderby Marsh, Creek and/or Chapel Six Marshes, although not specified. Potential dust effects are to be temporary and short-term and may only arise at particular times. Nonetheless, mitigation measures have been included to ensure that any potential impacts are minimised and where possible avoided. These measures represent embedded mitigation for the project and are included within the outline AQMP (Document Number: 8.1.2) and provided as part of the CoCP.

10.6.259 In relation to NRMM, the chapter considers a 50m zone of influence for designated sites, and does not identify Anderby Marsh, Creek or Chapel Six Marshes as being potentially impacted. It concludes that potential impacts on ecological receptors will be negligible, taking account of embedded mitigation measures within the outline AQMP, as well as the short-term, transient, phased nature of the construction works, the background pollutant concentrations and the localised nature of NRMM emissions.

10.6.260 In relation to vessel emissions, the chapter assessed potential impacts on sensitive onshore features from vessel movements within 250m and 1km of the receptors, associated with offshore export cable installation. This concluded that all such impacts would be negligible.

Features 1-34: All Features

10.6.261 The air quality targets for The Wash and Humber Estuary SPA's and The Wash and North Norfolk SAC are:

- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).

10.6.262 No direct impacts on the designated sites are anticipated from dust, NRMM or vessel emissions and potential impacts on habitats within the coastal wetland sites are addressed through embedded mitigation measures within the outline AQMP. The potential effect resulting from construction phase road traffic emissions will need to be assessed following completion of this element of the air quality assessment.

10.6.263 Background nitrogen levels within the SAC are approximately 11 N/ha/year (APIS). There are defined Nitrogen deposition targets for individual bird species, which vary in their sensitivity. **Specific assessment against these targets will be undertaken in a subsequent draft of the RIAA following refinement of the Project design.**

O&M

Pathway 1 – Habitat Loss

Features 1-34: All Features

10.6.264 During operation of the project no further land take is anticipated, therefore, habitat loss during operation does not require assessment within the RIAA.

Pathway 2 – Disturbance of Birds and Mammals During Operation and Maintenance

10.6.265 Section 9.3 of the Project Description chapter (PEIR Volume 1 Chapter 3) states *"Onshore, the O&M requirements will be largely corrective, accompanied by infrequent on-site inspections of the onshore ECC. However, all onshore infrastructure will be constantly monitored remotely, and there may be O&M staff visiting the OnSS to undertake works when necessary (currently expected to be once per week). The OnSS will not be manned; and security at the substation will be provided through the use of perimeter fencing and closed-circuit television (CCTV). Periodic access to TJBs may also be required for inspection".*

10.6.266 Once the substation is operational, activities would be limited to regular inspections and occasional maintenance. This would be highly localised within the substation, with a minimal likelihood of disturbance expected to the adjacent habitats and species. Any such maintenance would be subject to an Environmental Management System (EnMS) which would include specific measures to avoid potential impacts to protected/notable species (precise contents dependent upon ongoing survey results).

10.6.267 Planned maintenance of the cable route is likely to involve an annual visit by a small team. Maintenance would also be subject to an EnMS which would include specific measures to avoid potential impacts to bird species.

10.6.268 Unplanned maintenance may involve the repair of onshore cable faults. This is extremely rare (indicatively 1-2 events per lifetime). Typically, this involves excavating the two adjacent joint bays, pulling the cable back through the ducting and pulling a new cable through. Alternatively, the area of the fault may be excavated, and two new joints installed within this area. Methods for excavaction and reburial will be similar to the original installation.

10.6.269 The extent or nature of any unplanned corrective maintenance required cannot be predicted at this stage and therefore possible effects in terms of disturbance cannot be assessed. Any unplanned corrective maintenance required would be subject to any necessary consents and consultation with the relevant nature conservation bodies at the time.

10.6.270 The relevant SACO target is to *"Reduce the frequency, duration and/or intensity of disturbance affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed".* It clarifies that "*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*

- *changed local distribution on a continuing basis; and/or*
- *changed local abundance on a sustained basis; and/or*

- *the reduction of ability of any significant group of birds to survive, breed, or rear their young."*

Feature 1: Avocet

10.6.271 Implication for Conservation Objectives Unmitigatedg given that scheduled inspections will be infrequent, and that no permanent infrastructure such as TJBs will be located within [redacted] where avocet may breed, the nearest being [redacted], such activities would result in minor disturbance only. This is on the basis of scheduled inspections involving a single vehicle and personnel on foot.

10.6.272 Corrective maintenance is by its nature of unknown frequency, however is expected to be extremely rare, and again would be largely restricted to permanent infrastructure located away from the suitable avocet breeding habitat. Given the legal protection from disturbance afforded to breeding avocet, measures will be taken to ensure disturbance to nesting birds is avoided. Given that the incidence of such potential disturbance would be rare and that disturbance to nesting birds will be avoided, combined with the favourable conservation status of the Humber Estuary SPA avocet population, **there is no potential to undermine the conservation objectives of the Humber Estuary SPA, specific mitigation is not required and therefore there would be no AEoI of the site.**

Features 2 to 6: Golden Plover, Lapwing, Curlew, Oystercatcher and Redshank

Implication for Conservation Objectives Unmitigated

10.6.273 Most of the scheduled maintenance activity will be located at the OnSS and there have only been low number of records (and abundance) of golden plover, lapwing and curlew and no records of oystercatcher or redshank in the vicinity of the three OnSS options. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of The Wash Ramsar and **therefore there would be no AEoI of the identified designated sites from scheduled maintenance disturbance to non-breeding golden plover, lapwing, curlew, oystercatcher or redshank.**

10.6.274 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of very low frequency and in discreet areas at any one time. Given the widespread distribution of golden plover, lapwing and curlew across the survey area, the low number of records of oystercatcher and redshank and the availability of alternative arable land in the surrounding area, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objective (four) of the relevant designated sites. **Therefore, there would be no AEoI of the designated sites for the project alone.**

10.6.275 Further information is required to make an assessment of the impacts on the potentially connected breeding population of lapwing, curlew, oystercatcher and redshank and therefore an AEoI cannot be excluded at this stage.

Features 7 and 8: Dunlin and Sanderling

10.6.276 Most of the scheduled maintenance activity will be located at the OnSS and there have been no records of dunlin or sanderling in the vicinity of the three OnSS options during winter bird surveys. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of the designated sites and **therefore there would be no AEoI of those designated sites from scheduled maintenance disturbance to non-breeding dunlin and sanderling.**

10.6.277 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the low numbers of non-breeding dunlin and sanderling recorded within the survey area, and restricted distribution primarily at Anderby Marsh and the beach, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objectives of the Wash SPA or Ramsar or Humber Estuary SPA or Ramsar. **Therefore, there would be no AEoI of those designated sites for the project alone, arising from operational disturbance to non-breeding dunlin and sanderling.**

Feature 17: Dark-bellied brent goose

Implication for Conservation Objectives Unmitigated

10.6.278 Most of the scheduled maintenance activity will be located at the OnSS and there have not been records of dark-bellied brent geese in the vicinity of the three OnSS options. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of the relevant designated sites and **therefore there would be no AEoI of The Wash SPA, Ramsar or Gibraltar Point Ramsar from scheduled maintenance disturbance to dark-bellied brent goose.**

10.6.279 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs. Given the restricted distribution of dark-bellied brent geese within the zone of influence of the Project, concentrated at The Haven, the frequency of corrective maintenance in the vicinity of The Haven is expected to be low. This could still potential adversely impact on brent geese if it was to coincide with freezing weather conditions. This could undermine conservation objectives and associated targets.

Mitigation

Refer to Section 7 for Details of the Onshore Mitigation.

Integrity Test (Alone) – Mitigated

10.6.280 With mitigation in place, the conservation objectives and associated targets would not be undermined and therefore **the project alone during operation, with mitigation, would have no AEoI of The Wash SPA, Ramsar or Gibraltar Point Ramsar due to the disturbance of non-breeding dark-bellied brent goose.**

Feature 18: Pink-footed Goose

Implication for Conservation Objectives Unmitigated

10.6.281 The impact of operational phase maintenance on pink-footed goose would be very similar to that described for brent goose, and would be a lot less impactful than construction disturbance. Given that pink-footed geese were not as spatially concentrated as brent geese within the survey area, indicative of their utilisation of abundant field habitats across a large foraging range, and that their designated sites populations have undergone significant increases, operational phase disturbance would not undermine the conservation objectives of the sites designated for pink-footed goose. **Operational disturbance would not result in an AEoI of The Wash SPA and Ramsar or North Norfolk SPA and Ramsar in relation to non-breeding pink-footed goose.**

Features 19 and 20: Gadwall and Wigeon

Implication for Conservation Objectives Unmitigated

10.6.282 Most of the scheduled maintenance activity will be located at the OnSS and there have been no records of gadwall or wigeon in the vicinity of the three OnSS options during winter bird surveys. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of The Wash SPA and **therefore there would be no AEoI of that site from scheduled maintenance disturbance to non-breeding gadwall.**

10.6.283 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the restricted distribution of non-breeding gadwall and wigeon, primarily at Anderby Marsh, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objective (four) of The Wash SPA. **Therefore, there would be no adverse effect on the integrity of that designated site for the project alone, arising from operational disturbance to non-breeding gadwall or wigeon.**

10.6.284 Further information is required to make an assessment of the impacts on the potentially connected breeding population of gadwall and therefore an adverse effect on integrity cannot be excluded at this stage.

Feature 24: Common scoter

Implication for Conservation Objectives Unmitigated

10.6.285 Most of the scheduled maintenance activity will be located at the OnSS which are located inland and away from areas where common scoter have been recorded. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of The Wash SPA or Greater Wash SPA and **therefore there would be no AEoI of those sites from scheduled maintenance disturbance to non-breeding common scoter.**

10.6.286 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the restricted distribution of non-breeding common scoter, in the marine environment, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objectives of The Wash SPA or Greater Wash SPA. **Therefore, there would be no AEoI of those designated sites for the project alone, arising from operational disturbance to non-breeding common scoter.**

Feature Group 26: Terns

Implication for Conservation Objectives Unmitigated

10.6.287 Most of the scheduled maintenance activity will be located at the OnSS which are located inland and away from suitable habitat for breeding terns. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of the relevant designated sites and **therefore there would be no AEoI of those sites from scheduled maintenance disturbance to breeding terns.**

10.6.288 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the restricted distribution of breeding sandwich and little terns, foraging in the marine environment only, combined with the nature and frequency of onshore corrective maintenance works, such works would not undermine the relevant conservation objective (four) of the relevant designated sites. **Therefore, there would be no AEoI of those designated sites for the project alone, arising from operational disturbance to breeding sandwich and little terns.**

10.6.289 Further information is required to make an assessment of the impacts on the potentially connected breeding population of common tern and therefore an AEoI cannot be excluded at this stage.

Feature 27: Black-headed Gull

Implication for Conservation Objectives Unmitigated

10.6.290 Most of the scheduled maintenance activity will be located at the OnSS, where impacts would be on widely available arable land only. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of The Wash Ramsar and **therefore there would be no AEoI of the Wash Ramsar from scheduled maintenance disturbance to non-breeding or breeding black-headed gull.**

10.6.291 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the tolerance of non-breeding black-headed gull to disturbance, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objective (four) of The Wash Ramsar. **Therefore, there would be no AEoI of the Wash Ramsar for the project alone unmitigated, arising from operational disturbance to non-breeding black-headed gull.**

10.6.292 Further information is required to make an assessment of the impacts on the potentially connected breeding population of black-headed gull from corrective maintenance work and therefore an AEoI cannot be excluded at this stage.

Features 28 and 29: Bittern and Marsh Harrier

Implication for Conservation Objectives Unmitigated

10.6.293 Most of the scheduled maintenance activity will be located at the OnSS and there is no suitable habitat for bittern, or wetland habitat for marsh harrier, in the vicinity of the three OnSS options. Away from the OnSS, scheduled maintenance activity would be infrequent and would typically comprise of a single vehicle and personnel on foot. Given the nature and frequency of the works they could not undermine the conservation objectives of the Humber Estuary SPA and **therefore there would be no AEoI of that site from scheduled maintenance disturbance to non-breeding or breeding bittern or marsh harrier.**

10.6.294 Corrective maintenance is by its nature of unknown frequency and nature, but is most likely to be located at the accessible infrastructure such as the TJBs, be of low frequency and in discreet areas at any one time. Given the restricted distribution of non-breeding bittern, at Wolla Bank only, and the low levels of non-breeding marsh harrier activity recorded, combined with the nature and frequency of corrective maintenance works, such works would not undermine the relevant conservation objectives of the Humber Estuary SPA. **Therefore, there would be no AEoI of those designated sites for the project alone unmitigated, arising from operational disturbance to non-breeding bittern or marsh harrier.**

10.6.295 Further information is required to make an assessment of the impacts on the potentially connected breeding populations of bittern and marsh harrier and therefore an AEoI cannot be excluded at this stage.

Feature Group 31: Waterbird Assemblage

10.6.296 Refer to construction and decommissioning disturbance section for Feature Group 31: waterbird assemblage.

Feature 33: Otter

10.6.297 Once the substation is operational, activities will be limited to regular inspections and occasional maintenance. This would be highly localised within the substation, with a minimal likelihood of disturbance expected to the adjacent habitats and species. Any such maintenance would be subject to an Ecological Method Statement (EMS) which would include specific measures to avoid potential impacts to protected species or sensitive habitats (precise contents dependent upon ongoing survey results). Following the implementation of an agreed EMS, there would be no possibility of undermining the conservation objectives of The Wash and North Norfolk SAC in relation to otter.

10.6.298 Planned maintenance of the cable route is likely to involve an annual visit by a small team. Maintenance would be subject to an EMS which would include specific measures to avoid potential impacts to protected species or sensitive habitats.

10.6.299 Taking account of the embedded mitigation measures, the conservation objective to restore the otter population of The Wash and North Norfolk SAC would not be undermined, and there would be no AEoI from operational disturbance from the Project alone.

Pathway 3 – Decrease in Water Quality and Quantity (Impacting Prey Availability)

Features 1-34: All Features

10.6.300 As described in Section 9.3 of the Project Description chapter (PEIR Volume 1 Chapter 3), most operational maintenance activity will be undertaken at the OnSS, with infrequent on-site inspections, including inspection of assets at designated access points such as TJBs. Given the nature and frequency of the operational maintenance works, they **could not undermine the conservation objectives for any of the designated sites as a result of hydrological impacts and would not have an AEoI of those sites from the project alone.** This pathway is therefore excluded from further assessment for all features.

Pathway 4 – Decrease in Air Quality

Features 1-34: All features

10.6.301 As described in Volume 1 Chapter 27: Traffic and Transport of the PEIR, operational phase traffic movements are expected to be of a low frequency and therefore could not undermine the conservation objectives for any of the designated sites and would not have an AEoI of those sites from the project alone. This pathway is therefore excluded from further assessment for all features.

11 Stage 2: Assessment of Adverse Effect In-Combination

11.1.1 Screening for designated sites and features in-combination is presented in Section 8.2, 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 this draft RIAA, to inform the assessment of AEoI in-combination to the features and effects screened in.

11.1.2 In assessing the potential for in-combination effects associated with the Project, 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 form 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 the Project (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.

11.1.3 For this reason, all relevant projects/plans considered in-combination alongside the Project 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 8.2), with the plans and projects screened in for further consideration here defined within Table 11.1.

11.1.4 For each plan/project screened in, the in-combination MDS 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.

11.1.5 Table 11.1 below identifies, for all plans and projects screened in for consideration in combination, the relevant receptor group(s), the MDS 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 MDS, with that noted where relevant. Equivalent information for ornithology is provided in Section 11.4.

Table 11.1: In-combination projects and relevant years.

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Offshore windfarms												
Active	Aberdeen (EOWDC)		3a		444.9	458.8					Yes	2026 - 2031
Pre-Planning	Ayre		3a		604.9	621.7					Yes	unknown
Active	Beatrice		1a		566.4	579.6					Yes	2026 - 2031
Pre-Planning	Beech North		3a		454.0	470.8					Yes	unknown
Pre-Planning	Beech South		3a		348.8	366.3					Yes	unknown
Pre-Planning	Bellrock		3a		357.6	374.4					Yes	unknown
In-planning	Berwick Bank	1	2		375.5	385.8		Yes			Yes	2023-2025
Consented	Blyth Demonstration Phases 2&3	3	1a		229.9	231.8		Yes			Yes	2022-2025
Planned	Borkum Riffgrund 3	6			313.3	321.0		Yes				2023-2025
Pre-Planning	Bowdun		3a		397.0	413.6					Yes	2024 - 2028
Pre-Planning	Broadshore		3a		532.9	549.7					Yes	unknown
Pre- Planning	Campion	6			387.3	404.4		Yes			Yes	2024-2028
Pre-planning Application	Cluaran Deas Ear DEME E3	6			397.0	413.6		Yes				2024-2028
Approved	Courseulles-sur-mer	3			455.5	418.9		Yes				2022-2023
Under Construction	Dogger Bank A	1	1b		114.4	132.1		Yes			Yes	2022-2023
Under Construction	Dogger Bank B	1	1b		132.8	150.7		Yes			Yes	2022-2025
Under Construction	Dogger Bank C	2	1b		160.1	177.1		Yes			Yes	2024-2027
Pre-planning	Dogger Bank D		2		[redacted]	[redacted]					Yes	2026-2029
Pre-planning	Dogger Bank South (East)	6	2	2	81.2	98.7		Yes	Yes		Yes	2026-2029

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Pre-planning	Dogger Bank South (West)	6	2	2	94.6	112.5		Yes	Yes		Yes	2026-2029
Approved	Dieppe–- Le Treport	3			362.4	340.3		Yes				2022-2023
Active	Dudgeon		1a	1	19.9	11.15	Yes		Yes		Yes	2026-2031
In-planning	Dudgeon Extension	4	1d	1	13.5	0.0	Yes	Yes	Yes		Yes	2025-2026
Active	East Anglia 1		1a		149.1	144.4					Yes	2026-2031
Consented	East Anglia 1N	3	1c		133.1	127.1		Yes			Yes	2025-2028
Consented	East Anglia 2	3	1c		141.0	131.0		Yes			Yes	2024-2027
Consented	East Anglia 3	3	1c		118.9	122.4		Yes			Yes	2024-2027
Approved	EnBW He Dreiht	3			313.9	321.5		Yes				2023-2024
Concept/Early Plan	Endurance	6		3	43.2	60.0		Yes	Yes			2023-2025
Consented	Fecamp	3			394.3	363.8		Yes				2022-2023
Pre-planning Application	Five Estuaries	6	2		175.5	162.5		Yes			Yes	2026-2031
Planned	Forthwind Ltd	6			387.7	387.3		Yes				2024-2028
Active	Galloper		1a		172.6	158.4					Yes	2026-2031
Consented	Gode Wind 3	3			367.4	375.1		Yes				2023-2025
Active	Greater Gabbard		1a		173.9	159.3					Yes	2026-2031
Active	Gunfleet Sands		1a		195.9	177.5					Yes	2026-2031
Construction	Hollandse Kust Nord	2			198.9	204.6		Yes				2022-2023
Planned	Hollandse Kust (West)	6			189.6	193.4		Yes				2024-2025
Construction	Hollandse Kust (Zuid)	2			205.7	210.1		Yes				2023
Active	Hornsea 1		1a		21.4	38.2					Yes	2026-2031

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Active	Hornsea 2		1a		17.7	35.5					Yes	2026-2031
Consented	Hornsea 3	3	1c	1	59.4	70.9		Yes	Yes		Yes	2024-2025
In Planning	Hornsea 4	4	1d	1	36.5	53.3		Yes	Yes		Yes	2025-2030
Active	Humber Gateway		1a		45.5	33.1					Yes	2026-2031
Active	Hywind		1a		455.7	472.5					Yes	2026-2031
Construction	Inch cape	2	1c		374.5	382.8		Yes			Yes	2022-2023
Active	Inner Dowsing		1a	1	50.33	3.30	Yes		Yes		Yes	2026-2031
Active	Kentish Flats		1a		222.6	201.6					Yes	2026-2031
Active	Kentish Flats Extension		1a		223.3	201.6					Yes	2026-2031
Active	Kincardine		1a		418.1	431.6					Yes	2026-2031
Active	London Array		1a		198.3	182.1					Yes	2026-2031
Active	Lincs		1a	1	45.24	0.18	Yes		Yes		Yes	2026-2031
Active	Lynn		1a	1	53.61	10.61	Yes				Yes	2026-2031
Active	Methil		1a		389.1	388.9					Yes	2026-2031
Active	Moray East		1a		553.2	568.0					Yes	2026-2031
Consented	Moray west	3	1c		555.8	568.7		Yes			Yes	2023-2024
Pre- Planning	Morven BP E1	6			334.9	351.7		Yes				2024-2028
Pre-planning	Muir Mhor	6			425.36	450.45		Yes				2030-2031
Planned	N-10.1 (DE3C)	6			315.4	324.1		Yes				2028-2029
Planned	N-10.2 (DE3I)	6			308.8	318.3		Yes				2028-2029
Construction	Neart na Gaoithe		1a		357.0	363.0					Yes	2023

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Planned	North Sea Cluster – Nordsee Three (N-3.5)	6			351.0	358.6		Yes				2027-2028
Planned	North Sea Cluster 0-Delta Nordsee 1&2 (N-3.6)	6			346.7	354.4		Yes				2026-2027
Planned	North Sea Cluster – Gode Wind (N-3.7)	6			364.8	372.5		Yes				2024-2025
Planned	North Sea Cluster – Nordsee Two (N-3.8)	6			352.8	360.5		Yes				2024-2025
Planned	Atlantis 1 (N-6.6)	6			293.1	300.8		Yes				2026-2027
Planned	N-6.7	6			287.4	295.1		Yes				2026-2027
Planned	Global Tech II (N-7.2)	6			311.5	319.2		Yes				2025-2026
Planned	N-9.1	6			282.7	290.5		Yes				2027-2028
Planned	N-9.2	6			298.2	306.7		Yes				2027-2028
Planned	N-9.3	6			277.9	286.0		Yes				2026-2027
Planned	Nordsren II vest	6		1	362.0	374.8		Yes				2023-2024
Planned	Nordsren III vest	6		1	343.6	356.8		Yes				2023-2024
Consented	Norfolk Boreas	3	1c	1	94.9	100.5		Yes	Yes		Yes	2023-2026
Consented	Norfolk Vanguard East	3	1c		104.1	108.6		Yes			Yes	2023-2025
Consented	Norfolk Vanguard West	3	1c	1	83.8	86.7		Yes	Yes		Yes	2023-2025
Pre-planning Application	North Falls	6			169.9	155.1		Yes			Yes	2026-2029
Planned	Parc eolien pose au large de la Normadie (AO4)	6			406.5	369.0		Yes				2024-2026
In-planning	Pentland floating demonstrator	4			638.5	649.9		Yes				2023-2026
Consented	Perpetuus Tidal Energy	3			361.5	317.5		Yes				2023-2024

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Active	Race Bank		1a	1	22.8	0.00	Yes		Yes		Yes	2026-2031
Active	Rampion		1a		321.5	284.8					Yes	2026-2031
Pre-planning Application	Rampion 2	5	2		326.4	288.5		Yes			Yes	2023-2028
Active	Scroby Sands		1a	1	97.6	85.3					Yes	2026-2031
Under Construction	SeaGreen offshore windfarm	2	1a		375.5	385.8		Yes			Yes	2022-2023
Active	Sheringham Shoal		1a		34.0	16.7					Yes	2026-2031
In-planning	Sheringham Shoal Extension	4	1d	1	26.1	8.8	Yes	Yes	Yes		Yes	2025-2028
Under Construction	Sofia	2	1b		139.4	156.8		Yes			Yes	2023-2025
Active	Teesside		1a		182.2	177.8					Yes	2026-2031
Active	Thanet		1a		225.8	209.7					Yes	2026-2031
Concept/Early plan	Thor	6			472.8	485.9		Yes				2024-2027
Active	Triton Knoll		1a	1	7.7	5.5	Yes		Yes		Yes	2026-2031
Consented	Vesterhav Nord	3			524.9	538.0		Yes				2022-2023
Consented	Vesterhav Syd	3			491.1	503.1		Yes				2022-2023
Pre-planning	West of Orkney	6			663.0	673.7		Yes				2028-2030
Active	Westermost Rough		1a		59.5	53.9					Yes	2026 - 2031
Offshore windfarm cables												
Consented	Hornsea 3 Transmission Asset	3		1	19.2	25.5	Yes	yes	Yes			2026-2031
In Planning	Hornsea Project 4 (HOW04) Offshore Transmission Owner (OFTO)	6		1	36.2	53.0		Yes	Yes			2025-2030
Consented	Norfolk Boreas Transmission Asset	6		1	71.2	56.8		Yes	Yes			2025-2028

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Consented	Norfolk Vanguard West Transmission Asset	3		1	75.7	62.1		Yes	Yes			2023-2025
Consented	Norfolk Vanguard East Transmission Asset	3		1	75.7	62.1		Yes	Yes			2023-2025
Consented	Doggerbank A OFTO	3		3	81.5	85.8		Yes	Yes			2022-2023
Consented	DoggerBank B OFTO	3		1	81.5	85.8		Yes	Yes			2023-2026
Aggregate and Disposal Sites												
Active	Outer Dowsing Westminster Gravels Ltd (515/2)			1	1.08	0.00	Yes		Yes			2021-2029
Active	Outer Dowsing Westminster Gravels Ltd (515/1)			1	11.12	2.73	Yes		Yes			2021-2029
Active	Hanson Aggregates Marine Ltd (106/2)			1	27.62	8.58	Yes		Yes			2021-2029
Active	Hanson Aggregates Marine Ltd (106/3)			1	29.49	2.83	Yes		Yes			2021-2029
Active	Hanson Aggregates Marine Ltd (106/1)			1	30.39	10.19	Yes		Yes			2021-2029
Active	Hanson Aggregates Marine Ltd (400)			1	36.64	2.90	Yes		Yes			2021-2029
Active	Hanson Aggregates Marine Ltd (1805)			1	39.1	0.0	Yes		Yes			2021-2029
Active	Tarmac Marine Ltd (197)			1	36.94	6.43	Yes		Yes			2021-2029
Active	Tarmac Marine Ltd (481/1)			1	6.1	32.11	Yes		Yes			2021-2031
Active	Van Oord Ltd (481/2)			1	1.9	33.32	Yes		Yes			2024-2031
Active	Tarmac Marine Ltd (493)			1	39.65	6.10	Yes		Yes			2021-2031
Active	Race Bank Disposal Site			1	22.76	0.00	Yes		Yes			2021-2031
Active	Hornsea Disposal Area 1			1	9.1	24.1	Yes		Yes			2021-2031
In-planning	Aggregate area 2103			1	30.2	0.0	Yes		Yes			2023-2031
Subsea cables and pipelines												
Proposed	Eastern Link Cable	6		1	87.7	88.7			Yes			2027-2029
Active	Hornsea 1 OFTO	1		1	4.2	17.7	Yes					2021-2031

Status	Project /Plan Name	Tier – Marine Mammals	Tier - Ornithology	Tier – Other receptors	Distance to array (km)	Distance to ECC (km)	Relevant Receptor					Relevant Years
							Benthic and Intertidal Ecology	Marine Mammals	Migratory Fish	Onshore Ecology	Offshore ornithology	
Active	Hornsea 2 OFTO	1		1	5.2	18.1	Yes					2022-2031
Under Construction	Triton Knoll	2		1	14.3	0.0	Yes		Yes			2021-2031
Consented	Hornsea 3 Transmission Asset	3		1	19.2	25.5	Yes		Yes			2025-2031
In-planning	Hornsea 4 OFTO	1		1	36.2	53.0			Yes			2025-2030
Active	Dudgeon OFTO	1		1	28.0	17.5	Yes					2021-2031
Active	Race Bank OFTO	1		1	28.6	3.6	Yes					2021-2031
Active	Lincs	1		1	49.6	4.2	Yes					2021-2031
Active	Inner Dowsing	1		1	52.5	5.4	Yes					2021-2031
Active	Lynn	1		1	54.5	8.9	Yes					2021-2031
Oil and Gas Pipelines												
In-planning	Elgood to Blythe Gas Export	1		1	21.7	14.5	Yes		Yes			2021-2031
In-planning	Elgood to Blythe Umbilical	1		1	21.8	14.6	Yes		Yes			2021-2031
In-planning	Blythe to Thames Tie-in Gas Export	1		1	29.7	22.1			Yes			2021-2031
In-planning	Thames Export Pipeline	1		1	49.3	45.3			Yes			2021-2031
In-planning	Tolmount 3 Ich Methanol Pipieline	1		1	54.8	44.2			Yes			2021-2031
PrecommissIn-planning	Tolmount 20 Inch GAS Export Pipeline			1	54.8	44.2			Yes			2021-2031
Active	Gas Shearwater to Bacton Seal Line (Shell)			1	0.0	0.0	Yes					2021-2031
Oil and Gas Subsurface												
Precommissioned	Durango 48/21A-4	1		1	21.1	3.9	Yes		Yes			2021-2031
Precommissioned	Pipeline PL370 Cut End Point 1	1		1	58.5	61.9	Yes		Yes			2021-2031
Precommissioned	Pipeline PL370 Cut End Point 2	1		1	58.5	61.9	Yes		Yes			2021-2031
Precommissioned	53/02A-14A Leman South	1		1	79.4	82.5			Yes			2021-2031
Oil and Gas Surface												
Precommissioned	48/9A Mimas	1		1	18.4	32.7	Yes		Yes			2021-2031
Precommissioned	49/11B Tethys	1		1	36.1	43.8			Yes			2021-2031
Precommissioned	Tolmount	1		1	64.9	78.2			Yes			2021-2031
Precommissioned	44/23A Kelvin TM	1		1	98.8	113.9			Yes			2021-2031

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

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

11.2 Benthic and Intertidal Ecology

11.2.1 The potential for LSE in-combination from the Project with regard to benthic subtidal and intertidal ecology is summarised in Section 8.2, with the in-combination assessment presented below.

11.2.2 Information to inform the AA alone for subtidal and benthic intertidal ecology is provided in Section 10 which assesses seven impacts, across seven sites (North Norfolk Sandbanks and Saturn Reef SAC, Inner Dowsing, Race Bank, and North Ridge SAC, The Wash and North Norfolk Coast SAC, Humber Estuary Ramsar, Humber Estuary SAC, Gibraltar Point Ramsar, and The Wash Ramsar) during the construction, decommissioning, and operation and maintenance phases.

11.2.3 Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology considers that several of the impacts assessed for the Project alone are not considered relevant in the cumulative assessment due to:

- the highly localised nature of the impacts;
- management and mitigation measures in place at the Project and on other projects that will reduce the risk occurring; and
- where the potential significance of the impact from the Project alone has been assessed as negligible and there is no overall significance

11.2.4 Therefore, based on these conclusions, the in-combination assessment presented below excludes several impacts assessed for the Project alone. Table 11.2 summarises the impacts that are assessed in the benthic subtidal and intertidal ecology in-combination assessment presented here.

11.2.5 Figure 11.1 shows the location of the Projects considered in-combination for the benthic and intertidal ecology assessments.

Table 11.2: Screening of impacts for inclusion in AA in-combination, following AA alone conclusions (taken from PEIR Part 6, Volume 1, Chapter 9: Benthic Subtidal and Intertidal Ecology)

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
Physical habitat loss/disturbance	Yes, all phases	N/A

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
Suspended sediment/deposition	Yes, all phases	N/A
Accidental and Indirect Pollution	No	The impact is highly localised and of negligible significance according to PEIR Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology. Through existing standard operating and pollution prevention guidelines which are required for all marine vessels and installations (including through MARPOL), the potential for an effect from any marine project is inherently addressed through these standard requirements. Therefore, on this basis it is reasonable to conclude that there is no LSE in-combination and following the approach considered for this draft RIAA (and on other OWF projects), this impact is screened out of the in-combination assessment.
INNS	No	The impact is highly localised and of negligible significance according to PEIR Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology. Through existing standard operating guidance, industry legislation, codes of conduct, and best practice guidelines which are required for all marine vessels and installations (including the Invasive Alien Species [Enforcement and Permitting] Order 2019[10] and Marine Strategy Framework Directive[11]), the potential for an effect from any marine project is inherently addressed through these standard requirements. Therefore, on this basis it is reasonable to conclude that there is no LSE in-combination and following the approach considered for this draft RIAA (and on other OWF projects), this impact is screened out of the in-combination assessment.
Changes to physical processes	No	The impact is considered to be negligible within the PEIR Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology. The assessment for the impact alone concluded a negligible impact with no residual impacts from the Project, as it is generally

[10] https://www.legislation.gov.uk/uksi/2019/527/contents/made

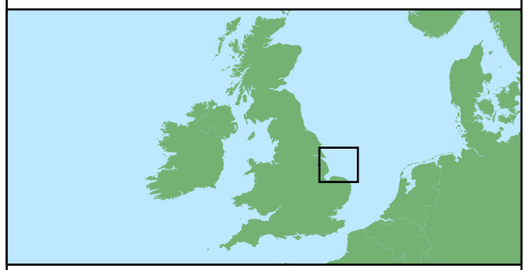
[11] https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive_en#:~:text=funded%20research%20contribution-,What%20the%20EU%20Marine%20Strategy%20Framework%20Directive%20(MSFD)%20is,economic%20and%20social%20activities%20depend.

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
		considered that the patterns of processes governing the overall evolution of the systems are at a much larger scale than the proposed works, and any changes to seabed morphology are not considered likely to influence the overall form and function of the system. Additionally, the range of effects are considered to be limited. Therefore, it is considered that there is no pathway for effect in-combination and following the approach considered for this draft RIAA (and on other OWF projects), this impact is screened out of the in-combination assessment.

300000
350000
400000
5950000
5900000
5850000
N
Hornsea Project 2 OFTO
Hornsea Project 2 OFTO
Hornsea 1 OFTO
MIMAS TO SATURN
Hornsea Disposal Area 1
Triton Knoll
493
106/1
106/2
197
400
106/3
Triton Knoll Transmission Asset
515/2
515/1
SHEARWATER TO BACTON (SEAL) 34IN GAS LINE
1805
481/1
481/2
Dudgeon Extension
DURANGO TO WAVENEY
ELGOOD TO BLYTHE GAS EXPORT / UMBILICAL
Dudgeon
Dudgeon Extension
Race Bank
Inner Dowsing
Lincs
Race Bank OFTO
Inner Dowsing OFTO
Lynn
Lincs OFTO
Race Bank Sea Disposal Area
Sheringham Shoal Extension
Dudgeon OFTO
Hornsea 3 Transmission Asset

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Offshore Wind Farms
- Offshore Wind Farm Cable Agreements
- Aggregate Areas
- Race Bank Disposal Site
- Pipelines



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:500,000

Plans and Projects Considered for Benthic and Intertidal Ecology

Figure 11.1

OUTER DOWSING OFFSHORE WIND

Date: 05/05/2023
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Revision: 0.1

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11.2.6 As outlined in Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology, for potential effects on benthic and intertidal ecology, planned projects were screened into the assessment based on a screening range that encapsulates the Project's benthic and intertidal study area as defined by the secondary ZoI, which has been defined based on the expected maximum distance that water from within the RLB might be transported on a single mean spring tide, in the flood and/or ebb direction. This screening area therefore encompasses the extent of impacts to benthic and intertidal ecology associated with the Project.

11.2.7 Table 11.1 above highlights the Projects which have been screened in for the in-combination assessment for benthic and subtidal ecology, these can be summarised into three main types of projects:

- OWFs – both planned and consented;
- OWF cables;
- Aggregate and disposal areas;
- Subsea cables and pipelines;
- Oil and gas pipelines;
- Oil and gas subsurface;
- Oil and gas surface; and
- Carbon capture and storage.

11.2.8 With regard to the potential impacts considered in-combination, the potential for a LSE in-combination was identified for the benthic habitats of the following sites (noting that not all effects apply to all sites):

- North Norfolk Sandbanks and Saturn Reef SAC;
- Inner Dowsing, Race Bank and North Ridge SAC;
- The Wash and North Norfolk Coast SAC;
- Humber Estuary Ramsar;
- Humber Estuary SAC;
- North Norfolk Coast Ramsar;
- North Norfolk Coast SAC;
- Gibraltar Point Ramsar; and
- The Wash Ramsar.

11.2.9 It is worth noting that the screening exercise undertaken to inform this draft RIAA was based on a broader cable corridor than the finalised cable route established at PEIR, which has resulted in an increased number of SACs and effects being considered here on a precautionary basis. An updated screening exercise will be undertaken before the final RIAA for application, which could result in a revised list of sites for the final RIAA.

Construction and decommissioning

11.2.10 The potential for an AEoI in-combination as a result of effects on benthic and intertidal ecology during construction and decommissioning phases relates to the sites listed above. As for the Project alone assessment, the potential for LSE during decommissioning would be no greater than, and potentially less than, those outlined for the construction phase.

Physical habitat loss/disturbance

11.2.11 There is the potential for in-combination physical habitat loss/disturbance as a result of both the construction and decommissioning activities associated with the Project and the Tier 1, 2 and 3 projects identified in Table 11.1. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic subtidal ecology study area (as defined within Section 8.2).

11.2.12 The plans or projects identified as potentially contributing to an in-combination effect on the sites listed above (paragraph 11.2.8), as a result of physical habitat loss/disturbance are as follows:

- Tier 1;
  - Inner Dowsing OWF;
  - Lincs OWF;
  - Triton Knoll OWF;
  - Race Bank OWF;
  - Dudgeon OWF;
  - Lynn OWF;
  - Sheringham Shoal Extension OWF;
  - Dudgeon Extension OWF;
  - Hornsea Three Transmission Asset;
  - Westminster Gravels Ltd (515/2);
  - Westminster Gravels Ltd (515/1);
  - Hanson Aggregates Marine Ltd (106/2);
  - Hanson Aggregates Marine Ltd (106/3);
  - Hanson Aggregates Marine Ltd (106/1);
  - Hanson Aggregates Marine Ltd (400);
  - Hanson Aggregates Marine Ltd (1805);
  - Tarmac Marine Ltd (197);
  - Tarmac Marine Ltd (481/1);
  - Tarmac Marine Ltd (493);

- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site;
- Hornsea Disposal Area 1;
- Hornsea 1 OFTO;
- Hornsea 2 OFTO;
- Triton Knoll Transmission Asset;
- Dudgeon OFTO;
- Race Bank OFTO;
- Lincs Transmission Asset;
- Inner Dowsing Transmission Asset;
- Gas Shearwater to Bacton Seal Line (Shell);
- Elgood to Blythe Gas Export Pipeline;
- Elgood to Blythe Umbilical Pipeline;
- Durango 48/21A-4 Oil and Gas Works; and
- 48/9A Mimas Oil and Gas Works.

- Tier 2;
  - No Tier 2 projects identified.
- Tier 3;
  - No Tier 3 projects identified.

Tier 1 Projects

11.2.13 Of the Tier 1 projects identified above, for a project to have an in-combination effect on a designated site with the Project with respect to physical habitat loss/disturbance, it is considered that there must be a direct overlap with an SAC that is also impacted by the Project. Therefore, several of the projects listed above do not require consideration, with only the following projects identified as having any overlap with the Inner Dowsing, Race Bank and North Ridge SAC (the only SAC considered to have a potential impact on physical habitat loss and disturbance from the Project):

- Inner Dowsing OWF;
- Lincs OWF;
- Race Bank OWF;
- Lynn OWF;
- Westminster Gravels Ltd (515/1);
- Tarmac Marine Ltd (481/1);

- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site
- Triton Knoll Transmission Asset;
- Race Bank OFTO;
- Lincs Transmission Asset; and
- Inner Dowsing Transmission Asset.

11.2.14 The Inner Dowsing OWF, Lincs OWF, Race Bank OWF, Lynn OWF, Westminster Gravels Ltd (515/1), Tarmac Marine Ltd (481/1), Van Oord Ltd (481/2), Race Bank Sea Disposal Site, Triton Knoll Transmission Asset, Race Bank OFTO, Lincs Transmission Asset, and Inner Dowsing Transmission Asset all have direct overlap with the Inner Dowsing, Race Bank and North Ridge SAC. The Project also overlaps with this SAC and therefore there is a potential for an in-combination effect to arise.

11.2.15 *S. spinulosa* is a feature of the Inner Dowsing, Race Bank and North Ridge SAC and as outlined within the project alone assessment, a pre-construction Annex I habitat survey will be implemented where the project crosses with the SAC to determine the location of any potential *S. spinulosa* reef features (Table 7.1). Mitigation options will be agreed with Natural England to identify the most appropriate measures to minimise the impact to any potential *S. spinulosa* reef. It is therefore anticipated that all habitat loss to *S. spinulosa* reef features within the SAC will be avoided, and therefore there will be no physical habitat loss/disturbance with the designated biogenic reef features. As there will be no interaction between the Project and the designated biogenic reef feature, it is considered that there is no pathway for the Project to act in-combination with the identified projects on this feature. There is, **therefore, no potential for AEoI on *S. spinulosa* reef features, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC in relation to physical habitat loss/disturbance from the Project in-combination with other Tier 1 plans and projects during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term**.

11.2.16 The SAC contains a variety of dynamic sandbanks, with an influx of sediments from the north, thus the inhabiting fauna are therefore likely to be relatively tolerant to habitat disturbances and there is a good chance of renewing the physical structure of the banks and associated benthic communities (JNCC and Natural England, 2010). The likely biotopes present within the Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' are deemed to be of low vulnerability, medium to high recoverability to habitat disturbance. Of the identified plans, projects and activities, only O&M activities from Race Bank OWF are expected to impact on the sandbank features of the SAC in-combination with the Project. It is noted that the Project will not directly impact on the Race Bank sandbank, and any activities from the Race Bank project are expected to small scale. Considering the medium to high recoverability of the communities of the sandbank feature, and the embedded mitigation for the Project to redistribute any removed sediment back within the SAC (to support the recovery of the physical sandbanks), and the ongoing sediment transport to the SAC, it is expected that the sandbank features will recover within a short (1 – 2 years) timeframe. There is, **therefore, no potential for AEoI on sandbank features, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC in relation to physical habitat loss/disturbance from the Project in-combination with other Tier 1 plans and projects and therefore, subject to natural change, the designated features will be maintained in the long-term**.

11.2.17 It is worth noting that the Race Bank Sea Disposal Site does have overlap with the Inner Dowsing, Race Bank and North Ridge SAC, however the Race Bank Sea Disposal Site is not operational and therefore there is no pathway to result in an in-combination effect on the Inner Dowsing, Race Bank and North Ridge SAC.

Tier 2 Projects

11.2.18 No Tier 2 projects identified.

Tier 3 Projects

11.2.19 No Tier 3 projects identified.

Suspended sediment/deposition

11.2.20 There is the potential for in-combination suspended sediment/deposition as a result of both the construction and decommissioning activities associated with the Project and the Tier 1, 2 and 3 projects identified in Table 11.1. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the screening range defined within Section 8.2..

11.2.21 The plans or projects identified to contribute to an in-combination effect on the sites listed above (paragraph 11.2.8), as a result of suspended sediment/deposition are as follows:

- Tier 1;
  - Inner Dowsing OWF;
  - Lincs OWF;
  - Triton Knoll OWF;

- Race Bank OWF;
- Dudgeon OWF;
- Lynn OWF;
- Sheringham Shoal Extension OWF;
- Dudgeon Extension OWF;
- Hornsea Three Transmission Asset;
- Westminster Gravels Ltd (515/2);
- Westminster Gravels Ltd (515/1);
- Hanson Aggregates Marine Ltd (106/2);
- Hanson Aggregates Marine Ltd (106/3);
- Hanson Aggregates Marine Ltd (106/1);
- Hanson Aggregates Marine Ltd (400);
- Hanson Aggregates Marine Ltd (1805);
- Tarmac Marine Ltd (197);
- Tarmac Marine Ltd (481/1);
- Tarmac Marine Ltd (493);
- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site;
- Hornsea Disposal Area 1;
- Hornsea 1 OFTO;
- Hornsea 2 OFTO;
- Triton Knoll Transmission Asset;
- Dudgeon OFTO;
- Race Bank OFTO;
- Lincs Transmission Asset;
- Inner Dowsing Transmission Asset;
- Gas Shearwater to Bacton Seal Line (Shell);
- Elgood to Blythe Gas Export Pipeline;
- Elgood to Blythe Umbilical Pipeline;
- Durango 48/21A-4 Oil and Gas Works; and
- 48/9A Mimas Oil and Gas Works.

- Tier 2;
  - No Tier 2 projects identified.
- Tier 3;
  - No Tier 3 projects identified.

Tier 1

11.2.22 Of the Tier 1 projects identified above, for a project to have an in-combination effect on a designated site with the Project with respect to suspended sediment/deposition, it is considered that there must be an overlap of the ZoI for suspended sediment/deposition to reach. It is considered within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology that up to 600m from the release point is considered to be the zone of lesser but measurable SSC increase and no measurable thickness of deposition. Therefore, projects and sites that fall within the 600m zone of measurable SSC increases have been assessed for a potential in-combination impact. The only sites considered to be within this ZoI for in-combination effects are the Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, and The Wash Ramsar. Additionally, several of the projects listed above do not require consideration, with only the following projects identified as having any overlap with any potential SAC:

- Inner Dowsing OWF;
- Lincs OWF;
- Race Bank OWF;
- Lynn OWF;
- Westminster Gravels Ltd (515/1);
- Hanson Aggregates Marine Ltd (106/3);
- Hanson Aggregates Marine Ltd (1805);
- Tarmac Marine Ltd (481/1);
- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site;
- Hornsea Three Transmission Asset;
- Triton Knoll Transmission Asset;
- Dudgeon OFTO;
- Race Bank OFTO;
- Lincs Transmission Asset; and
- Inner Dowsing Transmission Asset.

11.2.23 The Inner Dowsing OWF, Lincs OWF, Race Bank OWF, Lynn OWF, Westminster Gravels Ltd (515/1), Hanson Aggregates Marine Ltd (106/3), Hanson Aggregates Marine Ltd (1805), Tarmac Marine Ltd (481/1), Van Oord Ltd (481/2), Race Bank Sea Disposal Site, Triton Knoll Transmission Asset, Race Bank OFTO, Lincs Transmission Asset and Inner Dowsing Transmission Asset all have direct overlap with the Inner Dowsing, Race Bank and North Ridge SAC. The Hornsea Three Transmission Asset, Dudgeon OFTO and Race Bank OFTO all have direct overlap with The Wash and North Norfolk Coast SAC. The Race Bank OFTO has direct overlap with The Wash Ramsar site and as the Project also overlaps with this SAC. The Project also overlaps with this SAC and therefore there is a potential for an in-combination effect to arise.

11.2.24 Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology details that the highest increase in SSC and greatest likely thickness of deposition will occur in the 0-50 m zone, where all gravel sized sediment and also a large proportion of sands that are not resuspended high into the water column will settle. As distance increases the thickness of deposition and levels of SSC is likely to decrease with mainly fines remaining in suspension. For the three designated sites, the two features that are considered to be potentially impacted the most by suspended sediment/deposition are *S. spinulosa* reef and sandbanks which are slightly covered by sea water all the time. *S. spinulosa* reef are considered to have some level of tolerance, resilience and recoverability to SSC and deposition effects.

11.2.25 *S. spinulosa* are often found in areas of high-water movement with some degree of sediment transport essential for tube-building and feeding (Jackson and Hiscock, 2008). Given their preference for turbid waters their tolerance to the suspension and/or settlement of fine material during adjacent construction activity may be high (Jackson and Hiscock 2008; Tyler-Walters 2008). *S. spinulosa* reefs adjacent to for example aggregate dredging areas appear unimpacted by dredging operations (Pearce *et al*. 2007; Pearce *et al*. 2011). Evidence suggests that given the dynamic sedimentary environments in which sabellariids live, their populations can certainly persevere in turbid conditions in spite of 'typical' natural levels of burial (Last *et al*. 2011) and that recovery from burial events is high. In addition, the short-term and intermittent nature of the effects associated with the construction and decommissioning works, mean that it is considered that there will be limited impacts on *S. spinulosa* reef within the site.

11.2.26 For the designated sandbank feature at the site, the re-settlement of the deposited sediments will mean that all sediment is immediately available for transport at the naturally occurring rate and direction, controlled entirely by natural processes. As such, the sediment will have immediately re-joined the natural sedimentary environment within the local area and so by definition is not 'lost from the system' due to the dredging/spoil disposal process. Due to the dynamic nature of the sandwaves, these morphological features are considered to have moderate levels of recoverability (Part 6, Volume 1, Chapter 7: Marine Processes). It is therefore considered that as the Project has been concluded to have no AEoI on the features at this site from the Project alone (Section 10.2), it is considered that there is no pathway for effect in-combination between the project and any of the identified projects. There is, **therefore, no potential for AEoI, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, and The Wash Ramsar in relation to suspended sediment/deposition from the Project in-combination with other Tier 1 plans and projects during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term**.

Tier 2 Projects

11.2.27 No Tier 2 projects identified.

Tier 3 Projects

11.2.28 No Tier 3 projects identified.

O&M

11.2.29 The potential for an AEoI in-combination as a result of effects on benthic and intertidal ecology during O&M relates to the sites listed above.

Physical habitat loss/disturbance

11.2.30 There is the potential for in-combination physical habitat loss/disturbance as a result of both the O&M activities associated with the Project and the Tier 1, 2 and 3 projects identified in Table 11.1. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic ecology study area.

11.2.31 The plans or projects identified to contribute to an in-combination effect on the sites listed above (paragraph 11.2.8), as a result of physical habitat loss/disturbance are as follows:

- Tier 1;
  - Inner Dowsing OWF;
  - Lincs OWF;
  - Triton Knoll OWF;
  - Race Bank OWF;
  - Dudegon OWF;
  - Lynn OWF;

- Sheringham Shoal Extension OWF;
- Dudgeon Extension OWF;
- Hornsea Three Transmission Asset;
- Westminster Gravels Ltd (515/2);
- Westminster Gravels Ltd (515/1);
- Hanson Aggregates Marine Ltd (106/2);
- Hanson Aggregates Marine Ltd (106/3);
- Hanson Aggregates Marine Ltd (106/1);
- Hanson Aggregates Marine Ltd (400);
- Hanson Aggregates Marine Ltd (1805);
- Tarmac Marine Ltd (197);
- Tarmac Marine Ltd (481/1);
- Tarmac Marine Ltd (493);
- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site;
- Hornsea Disposal Area 1;
- Hornsea 1 OFTO;
- Hornsea 2 OFTO;
- Triton Knoll Transmission Asset;
- Dudgeon OFTO;
- Race Bank OFTO;
- Lincs Transmission Asset;
- Inner Dowsing Transmission Asset;
- Gas Shearwater to Bacton Seal Line (Shell);
- Elgood to Blythe Gas Export Pipeline;
- Elgood to Blythe Umbilical Pipeline;
- Durango 48/21A-4 Oil and Gas Works; and
- 48/9A Mimas Oil and Gas Works.

- Tier 2;
  - Dogger Bank South (East);
  - Dogger Bank South (West);

- Tier 3;
    - No Tier 3 projects identified

Tier 1 Projects

11.2.32 Of the Tier 1 projects identified above, for a project to have an in-combination effect on a designated site with the Project with respect to physical habitat loss/disturbance, it is considered that there must be a direct overlap with an SAC that is also impacted by the Project. Therefore, several of the projects listed above do not require consideration, with only the following projects identified as having any overlap with the Inner Dowsing, Race Bank and North Ridge SAC (the only SAC considered to have a potential impact on physical habitat loss and disturbance from the Project):

- Inner Dowsing OWF;
- Lincs OWF;
- Race Bank OWF;
- Lynn OWF;
- Westminster Gravels Ltd (515/1);
- Tarmac Marine Ltd (481/1);
- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site
- Triton Knoll Transmission Asset;
- Race Bank OFTO;
- Lincs Transmission Asset; and
- Inner Dowsing Transmission Asset.

11.2.33 The Inner Dowsing OWF, Lincs OWF, Race Bank OWF, Lynn OWF, Westminster Gravels Ltd (515/1), Tarmac Marine Ltd (481/1), Van Oord Ltd (481/2), Race Bank Sea Disposal Site, Triton Knoll Transmission Asset, Race Bank OFTO, Lincs Transmission Asset, and Inner Dowsing Transmission Asset all have direct overlap with the Inner Dowsing, Race Bank and North Ridge SAC. The Project also overlaps with this SAC and therefore there is a potential for an in-combination effect to arise. However, when factoring the pre-construction Annex I habitat surveys implemented during construction, it is considered that there will be no biogenic reef features affected by the physical presence of the cable. Additionally, any O&M works undertaken for the project will be informed by these pre-construction surveys will know the locations of designated reef features and where to avoid them. Therefore, it is anticipated that habitat loss of *S. spinulosa* reef features within the SAC will be avoided by any O&M effects, and therefore there will be no physical habitat loss with the designated reef features. As there will be no interaction between the Project and the designated biogenic reef feature, it is considered that there is no pathway for the Project to act in-combination with the identified projects on this feature. There is, **therefore, no potential for AEoI on *S. spinulosa* reef features, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC in relation to physical habitat loss/disturbance from the Project in-combination with other Tier 1 plans and projects during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term.**

11.2.34 A preliminary CBRA has been undertaken by the Project for the section of the cable route which passes through the Inner Dowsing, Race Bank and North Ridge SAC. This is helping to further define the approach to cable installation as well as informing the requirement or otherwise for cable protection material over the designated sandbank features within the SAC site and the type, design and installation process for any such protection.

11.2.35 The Project intends to discuss the outcomes of the CBRA with stakeholders throughout the remaining pre-application period, principally through the EPP, in determining the Project design including (where a need is identified) such options for alternative, feasible cable installation and protection techniques that would demonstrably avoid any adverse effects on the integrity of the sandbank features. Future phases of the Project design will subsequently inform the RIAA that will accompany the DCO Application, and which will set out in full the assessment of the potential AEoI on the SAC sandbank features..

Tier 2 Projects

11.2.36 No Tier 2 projects identified.

Tier 3 Projects

11.2.37 No Tier 2 Projects identified

Suspended sediment/deposition

11.2.38 There is the potential for in-combination suspended sediment/deposition as a result of the O&M activities associated with the Project and the Tier 1, 2 and 3 projects identified in Table 11.1. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic ecology study area.

11.2.39 The plans or projects identified to contribute to an in-combination effect on the sites listed above (paragraph 11.2.8), as a result of suspended sediment/deposition are as follows:

- Tier 1;
  - Inner Dowsing OWF;
  - Lincs OWF;
  - Triton Knoll OWF;
  - Race Bank OWF;
  - Dudgeon OWF;
  - Lynn OWF;
  - Sheringham Shoal Extension OWF;
  - Dudgeon Extension OWF;
  - Hornsea Three Transmission Asset;
  - Westminster Gravels Ltd (515/2);
  - Westminster Gravels Ltd (515/1);
  - Hanson Aggregates Marine Ltd (106/2);
  - Hanson Aggregates Marine Ltd (106/3);
  - Hanson Aggregates Marine Ltd (106/1);
  - Hanson Aggregates Marine Ltd (400);
  - Hanson Aggregates Marine Ltd (1805);
  - Tarmac Marine Ltd (197);
  - Tarmac Marine Ltd (481/1);
  - Tarmac Marine Ltd (493);
  - Van Oord Ltd (481/2);
  - Race Bank Sea Disposal Site;
  - Hornsea Disposal Area 1;
  - Hornsea 1 OFTO;
  - Hornsea 2 OFTO;
  - Triton Knoll Transmission Asset;
  - Dudgeon OFTO;
  - Race Bank OFTO;
  - Lincs Transmission Asset;

- Inner Dowsing Transmission Asset;
- Gas Shearwater to Bacton Seal Line (Shell);
- Elgood to Blythe Gas Export Pipeline;
- Elgood to Blythe Umbilical Pipeline;
- Durango 48/21A-4 Oil and Gas Works; and
- 48/9A Mimas Oil and Gas Works.

- Tier 2;
  - No Tier 2 projects identified.
- Tier 3;
  - No Tier 3 projects identified.

Tier 1

11.2.40 Of the Tier 1 projects identified above, for a project to have an in-combination effect on a designated site with the Project with respect to suspended sediment/deposition, it is considered that there must be an overlap of the ZoI for suspended sediment/deposition to reach. It is considered within Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology that up to 600m from the release point is considered to be the zone of lesser but measurable SSC increase and no measurable thickness of deposition. Therefore, projects and sites that fall within the 600m zone of measurable SSC increases have been assessed for a potential in-combination impact. The only sites considered to be within this ZoI for in-combination effects are the Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, and The Wash Ramsar. Additionally, several of the projects listed above do not require consideration, with only the following projects identified as having any overlap with any potential SAC:

- Inner Dowsing OWF;
- Lincs OWF;
- Race Bank OWF;
- Lynn OWF;
- Westminster Gravels Ltd (515/1);
- Hanson Aggregates Marine Ltd (106/3);
- Hanson Aggregates Marine Ltd (1805);
- Tarmac Marine Ltd (481/1);
- Van Oord Ltd (481/2);
- Race Bank Sea Disposal Site;
- Hornsea Three Transmission Asset;

- Triton Knoll Transmission Asset;
- Dudgeon OFTO;
- Race Bank OFTO;
- Lincs Transmission Asset; and
- Inner Dowsing Transmission Asset.

11.2.41 The Inner Dowsing OWF, Lincs OWF, Race Bank OWF, Lynn OWF, Westminster Gravels Ltd (515/1), Hanson Aggregates Marine Ltd (106/3), Hanson Aggregates Marine Ltd (1805), Tarmac Marine Ltd (481/1), Van Oord Ltd (481/2), Race Bank Sea Disposal Site, Triton Knoll Transmission Asset, Race Bank OFTO, Lincs Transmission Asset and Inner Dowsing Transmission Asset all have direct overlap with the Inner Dowsing, Race Bank and North Ridge SAC. The Hornsea Three Transmission Asset, Dudgeon OFTO and Race Bank OFTO all have direct overlap with The Wash and North Norfolk Coast SAC. The Race Bank OFTO has direct overlap with The Wash Ramsar site and as the Project also overlaps with this SAC. The Project also overlaps with this SAC and therefore there is a potential for an in-combination effect to arise.

11.2.42 Part 6, Volume 1, Chapter 9: Benthic and Intertidal Ecology details that the highest increase in SSC and greatest likely thickness of deposition will occur in the 0-50 m zone, where all gravel sized sediment and also a large proportion of sands that are not resuspended high into the water column will settle. As distance increases the thickness of deposition and levels of SSC is likely to decrease with mainly fines remaining in suspension. For the three designated sites, the two features that are considered to be potentially impacted the most by suspended sediment/deposition are *S. spinulosa* reef and which are slightly covered by sea water all the time. *S. spinulosa* reef are considered to have some level of tolerance, resilience and recoverability to SSC effects. In addition, the short-term and intermittent nature of the effects associated with the O&M works, mean that it is considered that there will be no significant impact to *S. spinulosa* reef within the sites.

11.2.43 For the designated sandbank feature at the site, the re-settlement of the deposited sediments will mean that all sediment is immediately available for transport at the naturally occurring rate and direction, controlled entirely by natural processes. As such, the sediment will have immediately re-joined the natural sedimentary environment within the local area and so by definition is not 'lost from the system' due to the dredging/spoil disposal process. Due to the dynamic nature of the sandwaves, these morphological features are considered to have moderate levels of recoverability (Part 6, Volume 1, Chapter 7: Marine Processes). It is therefore considered that as the project will have no impact on the features at this site from the project alone (Section 10.2), it is considered that there is no pathway for effect in-combination between the project and any of the identified projects. There is, **therefore, no potential for AEoI, having regard to the conservation objectives of the Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast SAC, and The Wash Ramsar in relation to suspended sediment/deposition from the Project in-combination with other Tier 1 plans and projects during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term**.

Tier 2 Projects

11.2.44 No Tier 2 projects identified.

Tier 3 Projects

11.2.45 No Tier 3 projects identified.

11.3 Marine Mammals

11.3.1 The potential for LSE in-combination from the Project with regard to marine mammals is summarised in Section 8.2, with the in-combination assessment presented below.

11.3.2 Information to inform the Project alone assessment for marine mammals is provided in Section 10.3 which assesses impacts on the three marine mammal features (harbour porpoise, harbour seal and grey seal) associated with three UK sites and 12 transboundary sites during construction, operation, maintenance and decommissioning (Table 8.1).

11.3.3 Part 6, Volume 1, Chapter 11: Marine Mammals considers that several of the impacts assessed for the Project alone are not considered relevant in the cumulative assessment due to:

- the highly localised nature of the impacts;
- management and mitigation measures in place at the Project and on other projects that will reduce the risk occurring; and
- where the potential significance of the impact from the Project alone has been assessed as negligible.

11.3.4 Therefore, based on these conclusions, the in-combination assessment excludes several impacts assessed for the Project alone. Table 11.3 summarises the impacts that are assessed in the marine mammal in-combination assessment presented here.

Table 11.3: Screening of impacts for inclusion in AA in-combination, following AA alone conclusions (taken from PEIR Part 6, Volume 1, Chapter 11: Marine Mammals)

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
Underwater noise	Yes, but for disturbance in construction and decommissioning only	Auditory injury (PTS): where PTS may result from activities such as pile driving and UXO clearance, suitable mitigation will be put in place to reduce injury risk to marine mammals (as a requirement of European Protected Species legislation). Barrier effects are considered to be highly localised and negligible significance in to PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.
Vessel disturbance	Yes, all phases	N/A
Collision risk	No	It is expected that all offshore wind projects will follow the Codes of Conduct provided by the WiSe

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
		Scheme[12], Scottish Marine Wildlife Watching Code[13] or Guide to Best Practice for Watching Marine Wildlife[14] to reduce the already low risk of collisions with marine mammals.
Indirect pollution	No	Impact is highly localised and of negligible significance according to PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.
Accidental pollution	No	Impact is highly localised and of negligible significance according to PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.
Changes to prey	No	Impact is highly localised and of negligible significance according to PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.

11.3.5 As with the Project alone assessments presented in Section 10.3, the in-combination assessment for marine mammals assesses whether the impacts listed above have the potential to prevent the conservation objectives of the relevant designated sites being met. The same approach is taken here; however, the conservation objectives are not repeated.

11.3.6 The in-combination assessment for marine mammals has been determined based on the plans and projects described within Table 11.1 where there is potential for any phase of such projects to have temporal or spatial overlap with that of the Project. No information is currently available regarding oil and gas seismic surveys. For the final draft RIAA a review of historical survey effort within the SNS will be undertaken to inform a realistic assessment.

11.3.7 For clarity, a Zone of Influence (ZOI) has been applied to screen in relevant offshore projects. The ZOI for marine mammals is the species-specific MU (North Sea MU for porpoise, Southeast MU for harbour seals, combined Southeast and Northeast MUs for grey seals).

11.3.8 The assessment presented here draws on the cumulative assessments presented in PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.

11.3.9 Effectively for a project to be screened in for in-combination assessment, there needs to be potential for relevant works to occur within the same timeframe as relevant works at the Project, with these identified in Table 11.3. 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.

11.3.10 Each project has been considered on the basis of effect–receptor pathway, data confidence and the temporal and spatial scales involved. This screened in only some of the Projects presented in Table 11.1.

[12] https://www.wisescheme.org/
[13] https://www.nature.scot/scottish-marine-wildlife-watching-code-smwwc-part-1
[14] https://www.nature.scot/guide-best-practice-watching-marine-wildlife-smwwc-part-2

11.3.11 The time period considered for marine mammals is 2022-2030 inclusive and the potential piling window for the Project is expected to be sometime between 2027-2029 inclusive. The tiering structure discussed in Section 8.2 was used for the assessment, noting that the tiering structure for marine mammals is different to that of the other receptors and aligns with the tiers proposed by Natural England in 2022 as presented within Table 8.3 and PEIR Part 6, Volume 1, Chapter 11: Marine Mammals.

11.3.12 Where possible for each project, information on the expected impacts on marine mammal features of the relevant designated sites have been collated and used to inform the in-combination assessment presented below.

Construction and decommissioning

Underwater noise

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

11.3.14 Of the Projects identified in Table 11.1 above, those with the potential for an in-combination effect with the Project with respect to underwater noise are limited to those with potential for a temporal overlap of the construction phases (specifically piling or, if known, UXO or seismic survey).

11.3.15 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.

11.3.16 As highlighted in the assessment of 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); and
- Geophysical and seismic survey -planned geophysical/seismic survey included within the screening range (where that information is in the public domain).

11.3.17 It is of note that vessel disturbance is considered separately, as is operational noise.

11.3.18 The potential for underwater noise to result during construction of the Project, together with the sensitivity of harbour porpoise, harbour seal and grey seal to such noise, has been discussed in Section 10.3 as part of the assessment of AEoI alone, with that information not repeated here.

11.3.19 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

11.3.20 Of the projects presented in Table 11.1, it is considered that only six projects have the potential to have an in-combination effect with the Project. For a project to be considered for underwater noise, they must overlap temporally with the anticipated noise generating stages of construction (2026-2029 inclusive, Part 6, Volume 1, Chapter 11: Marine Mammals) and spatially with the SNS SAC. Based on the latest guidance, a 26km EDR is considered appropriate for underwater noise effects and therefore for a project to be considered to act in combination with the Project spatially it must have an overlap with the summer area of the SNS SAC when factoring in a 26 km buffer. Following this, the considered projects are:

- Dudgeon Extension OWF;
- East Anglia 1N OWF;
- East Anglia 2 OWF;
- Hornsea 3 OWF;
- Hornsea 4 OWF;
- Norfolk Boreas OWF;
- Dogger Bank South (East);
- Dogger Bank South (West); and
- Hornsea Three.

11.3.21 Table 11.4 and Table 11.5 below provide further information on the potential for spatial and temporal in-combination effects (respectively) on the SNS SAC.

11.3.22 For the Tier 3 and 4 projects assessed, it is considered that the degree of certainty in terms of project programme timeframe and project scale decreases with the increasing tier allocation. Whilst it is recognised that the planned construction windows of these windfarm projects, where publicly available, may overlap with (and may extend beyond) the construction window of the Project, it is acknowledged, in common with all such projects with such a large construction window during the planning process and prior to securing a CfD, that actual construction may 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.

11.3.23 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 while enabling the areas of ''risk'' in-combination to be identified. The areas of risk are effectively seasons where 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 here for the Outline SNS SAC SIP (to be submitted as part of the DCO Application). 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.

11.3.24 The assessment of the potential for AEoI with respect to underwater noise for plans and projects in-combination with the Project in relation to harbour porpoise is determined below, with regard to the conservation objectives of the site.

Potential for significant disturbance to the species within the site

11.3.25 For the purposes of the assessment of AEoI in-combination for harbour porpoise, the methodology applied to the assessment alone for the conservation objectives concerned with disturbance in harbour porpoise has been extended to consider the potential for effect from the above projects in-combination.

11.3.26 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 much of the array area construction activities will fall within the SNS SAC summer area (although in total the construction timeline will extend across a number of seasons), the assessment is presented on a seasonal basis – to enable the potential for effect to be fully understood for which works may occur from the Project.

11.3.27 The following assessment includes a number of assumptions, with these summarised as follows:

- Only relevant works at the Project that may result in underwater noise planned during the summer season (April – September) within the period 2026 – 2029 (i.e. the months during the expected construction timeframe that the summer area of the SNS SAC supports higher densities of harbour porpoise plus one year either side) are considered. This is in line with the cumulative assessment for marine mammals presented in PEIR Part 6, Volume 1, Chapter 11: Marine Mammals. It is expected that site preparation works prior to foundation installation will take place intermittently between Q1 2026 – Q4 2026;
- An assumption that all UXO clearance, geophysical survey and foundation piles at the Project will be installed within the 2026-2029 timeframe, but UXO/geophysical survey will precede piling (in any case adding totals would be inaccurate given the high degree of EDR overlap that would result);
- All construction activities associated with the Project are relevant to the summer season only;
- Piling may be consecutive (single piling event per 24-hours) or concurrent (up to two piling rigs per 24-hours);
- Piling may be monopiles (26 km EDR) or pinpiles (15 km EDR);
- Should geophysical survey occur, a 5 km buffer has been applied (as the 12km EDR applies to air gun surveys not typical of an offshore windfarm); 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).

11.3.28 Table 11.4 summarises the potential for effect from a single event (assumed worst case, whether that be monopiles or UXO clearance) per day for the Project and the Projects assessed in combination with the Project. Only those projects whose impact areas overlap with the winter part of the SNS SAC have been considered. The potential effect from two activities (whichever would result in the worst footprint), to occur per 24-hours is summarised in Table 11.5. Figure 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, do not take account of overlap between projects and do not include the possibility of noise mitigation at source. It is therefore clear that the values in-combination represent a highly unlikely scenario – with considerable precaution built into the assessment.

11.3.29 Figure 11.2 shows the location of the Projects considered in-combination for underwater noise disturbance impacts.

Table 11.4: Spatial Effect In-Combination from a Single Event in a Single Day in Summer Season (cells highlighted in red are at risk of exceeding the threshold if unmitigated through the SIP process)

Project		Season Summer 25 (km^2)	Summer26 (km^2)	Summer27 (km^2)	Summer 28 (km^2)	Summer 29 (km^2)	Relevant activity
The Project	Max (km^2)	-	1726.31	1726.31	1726.31	1726.31	UXO/geophysical surveys Q2 2026-Q2 2027
	Min (km^2)	-	149.23	149.23	149.23	149.23	Piling Q2 2027-Q2 2029
Total for the Project	Max (km^2)	-	1726.31	1726.31	1726.31	1726.31	Daily unmitigated area (EDR of 26km)
	Min (km^2)	-	149.23	149.23	149.23	149.23	
	Max (%)	-	6.39%	6.39%	6.39%	6.39%	Daily unmitigated % (EDR of 26km)
	Min (%)	-	0.55%	0.55%	0.55%	0.55%	
Tier 2							
Dogger Bank C	Max (km^2)	25.32	25.32	25.32	-	-	UXO 2024
	Min (km^2)	0	0	0	-	-	Piling Q1 2025 – Q4 2027
Total for the Project and Tier 2	Max (km^2)	25.32	1751.63	1751.63	1726.31	1726.31	Daily unmitigated % (EDR of 26km)
	Min (km^2)	0	149.23	149.23	149.23	149.23	
	Max (%)	0.09%	6.48%	6.48%	6.39%	6.39%	Daily unmitigated % (EDR of 26km)
	Min (%)	0	0.55%	0.55%	0.55%	0.55%	
Tier 3							
Norfolk Boreas	Max (km^2)	-	2109.09	2109.09	2109.09	2109.09	UXO Q3 2025-Q1 2026
	Min (km^2)	-	383.39	383.39	383.39	383.39	Piling Q2 2026 – Q4 2028
East Anglia 1N	Max (km^2)	1181.16	1181.16	1181.16	1181.16	-	UXO Q1 2025-Q4 2025
	Min (km^2)	304.83	304.83	304.83	304.83	-	Piling Q1 2026 – Q3 2028
East Anglia 2	Max (km^2)	179.28	179.28	179.28	-	-	UXO Q1 2024 – Q4 2024
	Min (km^2)	0	0	0	-	-	

Project		Season Summer 25 (km^2)	Summer26 (km^2)	Summer27 (km^2)	Summer 28 (km^2)	Summer 29 (km^2)	Relevant activity
							Piling Q1 2025 – Q4 2027
Hornsea Three	Max (km^2)	431.54	-	431.54	-	-	UXO Q1 – Q4 2025 Piling Q1 – Q4 2027
	Min (km^2)	0	-	0	-	-	
Total for the Project + Tier 2 + Tier 3	Max (km^2)	1817.30	5221.16	5652.70	5016.56	3835.40	Daily unmitigated area (EDR of 26km)
	Min (km^2)	304.83	837.45	837.45	837.45	532.62	
	Max (%)	6.72%	19.31%	[redacted]	18.56%	14.19%	Daily unmitigated % (EDR of 26km)
	Min (%)	1.13%	3.10%	3.10%	3.10%	1.97%	
Tier 4							
Hornsea 4	Max (km^2)	-	2123.71	2123.71	2123.71	-	UXO Q4 2025 – Q3 2026
	Min (km^2)	-	1929.12	1929.12	1929.12	-	Piling Q4 2026 – Q2 2028
Dudgeon Extension	Max (km^2)	313.09	313.09	-	-	-	UXO 2025
	Min (km^2)	0	0	-	-	-	Piling 2026
Total for the Project + Tier 2 + Tier 3 + Tier 4	Max (km^2)	2130.39	7657.96	7776.41	7140.27	3835.40	Daily unmitigated area (EDR of 26km)
	Min (km^2)	304.83	2766.57	2766.57	2766.57	532.62	
	Max (%)	7.88%	[redacted]	[redacted]	[redacted]	14.19%	Daily unmitigated % (EDR of 26km)
	Min (km^2)	1.13%	10.24%	10.24%	10.24%	1.97%	

Table 11.5: Spatial Effect In-Combination from two Events in a Single Day per Season (cells highlighted in red are at risk of exceeding the threshold if unmitigated through the SIP process).

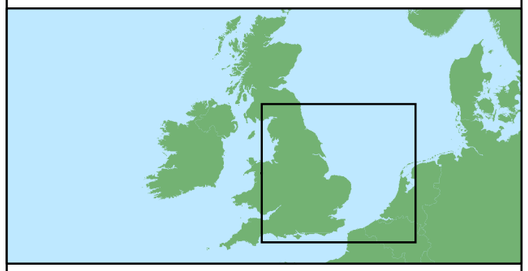
Project		Season					Relevant activity
		Summer 2025 (km2)	Summer 2026 (km2)	Summer 2027 (km2)	Summer 2028 (km2)	Summer 2029 (km2)	
The Project	Max (km^2)	-	2084.60	2084.60	2084.60	2084.60	UXO/geophysical surveys Q2 2026-Q2 2027
	Min (km^2)	-	149.23	149.23	149.23	149.23	Piling Q2 2027-Q2 2029
Total for the Project	Max (km^2)	-	2084.60	2084.60	2084.60	2084.60	Daily unmitigated area (EDR of 26km)
	Min (km^2)	-	149.23	149.23	149.23	149.23	
	Max (%)	-	7.71%	7.71%	7.71%	7.71%	Daily unmitigated % (EDR of 26km)
	Min (%)	-	0.55%	0.55%	0.55%	0.55%	
Tier 2							
Dogger Bank C	Max (km^2)	25.30	25.30	25.30	-	-	UXO 2024
	Min (km^2)	0	0	0	-	-	Piling Q1 2025 – Q4 2027
Total for the Project + Tier 2	Max (km^2)	25.30	2109.90	2109.90	2084.60	2084.60	Daily unmitigated % (EDR of 26km)
	Min (km^2)	0	149.23	149.23	149.23	149.23	
	Max (%)	0.09%	7.81%	7.81%	7.71%	7.71%	Daily unmitigated % (EDR of 26km)
	Min (%)	0%	0.55%	0.55%	0.55%	0.55%	
Tier 3							
Norfolk Boreas	Max (km^2)	-	2448.60	2448.60	2448.60	2448.60	UXO Q3 2025-Q1 2026
	Min (km^2)	-	383.39	383.39	383.39	383.39	Piling Q2 2026 – Q4 2028
East Anglia 1N	Max (km^2)	1366.1	1366.1	1366.1	1366.1	-	UXO Q1 2025-Q4 2025
	Min (km^2)	304.83	304.83	304.83	304.83	-	Piling Q1 2026 – Q3 2028
East Anglia 2	Max (km^2)	179.3	179.3	179.3	179.3	-	UXO Q1 2024 – Q4 204

Project		Season					Relevant activity
		Summer 2025 (km2)	Summer 2026 (km2)	Summer 2027 (km2)	Summer 2028 (km2)	Summer 2029 (km2)	
	Min (km^2)	0	0	0	0	-	Piling Q1 2025 – Q4 2027
Hornsea Three	Max (km^2)	502.10	-	502.10	-	-	UXO Q1 – Q4 2025
	Min (km^2)	0	-	0	-	-	Piling Q1 – Q4 2027
Total for the Project + Tier 2 + Tier 3	Max (km^2)	2072.80	6103.90	6606.00	6078.6	4533.20	Daily unmitigated area (EDR of 26km)
	Min (km^2)	304.83	837.45	837.45	837.45	532.62	
	Max (%)	7.67%	[redacted]	[redacted]	[redacted]	16.77%	Daily unmitigated % (EDR of 26km)
	Min (%)	1.13%	3.10%	3.10%	3.10%	1.97%	
Tier 4							
Hornsea 4	Max (km^2)	-	3682.8	3682.8	3682.8	-	UXO Q4 2025 – Q3 2026
	Min (km^2)	-	1929.12	1929.12	1929.12	-	Piling Q4 2026 – Q2 2028
Dudgeon Extension	Max (km^2)	651.00	651.00	-	-	-	UXO 2025
	Min (km^2)	313.09	313.09	-	-	-	Piling 2026
Total for the Project + Tier 2 + Tier 3 + Tier 4	Max (km^2)	2723.80	10437.70	10288.8	9761.40	4533.20	Daily unmitigated area (EDR of 26km)
	Min (km^2)	617.92	3079.66	2766.57	2766.57	532.62	
	Max (%)	10.07%	[redacted]	[redacted]	[redacted]	16.77%	Daily unmitigated % (EDR of 26km)
	Min (km^2)	2.29%	11.39%	10.24%	10.24%	1.97%	

80000
200000
320000
440000
560000
6160000
6040000
5920000
5800000
5680000
N
Blyth Demonstration Sites
Dogger Bank - Teesside B (Sofia)
Dogger Bank C - Teesside A
Hornsea Project Four (HOW04)
Hornsea Project Three (HOW03)
Dudgeon Extension
Sheringham Shoal Extension
Norfolk Boreas
Norfolk Vanguard West
Norfolk Vanguard East
East Anglia Three
East Anglia One North
East Anglia Two
Hollandse Kust (West)
Five Estuaries
Greater Gabbard
Rampion 2
Rampion Extension

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Endurance (Carbon Capture)
- Offshore Wind Farm



Coordinate System: WGS 1984 UTM Zone 31N

0 50 100 km

Scale: 1:2,000,000

Plans and Projects Considered for Marine Mammals

Figure 11.2

OUTER DOWSING OFFSHORE WIND

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11.3.30 It should be noted that the above tables are very much intended to represent an unmitigated and precautionary worst case scenario and do not take account of any overlap between individual activities associated with individual projects – which would occur in the unlikely event that all such activity occurred in the same day. Once such double counting is taken into account, the remaining potential for overlap (based on each project piling at the worst possible location for each project and assuming an unrealistic build out) is reduced.

11.3.31 Furthermore, the timeframe of projects means that such a risk on a day-by-day basis would not actually materialise, with the maximum values even more so (as this requires simultaneous works at all projects at the worst location). With uncertainty in pile schedule and build out of projects, it is hard to assess this, with a typical reduction in the order of approximately 15-25% based on previous examples. The removal of double counting that occurs from project overlap reinforces the relevance of the primary mitigation approach noted above – effectively adding certainty to the case that primary mitigation, the application of spatial and/or temporal mitigation on activity, would be able to provide sufficient and appropriate mitigation to avoid the risk of threshold exceedance (as applied through the SIP). The exact scenario or suite of measures that would be required can only be determined when there is certainty on construction timeframes for the in-combination projects.

How the SIP will manage adherence to the thresholds

11.3.32 The Outline SNS SAC SIP (which will be provided alongside the DCO Application) will manage adherence to the thresholds by addressing the risks with respect to the SNS SAC identified above. In particular, it will include confirmation of the relevant project design for the Project alone and include measures for mitigation that would fully address that risk, drawing on the range of mitigation options available.

11.3.33 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, the current DESNZ workstream that is providing much greater clarity on the risk posed by UXO clearance. Further, the recent paper by Hastie *et al*. (2019) provided 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 Outline SNS SAC SIP includes a requirement for a review on a specified timeframe and will therefore enable the process to draw on such advances and ensure, in the context of the risks posed by the Project alone, that the daily 20% and seasonal 10% thresholds with respect to the SNS SAC are not exceeded.

11.3.34 As concluded in Section 10.3, it is clear that the Project alone would not trigger the 20% threshold under any circumstance. However, there are apparent risks to the 20% threshold when other projects are screened in for assessment in-combination – on the assumption that all projects would in fact undertake piling activity on the same day. Such risks need to be placed in context, to determine where risk may actually exist and what measures are available to help mitigate that risk. Key to the process is the requirement on all projects assessed here in-combination to be subject to a SIP, which will ensure on a case-by-case basis that the thresholds will not be exceeded (alone and in-combination).

11.3.35 Table 11.4 determines the risk from the Project together with all in-combination projects, assuming a single event per day (on a minimum and maximum basis). For the Project together with the identified Tier 3 and 4 projects, the potential for the daily 20% threshold exceedance is primarily limited to the summers of 2025-2028 even under the maximum scenarios. Table 11.5 determines the risk of concurrent piling; as expected, the risk of the 20% threshold being exceeded increases if all projects simultaneously chose to undertake concurrent piling.

11.3.36 It is therefore clear that there is potential for a threshold exceedance to occur if all activity is unmitigated. However, the Outline SNS SAC SIP that will be produced will contain the process to be followed to determine the need for any mitigation as well as the type of mitigation required. Should mitigation be required to remain within the threshold, the Outline SNS SAC SIP will include as a primary mitigation measure the potential to vary schedules or location of works. Such mitigation could be applied here, to manage the risk from a worst case scenario (e.g. multiple projects all working at their worst case location simultaneously) and ensure that the thresholds are not exceeded. Given the number of variables involved, it is not possible to be clear on the exact scenario that will eventually be chosen or what primary mitigation measure will actually be required (if any). However, there are several routes that can be taken to avoid an exceedance of the daily 20% threshold and that the Outline SNS SAC SIP will provide for this to be applied.

11.3.37 In addition to the primary mitigation referred to above, the Outline SNS SAC SIP will also include provision for secondary mitigation. A number of potential solutions will be identified, including noise mitigation at source, with the caveat that these are options that could be applied should the SIP require it. The application of certain mitigation measures has been acknowledged by JNCC as resulting in a reduction in the EDR of mitigated (15km EDR) and unmitigated (26km EDR) monopile installation.

11.3.38 It would be disproportionate to identify the required mitigation at this point, since the need for any mitigation is not certain (and depends on the final construction timeframe of individual projects). It is the purpose of the SIP to acknowledge these risks, and to identify the appropriate measures should they be required (including the timeframe attached to the SIP process) to ensure that the Project, alone and/or in-combination, would not exceed the 20% or 10% threshold. Such a SIP is understood to be a requirement on all OWF within 26 km of the SNS SAC going forward.

In-combination effects on disturbance across a season

11.3.39 As regards the consideration of the potential for an in-combination effect across a season (the 10% value), there is a risk of the seasonal threshold being exceeded, regardless of whether or not the Project is included. However, as mentioned, it is clear that the risk is highly precautionary and an overestimate, for a number of reasons:

- For a number of the Projects, no total piling days exist and a precautionary assumption has been made;

- A number of the Projects have a very large construction window, are highly likely to progress to construction well before 2027 and it is therefore extremely unlikely that all projects will be in a position to construct within the same winter season (and for individual projects to the extent assumed);
- The assessment does not take temporal overlap between projects into account, which is likely to account for approximately 15-25% of the total threshold exceedance on a daily basis;
- 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 (As a result of the Review of Consents process or individual project DCO) – which will prevent any project exceeding the thresholds alone and/or in-combination.

11.3.40 Given the requirement for a SIP on all projects, together with the need for all projects to seek licensing for UXO clearance, it is considered that sufficient controls exist to ensure no seasonal threshold exceedance would occur, thus providing certainty of no AEoI with respect to the SNS SAC. It is clear that the key risks in-combination will depend on which project builds out within the same timeframe as the Project, with the level of certainty attached to these varying depending on their allocated tier project.

Table 11.6: Summary of risk to the 10% threshold in-combination from piling within the summer season

Tier	Project	Activities per summer season	Average area (km^2) overlap per day	Average % overlap per summer season	Threshold risk
N/A	The Project	47 days of piling	1,726.3 km^2	6.38%	Represents a considerable proportion. However, it is likely that piling would occur concurrently, reducing the amount of piling days. Capacity therefore exists with primary mitigation (through management of activities) as provided for in the SIP.
4	Dudgeon Extension	33 days of piling	363.38 km^2	0.25%	Very small contribution to the total. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	East Anglia 1 N	67 days of piling	736.7 km^2	2.7%	Small contribution to the total. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	East Anglia 2	75 days of piling	23 km^2	0.09%	Very small contribution to the total. Will require consideration of the SNS SAC (requirement of the project level SIP).
4	Hornsea 4	183 days of piling	2,301km^2	7.87%	Represents a considerable proportion. However, it is it is likely that piling would occur concurrently, reducing the amount of piling days. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	Norfolk Boreas	173 days of piling	1,249.4 km^2	4.6%	Represents a considerable proportion. However, it is it is likely that piling would occur concurrently, reducing the amount of piling days. Will require consideration of the SNS SAC (requirement of the project level SIP).

11.3.41 Table 11.6 presents the risks to the 10% seasonal thresholds, based on available project information and certainty. It bases the maximum number of piling days per season on maximum WTG locations but does not take account of project overlap given current uncertainty; these risks will be managed through the SIP process. However, it does show 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.

11.3.42 It can be concluded that, with the mitigation that will be afforded by the SIP, the MMMP and the anticipated requirement for a UXO-specific MMMP (which will be a condition of the UXO ML if UXO clearance is required and the ML applied for), **an AEoI will not occur as a result of disturbance to harbour porpoise (as defined by the daily 20% and seasonal 10% thresholds) for the Project alone and/or in-combination during construction and decommissioning as a result of piling.**

Seismic and Geophysical Survey

11.3.43 No specific information on the requirement for seismic and geophysical survey for the Project alone is identified at this point; although any surveys that are required will occur prior to the main construction phase in 2027 to 2030. 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) and is therefore incorporated within the current assessment (as the footprint of effect from any such survey would be incorporated into the footprint of effect from the UXO clearance; the footprints are not additive). Further, the requirement for a Project level SIP provides certainty that the conclusions drawn for the Project alone will remain valid and that no adverse effect would result in-combination, including a suite of measures that can be drawn on if required to ensure that conclusion holds true. No specific information on planned or proposed surveys in-combination has been identified within the relevant timeframe for inclusion in the assessment here.

Key points for the Project In-Combination with Respect to the SNS SAC

11.3.44 A summary of the key points for the Project in relation to the SNS SAC are provided in Table 11.7 below.

11.3.45 In the context of the MMMP, the Outline SNS SAC SIP and the anticipated requirement for a UXO-MMMP (if/when a UXO licence applied for), there is, **therefore, no AEoI resulting from disturbance of harbour porpoise within the SNS SAC from the Project in-combination during construction and decommissioning and therefore, subject to natural change, the feature will be maintained in the long-term.**

Table 11.7: Summary of the in-combination risk for the Project and the SNS SAC

Project element	Summer season	Risk Management
Piling within the Project array area	Risk of exceedance of the daily 20% threshold for the Project in-combination with Tier 3 and 4 projects on maximum design scenario's only (both single and concurrent piling). As projects are added, risk rises on a minimum scenario basis (excluding double counting between projects). 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 understood to apply to all OWF within 26 km of the SNS SAC. The SIPs are provided for within individual project DCOs or the Review of Consents (as relevant) and provide management and mitigation measures that ensure compliance with the thresholds in all cases, alone and/or in-combination. The SIPs will include detail on management for all types of underwater noise generated by the project.
UXO clearance within the Project array area	Risk of exceedance of the daily 20% threshold for the Project in-combination with Tier 3 and 4 projects on maximum design scenario's only (both single and concurrent UXO clearances). As projects are added, risk rises (excluding double counting between projects). Risk of exceedance of the seasonal 10% threshold in-combination depending on the number of piling/UXO clearance days committed to in a season by individual projects, location of any such activities and which projects are in a position to proceed.	
UXO clearance within the ECC	Some locations are outside consideration of the SNS SAC. Potential for daily 20% threshold exceedance in-combination depending on UXO location and which project is added. Risk of exceedance of the seasonal 10% threshold in-combination depending on the number of piling/UXO clearance days committed to in a season by individual projects, location of any such activities and which projects are in a position to proceed.	
Geophysical and seismic survey	Contribution not calculated given lack of information on planned survey type, location and duration. Any contribution to thresholds expected to be within the footprint of effect from UXO clearance	

Project element	Summer season	Risk Management
	and controlled through the SIP. Given the location of the summer extents relative to the Project, any contribution would be limited to survey within a short section of the ECC in any case.	

11.3.46 Table 11.8 below, drawing on the information presented in the screening report and section 8.2 summarises the relevant projects to be assessed in-combination for potential temporal and spatial effects in relation to construction of the Project. It should be noted that the location of the Projects screened is such that each project is relevant to a different suite of transboundary sites. Further, the Projects included are limited to those with potential for construction phase overlap – projects with O&M phase overlap are considered under vessel disturbance.

Table 11.8: Projects considered for the harbour and grey seal assessments.

Designated site	Relevant species	Project	Tier
▪ The Wash and North Norfolk Coast SAC; ▪ Doggersbank (Netherlands) SAC; ▪ Klaverbank SCI	Harbour seal	Dogger Bank C	2
		Dudgeon Extension	4
		East Anglia 1N	3
		East Anglia 2	3
		East Anglia 3	3
		Endurance	6
		Five Estuaries	5
		Hornsea 3	3
		Hornsea 4	4
		Norfolk Boreas	3
		Norfolk Vanguard East	3
		Norfolk Vanguard West	3
		North Falls	6
		Rampion 2	5
		Sheringham Shoal Extension	4
		Sofia	2
▪ Humber Estuary SAC; ▪ Humber Estuary Ramsar; ▪ Bancs des Flandres SAC; ▪ Doggersbank (Netherlands) SAC; ▪ Klaverbak SCI; ▪ SBZ 1 SCI; ▪ SBZ 2 SCI; ▪ SBZ 3 SCI;	Grey Seal	Blyth Demonstration Phases 2&3	3
		Dogger Bank C	2
		Dudgeon Extension	4
		East Anglia 1N	3
		East Anglia 2	3
		East Anglia 3	3
		Endurance	6
		Five Estuaries	5
		Hollandse Kust (West)	6
		Hornsea 3	3
		Hornsea 4	4
		Norfolk Boreas	3
		Norfolk Vanguard East	3

Designated site	Relevant species	Project	Tier
▪ Vlaamse Banked SCI; ▪ Vlakte van de Raan SCI; ▪ Voordelta SCI; ▪ Waddenzee SCI; ▪ Westerschelde & Saeftinghe SCI.		Norfolk Vanguard West	3
		North Falls	6
		Rampion 2	5
		Sheringham Shoal Extension	4
		Sofia	2

11.3.47 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.

11.3.48 For both species, there is no potential for underwater noise alone or in-combination to affect the habitats and supporting processes used by seals. The primary pathway for potential effect on the habitat and supporting processes for harbour and grey seals, is through impacts on prey species. Part 6, Volume 1, Chapter 10: Fish and Shellfish Ecology found the potential for effect on fish species to be minor at most, and therefore not significant in EIA terms. Impacts from underwater noise to fish are spatially limited and broadly restricted to the period of ensonification. Fish are not necessarily fully displaced from an ensonified area and consequently will remain within the ensonified area during noisy events and so will still be present upon return of the seals (should any seals be displaced). Whilst noise can result in behavioural changes in fish, these are short lived and so will also not lead to any potential implications for hunting behaviour in seals following cessation of the noise. Given the relative spatial and temporal scale and extent of the potential effects on fish species, combined with the spatial and temporal scale and location of the relevant designated sites and the wide ranging nature of seals, there is, therefore, no AEoI 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 the Project alone and/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.

11.3.49 The potential for the Project to contribute to any in-combination risk of injury (defined as risk of onset of PTS) with respect to harbour seal and grey seal is considered to be negligible. That conclusion is reinforced by the number of individual animals potentially at risk from unmitigated piling, which for the Project alone is 35 individuals as a worst case (0.72% of the reference population). For UXO clearance, the number of harbour seal and grey seal potentially affected is two individuals for both species (0.03% and 0.02% of the MU population) respectively, therefore only likely to occur for a fraction of the total UXO clearances anticipated. Such an effect is fully provided for within the MMMP and the anticipated requirement for a UXO-MMMP, with the mitigation area exceeding the range of effect. There is, therefore, no potential for AEoI with respect to injury (PTS) for harbour seal or grey seal for any of the sites under consideration as a result of the Project alone and/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.

11.3.50 In addition to the site-by site basis presented above, the potential for an in-combination effect on the population and distribution of harbour seal and grey seal applies to harbour seal and grey seal at sea regardless of the site within which they are associated and therefore is also considered here on a species-by-species basis (not withstanding seals from some sites having a greater potential for connectivity with the region around the Project than others).

Harbour Seal

11.3.51 Part 6, Volume 1, Chapter 11: Marine Mammals in Section 1.8 identifies the potential for the highest level of predicted disturbance to harbour seals across the MU is in 2026, when several central/southern North Sea projects are constructing. The impact from construction phase underwater noise at this time from all identified projects (Table 11.8, assuming all projects are constructing at the same time and that disturbance is additive across projects) results in a potential for a temporary disturbance of up to 313 individuals (6.5% of the harbour seal MU population) per day. By comparison, the total impact is expected to be lower throughout the remainder of the Project construction window (2026-2029). A maximum of 43 harbour seals (0.9% of the MU) may be disturbed per day in 2027 (assuming all considered projects are constructing at the same time, and that disturbance is additive across projects), reducing to 36 harbour seals (0.7% of the MU) in 2028, and 25 seals (0.5% of the MU) in 2029. The effect was considered to be of medium magnitude, with reproductive rates of individuals potentially impacted in the short term (over a limited number of breeding cycles but not enough to affect the population trajectory over a generational scale), and a sensitivity of low, resulting in a significance of minor, which is not significant in EIA terms.

Grey Seal

11.3.52 Part 6, Volume 1, Chapter 11: Marine Mammals in Section 1.8 identifies the potential for the highest level of predicted disturbance to harbour seals across the MU is in 2025, when several central/southern North Sea projects are constructing. The impact from construction phase underwater noise at this time from all identified projects (Table 11.8, assuming all projects are constructing at the same time and that disturbance is additive across projects) results in a potential for a temporary disturbance of up to 7,951 individuals (15 % of the grey seal MU population) per day. By comparison, the total impact is expected to be lower throughout the remainder Project construction window (2026-2029). At this time, a maximum of 7538 grey seals (14.2% of the MU) may be disturbed per day in 2026 (assuming all considered projects are constructing at the same time, and that disturbance is additive across projects), reducing to 5,338 grey seals (10.1 % of the MU) in 2027, 5,246 seals (9.9% of the MU) in 2028, and 3,508 (6.6% of the MU) in 2029. The effect was considered to be of medium magnitude, with reproductive rates of individuals potentially impacted in the short term (over a limited number of breeding cycles but not enough to affect the population trajectory over a generational scale), and a sensitivity of negligible, resulting in a significance of minor, which is not significant in EIA terms.

Conclusion for the In-Combination Assessment of Disturbance from Underwater Noise on Harbour Seal and Grey Seal

11.3.53 As regards risk of in-combination underwater noise during construction for harbour seal and grey seal, in line with the conclusions for disturbance from piling activity it can **therefore be concluded that no AEoI will result 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 the Project alone and/or in-combination during construction and decommissioning and therefore, subject to natural change, the population and distribution of grey seal and harbour seal will be maintained in the long-term.**

Vessel Presence Disturbance

11.3.54 The potential for an AEoI 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):

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

11.3.55 The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

11.3.56 The cumulative assessment presented in Part 6, Volume 1, Chapter 11: 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) the potential for disturbance from activities such as piling. Furthermore, 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. It should also be noted that for many of the Projects identified in Table 11.8, the risk of an in-combination effect resulting from vessel related disturbance is essentially an ongoing issue as many are licensed activities that have been in operation for some time (and some would therefore be included to some degree within the baseline level of shipping activity assessed for the Project). For example, Volume 2, Appendix 15.1: Navigational Risk Assessment reports on shipping and navigation baseline data collected through the period 2019-2021. The shipping and navigation data collected (and therefore the existing vessel movements applied as baseline) will therefore include vessel movements associated with offshore windfarms operational prior to 2019 (for example both East Anglia ONE and Hornsea Project One were completed in 2019 and therefore the later navigation surveys would cover the operational phases only).

11.3.57 The area surrounding the Project already experiences a reasonable amount of vessel traffic throughout the year. In the summer there is an average of 64-65 unique vessels per day passing through the study area, and 10 unique vessels per day through the array area with less in the winter (see Part 6, Volume 1, Chapter 15: Shipping and Navigation). Therefore, it is considered that the introduction of vessels during operation and maintenance is not a novel impact for marine mammals present in the area.

11.3.58 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 ten vessels are present in a given 5 km^2 construction area. This level of activity is unlikely to occur across the entire array area at any one time, rather this intensity is expected across approximately three or four 5 km^2 blocks. During the operational period of the Project, it is considered unlikely that vessel noise will impact marine mammal receptors at levels additional to the background vessel presence.

11.3.59 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.

11.3.60 It is not expected that the level of vessel activity during the O&M phase of the Project would cause a significant increase in the risk of disturbance by vessels or collision risk with vessels. The adoption of a vessel management plan (Table 7.1) 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 local, of 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.

11.3.61 For harbour porpoise, the 2019 advice on operations within the SNS SAC (JNCC, 2019) found that although it is expected that overall shipping levels are expected to increase as a result of increased windfarm activity in the North Sea, given the existing levels of shipping in the area it is unlikely that additional management measures will be required. Further, it identified that significant increases in vessel traffic associated with windfarm activity would require assessment – with that assessment for the Project alone presented above.

11.3.62 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 array area from other plans and projects, even considering the addition of construction and decommissioning phase traffic (a maximum of ten at any one time per 5km^2 area), will still be below this figure. It is therefore not expected that the level of vessel activity during construction and decommissioning of the Project would cause a significant increase in the risk of disturbance by vessels or collision risk with vessels.

11.3.63 The relevant conservation objectives for harbour porpoise are cited in The Screening Report (Outer Dowsing Offshore Wind, 2022).

11.3.64 The first two conservation objectives address risk of injury and disturbance. Part 6, Volume 1, Chapter 11: Marine Mammals found (in the context of existing shipping levels, the increase in those levels proposed during construction and decommissioning at the Project and the relevant project mitigation at both the Project and those considered in-combination) the increased vessel traffic associated with the construction and decommissioning phases of the Project and other projects in-combination is insufficient to result in mortality, injury or significant disturbance in marine mammals. That conclusion is supported at a site-based level by Heinänen and Skov (2015) as above.

11.3.65 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 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'. Vessels and shipping will not lead to a direct impact on the habitats and processes.

11.3.66 There is, therefore, no AEoI relevant to harbour porpoise for the SNS SAC from vessel disturbance from the Project alone during construction and decommissioning and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.

11.3.67 Jones *et al.,* (2017) presents an analysis of the predicted co-occurrence of ships and seals at sea which demonstrates that UK wide there is a large degree of predicted cooccurrence, particularly within 50 km of the coast close to seal haul-outs. There is no evidence relating decreasing seal populations with high levels of co-occurrence between ships and animals. In fact, in areas where seal populations are showing high levels of growth (e.g. southeast England) ship co-occurrences are highest (Jones *et al.,* 2017). Thomsen *et al*. (2006) estimated that both harbour and grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The potential for underwater noise from vessels during construction to disturb seal and grey seals will therefore be significantly less than that resulting from piling disturbance and highly localised to the vessel. Any disturbance associated with vessel movements would be contained within the footprint of wider construction level disturbance and would not significantly add to that.

11.3.68 As regards risk of in-combination vessel disturbance during construction for harbour seal and grey seal, in line with the conclusions for disturbance from piling activity it can **therefore be concluded that no AEoI will result 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 the Project alone and/or in-combination during construction and decommissioning and therefore, subject to natural change, the population and distribution of grey seal and harbour seal will be maintained in the long-term.**

O&M

Vessel Presence Disturbance

11.3.69 The potential for an AEoI in-combination as a result of vessel disturbance on marine mammals during O&M 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);
- 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 (Netherlands) SAC and Klaverbank SCI); and
- Transboundary sites (twelve sites for grey seal), specifically Doggersbank (Netherlands) SAC, Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SAC, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI and Waddenzee SCI.

11.3.70 Part 6, Volume 1, Chapter 11: 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 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.

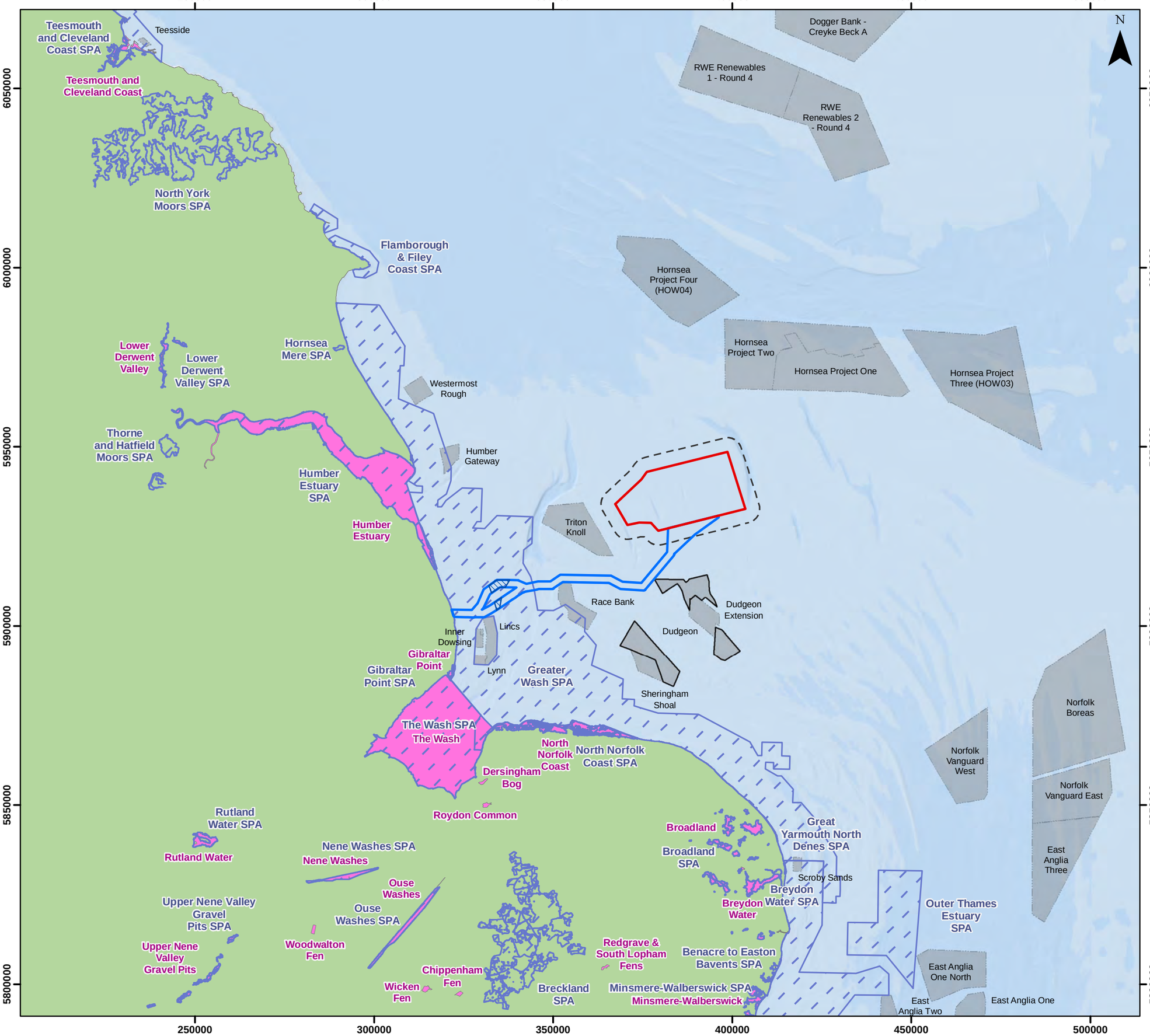
11.3.71 Vessel routes to and from offshore windfarms and other projects will predominantly use existing vessel routes where marine mammals will be accustomed to regular vessel movements and therefore vessel activity will already be an existing feature of the baseline. Vessel activity within array area are likely to be limited and relatively slow. Increases in 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 all projects. Such a low-level additional contribution to existing levels of shipping disturbance is not predicted to have a significant effect on any marine mammal population, with no anticipated changes to range or distribution of any species (Part 6, Volume 1, Chapter 11: Marine Mammals).

11.3.72 There is therefore no potential for the Project to contribute in any meaningful way to any in-combination effect. It can therefore be concluded that therefore no AEoI will result from vessel related disturbance for any of the sites under consideration as a result of the Project alone and/or in-combination during O&M and therefore, subject to natural change, the features will be maintained in the long-term.

11.4 Offshore and Intertidal Ornithology

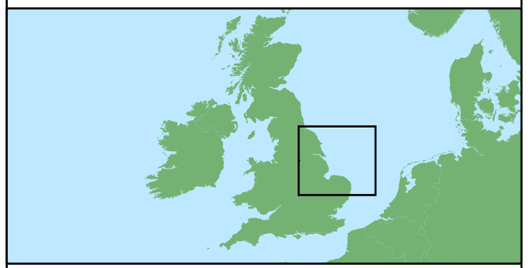
11.4.1 The potential impacts on ornithological receptors arising from collision and displacement from the Project in-combination with other projects is determined based on impacts reported by relevant projects screened in as per Table 11.1. The in-combination impacts have been calculated using a 'tiered' approach as presented in Table 8.4.

11.4.2 The location of the Project in relation to the SPAs and projects within closest proximity is presented in Figure 11.3 below.



Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- 4km Buffer from Array Area
- Offshore Wind Farms
- Future Wind Farm Extensions
- Special Protection Area
- Ramsar Site



Coordinate System: WGS 1984 UTM Zone 31N

0 25 50 km

Scale: 1:1,000,000

Location of the Project in relation to Protected Sites and Projects within Closest Proximity

Figure 11.3

OUTER DOWSING OFFSHORE WIND

Date: 09/05/2023
Produced By: BPHB
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Construction and Decommissioning

11.4.3 During the construction & decommissioning phase, the assessment of displacement impacts from the Project alone (Section 10.4) concluded no impacts of note for any of the species assessed. It is therefore considered that the Project will not make any material contribution to existing in-combination mortalities during the construction & decommissioning phase.

11.4.4 An overview of the screening process for disturbance and displacement in the construction & decommissioning phase is provided in Table 11.9 below. The sites that have been screened out are due to the assessment alone concluding a trivial and inconsequential level of effect, that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination impact.

Table 11.9: Summary of the sites and features considered for a disturbance and displacement assessment during construction and decommissioning phases for the Project in-combination.

Site	Feature	Bio-season	Screened In/Out
The Greater Wash SPA	Red-throated diver	Non-breeding	Out
	Common scoter	Non-breeding	Out
FFC SPA	Guillemot	Breeding and non-breeding	Out
	Razorbill	Breeding and non-breeding	Out
	Puffin*	Breeding and non-breeding	Out
	Gannet	Breeding and non-breeding	Out
Farne Islands SPA	Guillemot	Non-breeding	Out
	Puffin	Non-breeding	Out
Coquet Island SPA	Puffin*	Breeding and non-breeding	Out
Scottish SPAs			
Buchan Ness to Collieston Coast SPA	Guillemot*	Non-breeding	Out
Calf of Eday SPA	Guillemot*	Non-breeding	Out
Copinsay SPA	Guillemot*	Non-breeding	Out
East Caithness Cliffs SPA	Guillemot*; Razorbill*	Non-breeding	Out
Fair Isle SPA	Guillemot*; Razorbill*; Puffin*; Gannet*	Non-breeding	Out
Forth Islands (UK) SPA	Guillemot; Razorbill; Puffin; Gannet	Non-breeding	Out
Foula SPA	Guillemot; Razorbill*; Puffin	Non-breeding	Out
Fowlsheugh SPA	Guillemot; Razorbill*	Non-breeding	Out
Hermaness, Saxa, Vord and Valla Field SPA	Guillemot*; Puffin; Gannet	Non-breeding	Out

Site	Feature	Bio-season	Screened In/Out
Hoy SPA	Guillemot*; Puffin*	Non-breeding	Out
Marwick Head SPA	Guillemot*	Non-breeding	Out
North Caithness Cliffs SPA	Guillemot; Razorbill*; Puffin*	Non-breeding	Out
Noss SPA	Guillemot; Puffin*Gannet	Non-breeding	Out
Rousay SPA	Guillemot*	Non-breeding	Out
St Abb's Head SPA	Guillemot*; Razorbill*	Non-breeding	Out
Sumburgh Head SPA	Guillemot*	Non-breeding	Out
Troup, Pennan and Lion's Heads SPA	Guillemot; Razorbill*	Non-breeding	Out
West Westray	Guillemot*	Non-breeding	Out

* Species listed as Assemblage features

O&M

Disturbance and Displacement

11.4.5 The potential for offshore windfarms direct disturbance and displacement to result in an AEoI in-combination with the Project relates to the following designated sites and the relevant features:

- Coquet Island SPA; puffin;
- East Caithness Cliffs SPA; guillemot and razorbill;
- Farne Islands SPA; guillemot and puffin;
- Flamborough and Filey Coast SPA; gannet, guillemot and razorbill; and
- North Caithness Cliffs SPA; guillemot.

11.4.6 An overview of the screening process for disturbance and displacement in the O&M phase is provided in Table 11.10 below. The sites that have been screened out are due to the assessment for the Project alone concluding a trivial and inconsequential level of effect, that would be well within the error margins of the assessment, and therefore no potential for any material contribution for an in-combination impact.

Table 11.10: Summary of the sites and features considered for a disturbance and displacement assessment during O&M phases for the Project in-combination.

Site	Feature	Bio-season	Screened In/Out
The Greater Wash SPA	Red-throated diver	Non-breeding	Out
	Common Scoter	Non-breeding	Out
FFC SPA	Guillemot	Breeding and non-breeding	In
	Razorbill	Breeding and non-breeding	In

Site	Feature	Bio-season	Screened In/Out
	Puffin*	Breeding and non-breeding	In
	Gannet	Breeding and non-breeding	In
Farne Islands SPA	Guillemot	Non-breeding	In
	Razorbill	Non-breeding	Out
	Puffin	Non-breeding	In
Coquet Island SPA	Puffin*	Breeding and non-breeding	In
Scottish SPAs			
Buchan Ness to Collieston Coast SPA	Guillemot*	Non-breeding	Out
Calf of Eday SPA	Guillemot*	Non-breeding	Out
Copinsay SPA	Guillemot*	Non-breeding	Out
East Caithness Cliffs SPA	Guillemot*; Razorbill*	Non-breeding	In
Fair Isle SPA	Guillemot*; Razorbill*; Puffin*; Gannet*	Non-breeding	Out
Forth Islands (UK) SPA	Guillemot; Razorbill; Puffin; Gannet	Non-breeding	Out
Foula SPA	Guillemot; Razorbill*; Puffin	Non-breeding	Out
Fowlsheugh SPA	Guillemot; Razorbill*	Non-breeding	Out
Hermaness, Saxa, Vord and Valla Field SPA	Guillemot*; Puffin; Gannet	Non-breeding	Out
Hoy SPA	Guillemot*; Puffin*	Non-breeding	Out
Marwick Head SPA	Guillemot*	Non-breeding	Out
North Caithness Cliffs SPA	Guillemot; Razorbill*; Puffin*	Non-breeding	In (**Guillemot only**)
Noss SPA	Guillemot; Puffin*Gannet	Non-breeding	Out
Rousay SPA	Guillemot*	Non-breeding	Out
St Abb's Head SPA	Guillemot*; Razorbill*	Non-breeding	Out
Sumburgh Head SPA	Guillemot*	Non-breeding	Out
Troup, Pennan and Lion's Heads SPA	Guillemot; Razorbill*	Non-breeding	Out
West Westray	Guillemot*	Non-breeding	Out
Buchan Ness to Collieston Coast SPA	Guillemot*	Non-breeding	Out

* Species listed as Assemblage features

11.4.7 The assessments provided within this draft 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 windfarms 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 each bio-season, whilst the actual abundance is likely to be less than this throughout the months making up each bio-season;
- The population within offshore windfarm array area and/or buffers to the south of the Project 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 the offshore windfarm array area and their buffers are beyond a reasonable distance to assume they would be regularly used (if at all) by species during the breeding bio-season from relevant SPAs;
- 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 auks displaced during the non-migratory breeding bio-season is highly unlikely within all the offshore windfarms included within this assessment, as the species assessed in this draft RIAA are not solely dependent upon these area for all their foraging needs;
- Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the offshore windfarms 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 draft RIAA are highly unlikely to occur.

Coquet Island SPA – Puffin

11.4.8 Puffin has been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the Coquet SPA (presented in Section 10.4 and Appendix 7.1.1).

11.4.9 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (137.1km) plus 1SD (128.3km) of puffin from the Coquet Island SPA based on data from Woodward *et al*. (2019). Since puffins range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel Biologically Defined Minimum Population Scales (BDMPS) area during the non-breeding bio-season.

11.4.10 During the breeding bio-season it is considered that potential displacement impacts on puffin from FFC SPA may be attributed more highly to offshore windfarms within areas of sea within foraging distance from this breeding colony. In order to assess the potential in-combination impacts on puffin from multiple offshore windfarms, information was compiled on the seasonal abundance of puffins measured at each offshore windfarm site (plus 2km buffer). During this, only Berwick Bank was found to have apportioned impacts to puffins at the Coquet Islands SPA. The breeding season assessment therefore considers impacts resulting from this project, in-combination with the Project. The breeding season abundance reported in the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022) was subjected to a process of attribution to Coquet Islands (Appendix 7.1.4).

11.4.11 To determine the number of puffins from the Coquet Islands SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.11 in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and RoyalHaskoningDHV, 2022).

11.4.12 Cumulative totals were then apportioned to the Coquet Island SPA based on the proportion of breeding adults from the UK North Sea and English Channel BDMPS population that can be attributed to the Coquet Islands SPA as defined by Furness (2015). Following this approach to apportionment the proportion of the BDMPS populations from the Coquet Island SPA during non-breeding bio-season of 10.6% was applied, as previously agreed as being appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this Project through the EPP (Table 5.2).

11.4.13 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.12. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.13.

11.4.14 Table 11.11 below presents the abundance of puffins as attributed to the Coquet Islands SPA within all other offshore windfarms and their 2km buffers for consideration in this in-combination assessment. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.11: Non-breeding season mean peak abundances apportioned to the Coquet Island SPA for puffin from relevant tier one and two projects.

Project	Non-breeding season	
	Total	Apportioned
Tier 1 and 2 projects	23,570.0	15,530.9
Rampion 2	0.0	0.0
Berwick Bank	0.0	0.0
Outer Dowsing	1167.0	402.6
Total	**24,737.0**	**15,933.5**

Breeding Bio-season

11.4.15 During the breeding season, an estimated 197 (197.1) individuals are apportioned to the Coquet Island SPA from the Berwick Bank OWF. In combination with the 228 (227.5) individuals apportioned to Coquet Island SPA from the Project, the total number of individuals in-combination is 425 (424.6). The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is two (2.1) breeding adults.

11.4.16 Based on a citation population of 31,686 breeding adult puffins at the Coquet Island SPA and an annual background mortality of 1,933 breeding adults per annum, the addition of two displacement consequent mortalities would represent a 0.110% increase in baseline mortality, of which the Project contributes one (1.1) individual, representing a 0.059% increase in baseline mortality.

11.4.17 As the population of puffins has changed since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2019, which was 25,029 breeding adults, with an annual baseline mortality of 1,527 breeding adults per annum. The addition of two mortalities would represent a 0.139% increase in baseline mortality, the Project contributes one (1.1) individual representing a 0.075% increase in baseline mortality.

Non-breeding Bio-season

11.4.18 The in-combination number of individuals at risk of displacement from OWFs, including the Project that have been apportioned to the Coquet Island SPA is 4,896 (4,896.0) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 25 (24.5) individuals.

11.4.19 Considering the potential impact to the Coquet Island SPA citation population, the addition of 25 mortalities would represent a 1.266% increase in baseline mortality, of which the Project contributes less than one (0.6) mortality, representing a 0.032% increase in baseline mortality.

11.4.20 Assessing the potential impact to the more recent Coquet Island SPA SMP population during the non-breeding bio-season, the addition of 25 mortalities would represent a 2.985% increase in baseline mortality, of which the Project contributes less than one (0.6) mortality, representing a 0.041% increase in baseline mortality.

Annual Total

11.4.21 The in-combination number of puffins predicted to be displaced from all OWFs, including the Project, is 5,320 (5,320.0) individuals per annum. The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is 27 (26.6) individuals.

11.4.22 Considering the potential impact to the Coquet Island citation population, the addition of 27 mortalities would represent a 1.376% increase in baseline mortality, of which the Project contributes less than two (1.8) mortalities, representing a 0.091% increase in baseline mortality.

11.4.23 Assessing the potential impact to the more recent Coquet Island SPA SMP population, the addition of 27 mortalities would represent a 1.742% increase in baseline mortality, of which the Project contributes less than two (1.8) mortalities, representing a 0.115% increase in baseline mortality.

11.4.24 Although the increase in baseline mortality for both the citation and SMP population is greater than 1%, the Project alone contributes only less than two mortalities, which is not considered to represent any material contribution to the in-combination mortality. PVA has not been carried out by recent projects on this feature at this site. The requirement for PVA will be reassessed once the project has been refined post-PEIR.

11.4.25 **It is therefore concluded that the in-combination predicted puffin mortality due to displacement in the O&M phase would not adversely affect the integrity of the Coquet Island SPA.**

Table 11.12: In-combination displacement consequent mortalities for puffin at the Coquet Island SPA.

Bio-season	Abundance of adults apportioned to the Coquet Island SPA (array area plus 2km buffer)	Estimated mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Breeding	424.6	2.1	1.3 – 29.7	0.110	0.066 – 1.538	0.139	0.083 – 1.947
Non-breeding	4,771.8	24.5	14.7 – 342.7	1.266	0.760 – 17.730	1.603	0.962 – 22.445
Annual total	**5,320.1**	**26.6**	**16.0 – 372.4**	**1.376**	**0.826 – 19.267**	**1.742**	**1.045 – 24.392**

Table 11.13: in-combination displacement matrix for puffin attributed to the Coquet Island SPA, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	11	27	53	106	160	213	266	319	372	426	479	532
20	11	21	53	106	213	319	426	532	638	745	851	958	1,064
30	16	32	80	160	319	479	638	798	958	1,117	1,277	1,436	1,596
40	21	43	106	213	426	638	851	1,064	1,277	1,490	1,702	1,915	2,128
50	27	53	133	266	532	798	1,064	1,330	1,596	1,862	2,128	2,394	2,660
60	32	64	160	319	638	958	1,277	1,596	1,915	2,234	2,554	2,873	3,192
70	37	74	186	372	745	1,117	1,490	1,862	2,234	2,607	2,979	3,352	3,724
80	43	85	213	426	851	1,277	1,702	2,128	2,554	2,979	3,405	3,830	4,256
90	48	96	239	479	958	1,436	1,915	2,394	2,873	3,352	3,830	4,309	4,788
100	53	106	266	532	1,064	1,596	2,128	2,660	3,192	3,724	4,256	4,788	5,320

East Caithness Cliffs SPA – Guillemot (Non-breeding Bio-season)

11.4.26 Guillemot has been screened in for the assessment of the O&M phase during the non-breeding season to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the East Caithness Cliffs SPA (presented in Section 10.4 and Appendix 7.1.1).

11.4.27 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. To determine the number of guillemots from the East Caithness Cliffs SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.14, in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and Royal HaskoningDHV, 2022).

11.4.28 Cumulative totals were then apportioned to the East Caithness Cliffs SPA based on the proportion of breeding adults from the UK North Sea and English Channel BDMPS population that can be attributed to the East Caithness Cliffs SPA as defined by Furness (2015). Following this approach to apportionment the proportion of the BDMPS populations from the East Caithness Cliffs SPA during non-breeding bio-season of 9.2% was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this Project through the EPP (Section 5.3).

11.4.29 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.15. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.16.

11.4.30 Table 11.14 below presents the total abundance of guillemots from relevant projects (array area plus 2km buffer), alongside numbers apportioned to the East Caithness Cliffs SPA. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.14: Non-breeding season mean peak abundances and abundances apportioned to the East Caithness Cliffs SPA for guillemot from relevant tier one and two projects.

Project	Non-breeding season	
	Total	Apportioned
Tier 1 and 2 projects	256,401.0	23,588.9
Rampion 2	13,020.0	1,197.8
Berwick Bank	44,171.0	4,063.7
Outer Dowsing	22,248.0	2,046.8
Total	335,840.0	30,897.3

11.4.31 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the East Caithness Cliffs SPA is 30,897 (30,897.3) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 155 (154.5) individuals.

11.4.32 Considering the potential impact to the East Caithness Cliffs citation population of 106,700 breeding adults with a baseline mortality of 6,509 individuals per annum, the addition of 155 mortalities would represent a 2.374% increase in baseline mortality, of which the Project contributes 10 (10.3) mortalities, representing a 0.158% increase in baseline mortality.

11.4.33 Assessing the potential impact to the more recent 2015 East Caithness Cliffs SMP population of 149,228 breeding adults with a baseline mortality of 9,103 individuals per annum, the addition of 155 mortalities would represent a 1.697% increase in baseline mortality, of which the Project contributes 10 (10.3) mortalities, representing a 0.050% increase in baseline mortality.

11.4.34 Though the percentage increase exceeds 1%, it is considered that the estimated impact will not have a measurable impact on the guillemot feature of the East Caithness SPA owing to several elements of precaution in the assessment. Though the apportioned number of individuals to the East Caithness Cliffs SPA in the non-breeding season is 9.2% (Appendix 7.1.4), this number is considered an overestimate based on available data. Based on three years of tracking data of guillemots at the East Caithness Cliffs SPA presented by Buckingham *et al*. (2022), the Project is considered well outside of the core foraging areas of guillemots from this colony, and therefore the number of birds from the BDMPS overlapping with projects in the southern North Sea is considered to be measurably less than 9%. In addition, the use of mean peaks within the assessment results in an overestimate of density, assuming that the peak number of individuals recorded in one month is reflective of abundance throughout the season.

11.4.35 Based on this evidence, the Project in-combination with other projects is not considered having a measurable impact on the guillemot feature of the East Caithness Cliffs SPA. In addition, the project alone contributes an impact of less than 0.1% increase in baseline mortality and therefore is considered *de minimis*.

11.4.36 **It is therefore concluded that the in-combination predicted guillemot mortality due to displacement in the O&M phase would not adversely affect the integrity of the East Caithness Cliffs SPA.**

Table 11.15: in-combination displacement consequent mortalities for guillemot at the East Caithness Cliffs SPA.

Bio-season	Abundance of adults apportioned to the FFC SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Non-breeding	30,897.3	154.5	92.7 – 2,162.8	2.374	1.424 – 33.230	1.697	1.018 – 23.759

Table 11.16: in-combination displacement matrix for guillemot attributed to the East Caithness in the non-breeding bio-season, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	31	62	154	309	618	927	1,236	1,545	1,854	2,163	2,472	2,781	3,090
20	62	124	309	618	1,236	1,854	2,472	3,090	3,708	4,326	4,944	5,561	6,179
30	93	185	463	927	1,854	2,781	3,708	4,635	5,561	6,488	7,415	8,342	9,269
40	124	247	618	1,236	2,472	3,708	4,944	6,179	7,415	8,651	9,887	11,123	12,359
50	154	309	772	1,545	3,090	4,635	6,179	7,724	9,269	10,814	12,359	13,904	15,449
60	185	371	927	1,854	3,708	5,561	7,415	9,269	11,123	12,977	14,831	16,684	18,538
70	216	433	1,081	2,163	4,326	6,488	8,651	10,814	12,977	15,140	17,302	19,465	21,628
80	247	494	1,236	2,472	4,944	7,415	9,887	12,359	14,831	17,302	19,774	22,246	24,718
90	278	556	1,390	2,781	5,561	8,342	11,123	13,904	16,684	19,465	22,246	25,027	27,807
100	309	618	1,545	3,090	6,179	9,269	12,359	15,449	18,538	21,628	24,718	27,807	30,897

East Caithness Cliffs SPA – Razorbill (Non-breeding Bio-season)

11.4.37 Razorbill has been screened in for the assessment of the O&M phase during the non-breeding bio-seasons to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the East Caithness Cliffs SPA (presented in Section 10.4 Appendix 7.1.1).

11.4.38 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. To determine the number of razorbills from the East Caithness Cliffs SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.17 in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and Royal HaskoningDHV, 2022).

11.4.39 Cumulative totals were then apportioned to the East Caithness Cliffs SPA based on the proportion of breeding adults from the UK North Sea and English Channel BDMPS population that can be attributed to the East Caithness Cliffs SPA as defined by Furness (2015). Following this approach to apportionment the proportion of the BDMPS populations from the East Caithness Cliffs SPA during non-breeding bio-season of 4.2% was applied, as previously agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this project through the EPP (Table 5.2).

11.4.40 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on razorbill. However, based on SNCB advice (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.18. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.19.

11.4.41 Table 11.17 below presents the total abundance of razorbill from relevant projects (array area plus 2km buffer), alongside numbers apportioned to the East Caithness Cliffs SPA. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.17: Non-breeding season mean peak abundances and abundances apportioned to the East Caithness Cliffs SPA for razorbill from relevant tier one and two projects.

Project	Autumn migration		Migration-free winter		Spring migration		Non-breeding total	
	Total	Apportioned	Total	Apportioned	Total	Apportioned	Total	Apportioned
Tier 1 and 2 projects	42,299.0	1,776.6	26,311.0	289.4	34,256.0	1,438.8	140,170.0	3,504.7
Rampion 2	18.0	0.8	22.0	0.2	2,130.0	89.5	2,170.0	90.5
Berwick Bank	8,849.0	371.7	1,399.0	15.4	7,480.0	314.2	17,728.0	701.2
The Project	2,339.0	98.2	2,570.0	28.3	5,229.0	219.6	10,138.0	346.1
Total	**53,505.0**	**2,247.2**	**30,302.0**	**333.3**	**49,095.0**	**2,062.0**	**170,206.0**	**4,642.5**

Post-breeding Migration Bio-season.

11.4.42 During the post-breeding migration bio-season, the in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the East Caithness Cliffs SPA is 2,247 (2,247.2) individuals. The displacement consequent mortality, based on 50% displacement and 1% mortality is 11 (11.2) individuals.

11.4.43 Considering the potential impact to the East Caithness Cliffs citation population of 15,800 breeding adults with a baseline mortality of 1,659 individuals per annum, the addition of 11 mortalities would represent a 0.677% increase in baseline mortality, of which the Project contributes less than one (0.5) mortality, representing a 0.030% increase in baseline mortality.

11.4.44 Assessing the potential impact to the more recent East Caithness Cliffs SMP population of 30,172 breeding adults with a baseline mortality of 3,168 individuals per annum, the addition of 11 mortalities would represent a 0.355% increase in baseline mortality, of which the Project contributes less than one (0.5) mortality, representing a 0.016% increase in baseline mortality.

Migration-free Winter Bio-season.

11.4.45 During the migration-free winter bio-season, the in-combination number of individuals at risk of displacement from OWFs, including Outer Dowsing, that have been apportioned to the East Caithness Cliffs SPA is 333 (333.3) individuals. The displacement consequent mortality, based on 50% displacement and 1% mortality is two (1.7) individuals.

11.4.46 Considering the potential impact to the East Caithness Cliffs citation population, the addition of two mortalities would represent a 0.100% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.009% increase in baseline mortality.

11.4.47 Assessing the potential impact to the more recent East Caithness Cliffs SMP population, the addition of two mortalities would represent a 0.053% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.005% increase in baseline mortality.

Return Migration Bio-season

11.4.48 During the return migration bio-season, the in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the East Caithness Cliffs SPA is 2,062 (2,062.0) individuals. The displacement consequent mortality, based on 50% displacement and 1% mortality is 10 (10.3) individuals.

11.4.49 Considering the potential impact to the East Caithness Cliffs citation population, the addition of 10 mortalities would represent a 0.621% increase in baseline mortality, of which the Project contributes one (1.1) mortality, representing a 0.067% increase in baseline mortality.

11.4.50 Assessing the potential impact to the more recent East Caithness Cliffs SMP population, the addition of 10 mortalities would represent a 0.325% increase in baseline mortality, of which the Project contributes one (1.1) mortality, representing a 0.035% increase in baseline mortality.

Non-breeding Total

11.4.51 Across all non-breeding bio-seasons, the total in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the East Caithness Cliffs SPA is 4,643 (4,642.5) individuals. The displacement consequent mortality, based on 50% displacement and 1% mortality is 23 (23.2) individuals.

11.4.52 Considering the potential impact to the East Caithness Cliffs citation population, the addition of 23 mortalities would represent a 1.399% increase in baseline mortality, of which the Project contributes less than two (1.7) mortalities, representing a 0.105% increase in baseline mortality.

11.4.53 Assessing the potential impact to the more recent East Caithness Cliffs SMP population, the addition of 23 mortalities would represent a 0.733% increase in baseline mortality, of which the Project contributes less than two (1.7) mortalities, representing a 0.055% increase in baseline mortality.

11.4.54 Therefore, the in-combination impacts resulting from displacement are considered indistinguishable from natural fluctuations in the population. In addition, the project alone contributes an impact of less than 0.1% increase in baseline mortality and therefore is considered *de minimis*.

11.4.55 **It is therefore concluded that the in-combination predicted razorbill mortality due to displacement in the O&M phase would not adversely affect the integrity of the East Caithness Cliffs SPA**.

Table 11.18: in-combination displacement consequent mortalities for razorbill at the East Caithness Cliffs SPA.

Bio-season	Abundance of adults apportioned to the East Caithness Cliffs SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Post-breeding migration	2247.2	11.2	6.7 – 157.3	0.677	0.406 – 9.482	0.355	0.213 – 4.965
Migration-free winter	333.3	1.7	1.0 – 23.3	0.100	0.060 – 1.406	0.053	0.032 – 0.736
Return migration	2062.0	10.3	6.2 – 144.3	0.621	0.373 – 8.700	0.325	0.195 – 4.556
Non-breeding total	**4642.5**	**23.2**	**13.9 – 325.0**	**1.399**	**0.840 – 19.589**	**0.733**	**0.440 – 10.258**

Table 11.19: in-combination displacement matrix for razorbill attributed to the East Caithness Cliffs SPA in the non-breeding bio-seasons, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach..

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	9	23	46	93	139	186	232	279	325	371	418	464
20	9	19	46	93	186	279	371	464	557	650	743	836	929
30	14	28	70	139	279	418	557	696	836	975	1,114	1,254	1,393
40	19	37	93	186	371	557	743	929	1,114	1,300	1,486	1,671	1,857
50	23	46	116	232	464	696	929	1,161	1,393	1,625	1,857	2,089	2,322
60	28	56	139	279	557	836	1,114	1,393	1,671	1,950	2,229	2,507	2,786
70	33	65	163	325	650	975	1,300	1,625	1,950	2,275	2,600	2,925	3,250
80	37	74	186	371	743	1,114	1,486	1,857	2,229	2,600	2,972	3,343	3,714
90	42	84	209	418	836	1,254	1,671	2,089	2,507	2,925	3,343	3,761	4,179
100	46	93	232	464	929	1,393	1,857	2,322	2,786	3,250	3,714	4,179	4,643

Farne Islands SPA – Guillemot (Non-breeding Bio-season)

11.4.56 Guillemot has been screened in for the assessment of the O&M phase during the non-breeding season to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the Farne Islands SPA (presented in Section 10.4 and Appendix 7.1.1).

11.4.57 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. To determine the number of guillemots from the Farne Islands SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.20, in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and Royal HaskoningDHV, 2022).

11.4.58 Cumulative totals were then apportioned to the Farne Islands SPA based on the proportion of breeding adults from the UK North Sea and English Channel BDMPS population that can be attributed to the Farne Islands SPA as defined by Furness (2015). Following this approach to apportionment the proportion of the BDMPS populations from the Farne Islands SPA during non-breeding bio-season of 3.7% was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this project through the EPP (Table 5.2).

11.4.59 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on SNCB advice (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.21. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.22. Table 11.20 below presents the total abundance of guillemots from relevant projects (array area plus 2km buffer), alongside numbers apportioned to the Farne Islands SPA. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.20: Non-breeding season mean peak abundances and abundances apportioned to the Farne Islands SPA for guillemot from relevant tier one and two projects.

Project	Non-breeding season	
	Total	Apportioned
Tier 1 and 2 projects	256,401.0	9,486.8
Rampion 2	13,020.0	481.7
Berwick Bank	44,171.0	1,634.3
Outer Dowsing	22,248.0	823.2
Total	**335,840.0**	**12,426.1**

11.4.60 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the Farne Islands SPA is 12,426 (12,426.0) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 62 (62.1) individuals.

11.4.61 Considering the potential impact to the Farne Islands citation population of 65,751 breeding adults with a baseline mortality of 4,011 individuals per annum, the addition of 62 mortalities would represent a 1.549 % increase in baseline mortality, of which the Project contributes four (4.2) mortalities, representing a 0.104% increase in baseline mortality.

11.4.62 Assessing the potential impact to the more recent 2017 Farne Islands SMP population of 64,042 breeding adults with a baseline mortality of 3,907 individuals per annum, the addition of 62 mortalities would represent a 1.590% increase in baseline mortality, of which the Project contributes four (4.2) mortalities, representing a 0.106% increase in baseline mortality. Given that the percentage increase in baseline mortality is over 1% for both the citation and SMP population sizes, further consideration is given to these impacts below.

11.4.63 PVA has been undertaken for the Berwick Bank RIAA for the impacts of the project alone on guillemot at the Farne Islands SPA (RPS and Royal HaskoningDHV, 2022). The project presented data for a range of scenarios, including baseline conditions (i.e. no additional mortalities), the Developers approach (resulting in 37 additional mortalities per annum), and a worst case approach resulting in 167 additional mortalities per annum. The CPS value for the analysis, representing the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, indicated that the worst case scenario would result in a reduction in SPA population size of 8% after 35 years. The associated reduction in population growth rate would represent a worst case scenario of 0.2%. The conclusion from this analysis was that the impacts would not be significantly different to an unimpacted population after 35 years. Additionally, since this scenario is based on over double the mortalities presented within this in-combination assessment, it is therefore considered that the impacts resulting from the Project in-combination with other projects will not be significant.

11.4.64 In addition to this conclusion, it should also be noted that the assessment is already considered precautionary in nature, because it is based on mean peak abundance, which is likely to overestimate the abundance of individuals present in the area throughout the whole season, while also not accounting for the fact that individuals are possibly double counted across multiple projects within similar areas, thus further over-inflating predicted impacts.

11.4.65 Therefore, although the in-combination impacts resulting from displacement exceed a 1% increase in baseline mortality, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population based on PVA analysis carried out for other projects.

11.4.66 **It is therefore concluded that the in-combination predicted guillemot mortality due to displacement in the O&M phase would not adversely affect the integrity of the Farne Islands SPA.**

Table 11.21: In-combination displacement consequent mortalities for guillemot at the Farne Islands SPA.

Bio-season	Abundance of adults apportioned to the Farne Islands SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Non-breeding	12,426.0	62.1	37.3 – 869.8	1.549	0.929 – 21.687	1.590	0.954 – 22.266

Table 11.22: In-combination displacement matrix for guillemot attributed to the Farne Island SPA in the non-breeding bio-season, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing The Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	12	25	62	124	249	373	497	621	746	870	994	1,118	1,243
20	25	50	124	249	497	746	994	1,243	1,491	1,740	1,988	2,237	2,485
30	37	75	186	373	746	1,118	1,491	1,864	2,237	2,609	2,982	3,355	3,728
40	50	99	249	497	994	1,491	1,988	2,485	2,982	3,479	3,976	4,473	4,970
50	62	124	311	621	1,243	1,864	2,485	3,107	3,728	4,349	4,970	5,592	6,213
60	75	149	373	746	1,491	2,237	2,982	3,728	4,473	5,219	5,964	6,710	7,456
70	87	174	435	870	1,740	2,609	3,479	4,349	5,219	6,089	6,959	7,828	8,698
80	99	199	497	994	1,988	2,982	3,976	4,970	5,964	6,959	7,953	8,947	9,941
90	112	224	559	1,118	2,237	3,355	4,473	5,592	6,710	7,828	8,947	10,065	11,183
100	124	249	621	1,243	2,485	3,728	4,970	6,213	7,456	8,698	9,941	11,183	12,426

Farne Islands SPA – Puffin (Non-breeding Bio-season)

11.4.67 Puffin has been screened in for the assessment of the O&M phase during the non-breeding season to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the Farne Islands SPA (presented in Section 10.4 Appendix 7.1.1).

11.4.68 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. To determine the number of puffins from the Farne Islands SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.23, in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and RoyalHaskoningDHV, 2022).

11.4.69 Cumulative totals were then apportioned to the Farne Islands SPA based on the proportion of breeding adults from the UK North Sea and English Channel BDMPS population that can be attributed to the Farne Islands SPA as defined by Furness (2015). Following this approach to apportionment the proportion of the BDMPS populations from the Farne Islands SPA during non-breeding bio-season of 34.5% was applied, as agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England, 2020) and for this Project through the EPP (Table 5.2).

11.4.70 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on puffin. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.24. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.25Table 11.23 below presents the total abundance of puffins from relevant projects (array area plus 2km buffer), alongside numbers apportioned to the Farne Islands SPA. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.23: Non-breeding season mean peak abundances and abundances apportioned to the Farne Islands SPA for puffin from relevant tier one and two projects.

Project	Non-breeding season	
	Total	Apportioned
Tier 1 and 2 projects	45,017.0	15,530.9
Rampion 2	0.0	0.0
Berwick Bank	0.0	0.0
Outer Dowsing	1,167.0	402.6
Total	**46,184.0**	**15,933.5**

11.4.71 The in-combination number of individuals at risk of displacement from OWFs, including the Project that have been apportioned to the Farne Islands SPA is 15,934 (15,933.5) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 80 (79.7) individuals.

11.4.72 Considering the potential impact to the Farne Islands citation population of 76,798 breeding adults, with a background mortality of 4,685 individuals per annum, the addition of 80 mortalities would represent a 1.701% increase in baseline mortality, of which the Project contributes two (2.0) mortalities, representing a 0.043% increase in baseline mortality.

11.4.73 Assessing the potential impact to the more recent 2019 Farne Islands SMP population of 43,752 breeding adults, with a background mortality of 2,669 individuals per annum, the addition of 80 mortalities would represent a 2.985% increase in baseline mortality, of which the Project contributes two (2.0) mortalities, representing a 0.075% increase in baseline mortality. PVA has not been carried out by recent projects on this feature at this site. The requirement for PVA will be reassessed once the project has been refined post-PEIR.

11.4.74 Although the increase in baseline mortality for both the citation and SMP population is greater than 1%, the project alone contribution represents a <0.1% increase in baseline mortality for both populations. Therefore, the impact from the Project is considered *de minimis*.

11.4.75 **It is concluded that the Project is not leading to an adverse effect on puffin from the Farne Islands SPA alone or in-combination during the O&M phase**.

Table 11.24: In-combination displacement consequent mortalities for puffin at the Farne Islands SPA.

Bio-season	Abundance of adults apportioned to the Farne Islands SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Non-breeding	12,426.0	62.1	37.3 – 869.8	1.549	0.929 – 21.687	1.590	0.954 – 22.266

Table 11.25: In-combination displacement matrix for puffin attributed to the Farne Islands SPA in the non-breeding bio-season, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	12	25	62	124	249	373	497	621	746	870	994	1,118	1,243
20	25	50	124	249	497	746	994	1,243	1,491	1,740	1,988	2,237	2,485
30	37	75	186	373	746	1,118	1,491	1,864	2,237	2,609	2,982	3,355	3,728
40	50	99	249	497	994	1,491	1,988	2,485	2,982	3,479	3,976	4,473	4,970
50	62	124	311	621	1,243	1,864	2,485	3,107	3,728	4,349	4,970	5,592	6,213
60	75	149	373	746	1,491	2,237	2,982	3,728	4,473	5,219	5,964	6,710	7,456
70	87	174	435	870	1,740	2,609	3,479	4,349	5,219	6,089	6,959	7,828	8,698
80	99	199	497	994	1,988	2,982	3,976	4,970	5,964	6,959	7,953	8,947	9,941
90	112	224	559	1,118	2,237	3,355	4,473	5,592	6,710	7,828	8,947	10,065	11,183
100	124	249	621	1,243	2,485	3,728	4,970	6,213	7,456	8,698	9,941	11,183	12,426

Flamborough and Filey Coast SPA – Guillemot

11.4.76 Guillemot has been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4).

11.4.77 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (73.2km) plus 1SD (80.5) of guillemot from the FFC SPA based on data from Woodward *et al*. (2019). Since guillemots range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the non-breeding bio-season. Projects included within the in-combination assessment are presented in Table 11.26 below.

11.4.78 During the breeding bio-season it is considered that potential displacement impacts on guillemot from FFC SPA may be attributed more highly to offshore windfarms within areas of sea within foraging distance from this breeding colony. In order to assess the potential in-combination impacts on guillemot from multiple offshore windfarms, information was compiled on the seasonal abundance of guillemots measured at each offshore windfarm site (plus 2km buffer). The seasonal guillemot abundances were then subjected to a process of attribution to FFC SPA (Appendix 7.1.4).

11.4.79 Outside of the breeding bio-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. This apportionment is based on calculating the proportion of the breeding adults within the UK North Sea and English Channel BDMPS population that can be attributed to the FFC SPA as defined by Furness (2015), based on the data within that report. Following this approach to apportionment the proportion of the BDMPS populations from FFC SPA during non-breeding bio-season of 4.4% was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England, 2020) and for this Project through the EPP (Table 5.1).

11.4.80 The total numbers presented in Table 10.23 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Windfarm Extension Projects RIAA (Royal HaskoningDHV, 2022). The following amendments were made to the values presented:

- Updated totals from Hornsea Four following DCO application submission (Ørsted, 2022);
- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);
- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time the Project is predicted to be operation; and

- Inclusion of values from the Project.

11.4.81 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on SNCB advice (SNBs, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is presented in Table 11.26Table 11.27. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.26Table 11.28Table 11.26 below presents the abundance of guillemots as attributed to FFC SPA within all other offshore windfarms and their 2km buffers for consideration in this in-combination assessment. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.26: In-combination displacement total for guillemot attributed to the FFC SPA

Project	Seasonal population at risk of displacement			Tier
	Breeding	Non-breeding	Annual Total	
Beatrice	0.0	121.2	121.2	1a
Blyth Demonstration Site	0.0	58.1	58.1	1a
Dudgeon	0.0	23.8	23.8	1a
East Anglia One	0.0	28.2	28.2	1a
EOWDC	0.0	9.9	9.9	1a
Galloper	0.0	26.1	26.1	1a
Greater Gabbard	0.0	24.1	24.1	1a
Gunfleet Sands	0.0	16.0	16.0	1a
Hornsea Project One	4,554.0	356.3	4,910.4	1a
Hornsea Project Two	3,581.0	579.2	4,160.5	1a
Humber Gateway	99.0	6.1	105.1	1a
Hywind	0.0	94.0	94.0	1a
Hywind 2 Demonstration	0.0	94.0	94.0	1a
Kentish Flats	0.0	0.1	0.1	1a
Kentish Flats Extension	0.0	0.2	0.2	1a
Kincardine	0.0	0.0	0.0	1a
Lincs, Lynn & Inner Dowsing	0.0	35.8	35.8	1a
London Array	0.0	16.6	16.6	1a
Methil	0.0	0.0	0.0	1a
Race Bank	0.0	31.2	31.2	1a
Rampion	0.0	683.6	683.6	1a
Scroby Sands	-	-	0.0	1a
Sheringham Shoal	0.0	31.5	31.5	1a
Teesside	267.0	39.6	306.6	1a
Thanet	0.0	5.5	5.5	1a
Westermost Rough	347.0	21.4	368.4	1a

Project	Seasonal population at risk of displacement			Tier
	Breeding	Non-breeding	Annual Total	
Triton Knoll	425.0	32.8	457.8	1a
Moray East	0.0	24.1	24.1	1b
Neart na Gaoithe	0.0	165.5	165.5	1b
Seagreen Alpha	0.0	206.0	206.0	1b
Seagreen Bravo	0.0	181.0	181.0	1b
Dogger Bank A	1,893.0	270.2	2,162.7	1b
Dogger Bank B	3,318.0	467.3	3,785.0	1b
Sofia	1,824.0	162.8	1,986.7	1b
Firth of Forth Alpha	0.0	206.3	206.3	1b
Firth of Forth Bravo	0.0	180.9	180.9	1c
East Anglia Three	0.0	125.8	125.8	1c
Dogger Bank C	1,149.0	99.8	1,248.9	1c
Hornsea Three	0.0	782.0	782.0	1c
Inch Cape	0.0	139.8	139.8	1c
Moray West	0.0	1,680.0	1,679.7	1c
Norfolk Boreas	0.0	606.2	606.2	1c
Norfolk Vanguard	0.0	210.2	210.2	1c
East Anglia ONE North	0.0	83.1	83.1	1c
East Anglia TWO	0.0	73.7	73.7	1c
Hornsea Four	5,235.0	1,631.0	6,865.9	1d
Dudgeon Extension Project	0.0	655.0	655.0	1d
Sheringham Shoal Extension Project	0.0	47.7	47.7	1d
Rampion 2	0.0	574.0	574.0	2
Berwick Bank	0.0	0.0	0.0	2
Five Estuaries	-	-	-	2
Dogger Bank South (East and West)	-	-	-	2
Dogger Bank D	-	-	-	2
The Project	12,284.0	22,248.0	34,532.0	2

Project	Seasonal population at risk of displacement			Tier
	Breeding	Non-breeding	Annual Total	
All Projects Total	**34,976.0**	**33,155.7**	**68,130.9**	**-**

Breeding Bio-season

11.4.82 The in-combination number of breeding adults attributed to FFC SPA at risk of displacement from OWFs, including the Project, during the breeding bio-season is 68,131 (68,130.9). The predicted consequent mortality, based on 50% displacement and 1% mortality, is 175 (174.9) breeding adults.

11.4.83 Based on a citation population of 83,214 breeding adult guillemots at FFC SPA and an annual background mortality of 5,076 breeding adults per annum, the addition of 175 displacement consequent mortalities would represent a 3.445% increase in baseline mortality, of which the Project contributes 61 (61.4) individuals, representing a 1.210% increase in baseline mortality.

11.4.84 As the population of guillemot has increased significantly 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 121,754 breeding adults, with an annual baseline mortality of 7,427 breeding adults per annum. The addition of 175 mortalities would represent a 2.355% increase in baseline mortality, the Project contributes 61 (61.4) individuals representing a 0.827% increase in baseline mortality.

Non-breeding Bio-season

11.4.85 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to FFC SPA is 33,156 (33,155.7) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 166 (165.8) individuals.

11.4.86 Considering the potential impact to the FFC citation population, the addition of 166 individuals would represent a 3.266% increase in baseline mortality, of which the Project contributes five (4.9) mortalities, representing a 0.097% increase in baseline mortality.

11.4.87 Assessing the potential impact to the more recent FFC SMP population during the post-breeding migration bio-season, the addition of 166 individuals would represent a 2.232% increase in baseline mortality, of which the Project contributes five (4.9) mortality, representing a 0.066% increase in baseline mortality.

Annual Total

11.4.88 The in-combination number of guillemots predicted to be displaced from all OWFs, including the Project, is 68,131 (68,130.9) individuals per annum. The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is 341 (340.7) individuals.

11.4.89 Considering the potential impact to the FFC citation population, the addition of 341 mortalities would represent a 6.711% increase in baseline mortality, of which the Project contributes 66 (66.3) mortalities, representing a 1.307% increase in baseline mortality.

11.4.90 Assessing the potential impact to the more recent FFC SMP population, the addition of 341 mortalities would represent a 4.587% increase in baseline mortality, of which the Project contributes 66 (66.3) mortalities, representing a 0.893% increase in baseline mortality. Due to the percentage increase in baseline mortality exceeding 1%, further consideration to these impacts is given below.

11.4.91 Based on PVA undertaken by the Dudgeon and Sheringham Shoal Extension projects (Royal HaskoningDHV, 2022), between 1986 and 2017, the guillemot population at the FFC SPA had an average annual growth rate of 3.8%. This rises to 4.6% when considering trends between 2008 and 2017. Assuming that the population continues to increase at the more precautionary rate of 3.8%, PVA analysis concluded that even the scenario based on a 70% displacement rate and 10% mortality rate, with an annual mortality of 3,079 individuals, would not result in a population decline. Considering the impacts of the Project in-combination with other projects, the addition of 341 mortalities per annum would therefore not impact the integrity of the guillemot feature of the FFC SPA.

11.4.92 In addition to this conclusion, it should also be noted that the assessment is already considered precautionary in nature, based on mean peaks which overestimate the abundance of individuals present in the area throughout the whole season, while also not accounting for the fact that individuals are likely to have been double counted across multiple projects within similar areas, thus further over-inflating predicted impacts.

11.4.93 Although the in-combination impacts resulting from displacement exceed a 1% increase in baseline mortality, based on the evidence provided above, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population.

11.4.94 **It is therefore concluded that the in-combination predicted guillemot mortality due to displacement in the O&M phase would not adversely affect the integrity of the FFC SPA.**

Table 11.27: In-combination displacement consequent mortalities for guillemot at the FFC SPA.

Bio-season	Abundance of adults apportioned to the FFC SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Breeding	34,976.0	174.9	104.9 – 2,448.3	3.445	2.067 – 48.233	2.355	1.413 – 32.965
Non-breeding	33,155.7	165.8	99.5 – 2,320.9	3.266	1.960 – 45.723	2.232	1.339 – 31.250
Annual Total	**68,130.9**	**340.7**	**204.4 – 4,769.2**	**6.711**	**4.027 – 93.954**	**4.587**	**2.752 – 64.214**

Table 11.28: In-combination displacement matrix for guillemot at the FFC SPA, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	68	136	341	681	1,363	2,044	2,725	3,407	4,088	4,769	5,450	6,132	6,813
20	136	273	681	1,363	2,725	4,088	5,450	6,813	8,176	9,538	10,901	12,264	13,626
30	204	409	1,022	2,044	4,088	6,132	8,176	10,220	12,264	14,308	16,351	18,395	20,439
40	273	545	1,363	2,725	5,450	8,176	10,901	13,626	16,351	19,077	21,802	24,527	27,252
50	341	681	1,703	3,407	6,813	10,220	13,626	17,033	20,439	23,846	27,252	30,659	34,066
60	409	818	2,044	4,088	8,176	12,264	16,351	20,439	24,527	28,615	32,703	36,791	40,879
70	477	954	2,385	4,769	9,538	14,308	19,077	23,846	28,615	33,384	38,153	42,923	47,692
80	545	1,090	2,725	5,450	10,901	16,351	21,802	27,252	32,703	38,153	43,604	49,054	54,505
90	613	1,226	3,066	6,132	12,264	18,395	24,527	30,659	36,791	42,923	49,054	55,186	61,318
100	681	1,363	3,407	6,813	13,626	20,439	27,252	34,066	40,879	47,692	54,505	61,318	68,131

Flamborough and Filey Coast SPA – Razorbill

11.4.95 Razorbill has been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4 and Appendix 7.1.1).

11.4.96 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (88.7km) plus 1SD (75.9km) of razorbill from the FFC SPA based on data from Woodward *et al*. (2019). Since razorbills range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the non-breeding bio-season. Projects included within the in-combination assessment are presented in Table 11.29 below.

11.4.97 During the breeding bio-season it is considered that potential displacement impacts on razorbills from FFC SPA may be attributed more highly to offshore windfarms within areas of sea within foraging distance from this breeding colony. In order to assess the potential in-combination impacts on razorbill from multiple offshore windfarms, information was compiled on the seasonal abundance of razorbills measured at each offshore windfarm site (plus 2km buffer). The seasonal razorbill abundances were then subjected to a process of attribution to FFC SPA (Appendix 7.1.4).

11.4.98 Outside of the breeding bio-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. This apportionment is based on calculating the proportion of the breeding adults within the UK North Sea and English Channel BDMPS population that can be attributed to the FFC SPA as defined by Furness (2015), based on the data within that report. Following this approach to apportionment the proportion of the BDMPS populations from FFC SPA during the migration bio-seasons of 3.4%, and during the migration-free winter bio-season of 0.9% was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this project through the EPP (Table 5.2).

11.4.99 The total numbers presented in Table 11.29 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Windfarm Extension Projects RIAA (Royal HaskoningDHV, 2022). The following amendments were made to the values presented:

- Updated totals from Hornsea Four following DCO application submission (Ørsted, 2022);
- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);

- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time the Project is predicted to be operation; and
- Inclusion of values from the Project.

11.4.100 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on razorbill. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.30. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.31.

11.4.101 Table 11.29 below presents the abundance of razorbills as attributed to FFC SPA within all other offshore windfarms and their 2km buffers for consideration in this in-combination assessment. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.29: in-combination displacement total for razorbill attributed to the FFC SPA.

Project	Seasonal population at risk of displacement					Tier
	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual total	
Beatrice	0.0	28.3	15	28.3	71.6	1a
Blyth Demonstration Site	0.0	3.1	1.6	3.1	7.8	1a
Dudgeon	0.0	11.8	20.1	11.8	43.7	1a
East Anglia One	0.0	0.9	4.2	11	16.1	1a
EOWDC	0.0	2.2	0.2	0.9	3.3	1a
Galloper	0.0	1.5	2.8	13.4	17.7	1a
Greater Gabbard	0.0	0.0	10.5	2.8	13.3	1a
Gunfleet Sands	0.0	0.0	0.8	0.0	0.8	1a
Hornsea Project One	534.5	163.6	41	61.3	800.4	1a
Hornsea Project Two	1,210.00	143.5	19.4	56.7	1429.9	1a
Humber Gateway	0.0	0.7	0.4	0.7	1.8	1a
Hywind	0.0	24.4	0.3	-	24.7	1a
Hywind 2 Demonstration	0.0	24	0.0	0.0	24	1a
Kentish Flats Extension	-	-	-	-	0.0	1a
Kentish Flats	-	-	-	-	0.0	1a
Kincardine	0.0	0.0	0.0	0.0	0.0	1a
Lincs, Lynn & Inner Dowsing	0.0	1.1	0.6	1.1	2.8	1a
London Array	0.0	0.7	0.4	0.7	1.8	1a
Methil	0.0	0.0	0.0	0.0	0.0	1a
Race Bank	0.0	1.4	0.8	1.4	3.6	1a
Rampion	0.0	2.2	33.6	113.1	148.9	1a
Scroby Sands	-	-	-	-	-	1a
Sheringham Shoal	0.0	45.7	5.7	1.0	52.4	1a
Teesside	0.0	2.1	0.1	0.7	2.9	1a
Thanet	0.0	0.0	0.4	0.7	1.1	1a

Project	Seasonal population at risk of displacement					Tier
	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual total	
Westermost Rough	91	4.1	4.1	3.1	102.3	1a
Triton Knoll	0.0	8.6	23.1	4	35.7	1a
Moray East	0.0	37.5	0.8	5.7	44	1b
Neart na Gaoithe	0.0	186.7	13.7	-	200.4	1b
Seagreen Alpha	0.0	0.0	30	-	30	1b
Seagreen Bravo	0.0	0.0	34	-	34	1b
East Anglia Three	0.0	38.1	40.5	51.8	130.4	1b
Dogger Bank A	375	53.6	46.7	141.1	616.4	1b
Dogger Bank B	461.4	71.3	57.9	174	764.6	1b
Sofia	345.9	20.1	38.5	100.4	504.9	1b
Firth of Forth Alpha	0.0	-	29.8	-	29.8	1b
Firth of Forth Bravo	0.0	-	34.3	-	34.3	1c
Dogger Bank C	250.2	10.6	25.9	65.2	351.9	1c
Hornsea Three	516	69	99	72	756	1c
Inch Cape	0.0	97.6	17.6	-	115.2	1c
Moray West	0.0	120.5	5	121.9	247.4	1c
East Anglia ONE North	0.0	2.9	1.5	7	11.4	1c
East Anglia TWO	0.0	1.5	3.7	7.8	13	1c
Norfolk Boreas	0.0	8.9	28.8	11.7	49.4	1c
Norfolk Vanguard	0.0	29.5	22.7	31.4	83.6	1c
Hornsea Four	215.1	145.7	12.5	15.2	388.5	1c
Dudgeon Extension Project	0.0	31.4	22.8	10.9	65.1	1d
Sheringham Shoal Extension Project	0.0	10.7	18.5	4.9	34.1	1d
Rampion 2	0.0	0.6	0.6	72	73.2	2
Berwick Bank	0.0	300.9	37.8	254.3	593	2
Five Estuaries	-	-	-	-	-	2
Dogger Bank South (East and West)	-	-	-	-	-	2

Project	Seasonal population at risk of displacement					Tier
	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual total	
Dogger Bank D	-	-	-	-	-	2
The Project	2,736.9	79.0	23.5	176.7	3,016.1	2
All Projects Total	**6,736.0**	**1,786.0**	**831.2**	**1,639.8**	**10,993.3**	**-**

Breeding Bio-season

11.4.102 The in-combination number of breeding adults attributed to FFC SPA at risk of displacement from OWFs, including the Project, during the breeding bio-season is 6,736 (6,736.0). The predicted consequent mortality, based on 50% displacement and 1% mortality, is 34 (33.7) breeding adults.

11.4.103 Based on a citation population of 21,140 breeding adult razorbills at FFC SPA and an annual background mortality of 2,220 breeding adults per annum, the addition of 34 displacement consequent mortalities would represent a 1.517% increase in baseline mortality, of which the Project contributes 14 (13.7) individuals, representing a 0.617% increase in baseline mortality.

11.4.104 As the population of razorbills has increased significantly 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 40,506 breeding adults, with an annual baseline mortality of 4,253 breeding adults per annum. The addition of 34 mortalities would represent a 0.792% increase in baseline mortality, of which the Project contributes 14 (13.7) individuals representing a 0.322% increase in baseline mortality.

Non-breeding Bio-season

11.4.105 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to FFC SPA is 1,128 (1,127.9) individuals in the post-breeding migration bio-season, 831 (83.2) in the migration-free winter bio-season and 1,640 (1,639.8) individuals in the return migration bio-season.

11.4.106 The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is nine (8.9) individuals in the post-breeding migration bio-season, four (4.2) individuals in the migration-free winter bio-season, and eight (8.2) individuals in the return migration bio-season.

11.4.107 Considering the potential impact to the FFC citation population during the post-breeding migration bio-season, the addition of nine individuals would represent a 0.402% increase in baseline mortality, of which the Project contributes less than one (0.4) mortality, representing a 0.018% increase in baseline mortality. During the migration-free winter bio-season, the addition of four individuals would represent a 0.187% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.005% increase in baseline mortality. During the return migration bio-season, the addition of eight mortalities would represent a 0.369% increase in baseline mortality, of which the Project contributes less than one (0.9) mortality, representing a 0.040% increase in baseline mortality.

11.4.108 Assessing the potential impact to the more recent FFC SMP population during the post-breeding migration bio-season, the addition of nine individuals would represent a 0.210% increase in baseline mortality, of which the Project contributes less than one (0.4) mortality, representing a 0.009% increase in baseline mortality. During the migration-free winter bio-season, the addition of four individuals would represent a 0.098% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.003% increase in baseline mortality. During the return migration bio-season, the addition of eight mortalities would represent a 0.193% increase in baseline mortality, of which the Project contributes less than one (0.9) mortality, representing a 0.021% increase in baseline mortality.

Annual Total

11.4.109 The in-combination number of razorbills predicted to be displaced from all OWFs, including the Project, is 10,993 (10,993.3) individuals per annum. The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is 55 (55.0) individuals.

11.4.110 Considering the potential impact to the FFC citation population, the addition of 55 mortalities would represent a 2.476% increase in baseline mortality, of which the Project contributes 15 (15.1) mortalities, representing a 0.679% increase in baseline mortality.

11.4.111 Assessing the potential impact to the more recent FFC SMP population, the addition of 55 mortalities would represent a 1.292% increase in baseline mortality, of which the Project contributes 15 (15.1) mortalities, representing a 0.355% increase in baseline mortality. Due to the percentage increase in baseline mortality exceeding 1%, further consideration to this impact is given below.

11.4.112 Though the impact exceeds a 1% increase in baseline mortality, the in-combination impacts are not expected to impact the integrity of the razorbill feature of the FFC SPA based on PVA undertaken by the Dudgeon and Sheringham Shoal Extension projects (Royal HaskoningDHV, 2022). Between 1986 and 2017, the razorbill population at the FFC SPA had an average annual growth rate of 5.8%. This rises to 9.7% when considering trends between 2008 and 2017.

11.4.113 Assuming that the population continues to increase at the more precautionary rate of 5.8%, PVA analysis concluded that even the scenario based on a 70% displacement rate and 10% mortality rate, with an annual mortality of 502 individuals per annum, would not result in a population decline. Considering the impacts of the Project in-combination with other projects, the addition of 55 mortalities per annum would therefore not impact the integrity of the razorbill feature of the FFC SPA.

11.4.114 In addition to this conclusion, it should also be noted that the assessment is already considered precautionary in nature, based on mean peaks which overestimate the abundance of individuals present in the area throughout the whole season, while also not accounting for the fact that individuals are likely to have been double counted across multiple projects within similar areas, thus further over-inflating predicted impacts.

11.4.115 Therefore, although the in-combination impacts resulting from displacement exceed a 1%, based on the evidence provided above, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population.

11.4.116 **It is therefore concluded that the in-combination predicted razorbill mortality due to displacement in the O&M phase would not adversely affect the integrity of the FFC SPA**.

Table 11.30: In-combination displacement consequent mortalities for Razorbill at the FFC SPA.

Bio-season	Abundance of adults apportioned to the FFC SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Migration-free breeding	6,736.0	33.7	20.2 – 471.5	1.517	0.910 – 21.243	0.792	0.475 – 11.086
Post-breeding migration	1,786.0	8.9	5.4 – 125.0	0.402	0.241 – 5.632	0.210	0.126 – 2.939
Return migration	1,639.8	8.2	4.9 – 114.8	0.369	0.222 – 5.171	0.193	0.116 – 2.699
Migration-free winter	831.2	4.2	2.5 – 58.2	0.187	0.112 – 2.621	0.098	0.059 – 1.368
Annual Total	**10,993.3**	**55.0**	**33.0 – 769.5**	**2.476**	**1.486 – 34.668**	**1.292**	**0.775 – 18.093**

Table 11.31: In-combination displacement matrix for razorbill at the FFC SPA, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	11	22	55	110	220	330	440	550	660	770	879	989	1,099
20	22	44	110	220	440	660	879	1,099	1,319	1,539	1,759	1,979	2,199
30	33	66	165	330	660	989	1,319	1,649	1,979	2,309	2,638	2,968	3,298
40	44	88	220	440	879	1,319	1,759	2,199	2,638	3,078	3,518	3,957	4,397
50	55	110	275	550	1,099	1,649	2,199	2,748	3,298	3,848	4,397	4,947	5,497
60	66	132	330	660	1,319	1,979	2,638	3,298	3,957	4,617	5,277	5,936	6,596
70	77	154	385	770	1,539	2,309	3,078	3,848	4,617	5,387	6,156	6,926	7,695
80	88	176	440	879	1,759	2,638	3,518	4,397	5,277	6,156	7,036	7,915	8,794
90	99	198	495	989	1,979	2,968	3,957	4,947	5,936	6,926	7,915	8,904	9,894
100	110	220	550	1,099	2,199	3,298	4,397	5,497	6,596	7,695	8,794	9,894	10,993

Flamborough and Filey Coast SPA – Puffin

11.4.117 Puffin has been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4).

11.4.118 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (137.1km) plus 1SD (128.3km) of puffin from the FFC SPA based on data from Woodward *et al*. (2019). Since guillemots range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the non-breeding bio-season. Projects included within the in-combination assessment are presented in Table 11.32 below.

11.4.119 During the breeding bio-season it is considered that potential displacement impacts on puffin from FFC SPA may be attributed more highly to offshore windfarms within areas of sea within foraging distance from this breeding colony. In order to assess the potential in-combination impacts on puffin from multiple offshore windfarms, information was compiled on the seasonal abundance of puffins measured at each offshore windfarm site (plus 2km buffer). The seasonal puffin abundances were then subjected to a process of attribution to FFC SPA (Appendix 4).

11.4.120 Outside of the breeding bio-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. This apportionment is based on calculating the proportion of the breeding adults within the UK North Sea and English Channel BDMPS population that can be attributed to the FFC SPA as defined by Furness (2015), based on the data within that report. Following this approach to apportionment the proportion of the BDMPS populations from FFC SPA during non-breeding bio-season of 0.8% was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this project through the EPP (Table 5.2).

11.4.121 The total numbers presented in Table 11.32 are derived from in-combination tables presented for the Hornsea Four RIAA (Ørsted, 2022). The following amendments were made to the values presented:

- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);
- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time the Project is predicted to be operation; and
- Inclusion of values from the Project.

11.4.122 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on advice from SNCBs (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.33. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.34.

11.4.123 Table 11.32 below presents the abundance of puffins as attributed to FFC SPA within all other offshore windfarms and their 2km buffers for consideration in this in-combination assessment. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.32: in-combination displacement total for puffin attributed to the FFC SPA.

Project	Seasonal population at risk of displacement			Tier
	Breeding	Non-breeding	Annual Total	
Beatrice	0.0	10.0	10.0	1a
Blyth Demonstration Site	0.0	1.0	1.0	1a
Dudgeon	0.0	0.0	0.0	1a
East Anglia One	0.0	0.0	0.0	1a
EOWDC	0.0	0.0	0.0	1a
Galloper	0.0	0.0	0.0	1a
Greater Gabbard	0.0	0.0	0.0	1a
Gunfleet Sands	-	-	0.0	1a
Hornsea Project One	407.0	5.0	412.0	1a
Humber Gateway	15.0	0.0	15.0	1a
Hywind 2 Demonstration	0.0	0.0	0.0	1a
Kentish Flats	-	-	0.0	1a
Kentish Flats Extension	0.0	0.0	0.0	1a
Kincardine	0.0	0.0	0.0	1a
Lincs, Lynn and Inner Dowsing	0.0	0.0	0.0	1a
London Array	0.0	0.0	0.0	1a
Methil	0.0	0.0	0.0	1a
Race Bank	0.0	0.0	0.0	1a
Rampion	0.0	0.0	0.0	1a
Scroby Sands	-	-	0.0	1a
Sheringham Shoal	0.0	0.0	0.0	1a
Teesside	35.0	0.0	35.0	1a
Thanet	0.0	0.0	0.0	1a
Westermost Rough	61.0	0.0	61.0	1a
Triton Knoll	23.0	0.0	23.0	1a
Hornsea Project Two	178.0	8.0	186.0	1b

Project	Seasonal population at risk of displacement			Tier
	Breeding	Non-breeding	Annual Total	
Moray East	0.0	3.0	3.0	1b
Neart na Gaoithe	0.0	9.0	9.0	1b
Seagreen Alpha	0.0	6.0	6.0	1b
Seagreen Bravo	0.0	16.0	16.0	1b
Dogger Bank A	11.0	1.0	12.0	1b
Dogger Bank B	31.0	3.0	34.0	1b
Sofia	11.0	1.0	12.0	1b
Seagreen Bravo	0.0	16.0	16.0	1c
Dogger Bank C	10.0	1.0	11.0	1c
East Anglia Three	0.0	1.0	1.0	1c
Hornsea Three	20.0	1.0	21.0	1c
Inch Cape	0.0	11.0	11.0	1c
Moray West	0.0	16.0	16.0	1c
East Anglia One North	-	-	0.0	1c
East Anglia Two	0.0	0.0	0.0	1c
Norfolk Boreas	0.0	1.0	1.0	1d
Norfolk Vanguard	0.0	0.0	0.0	1d
Hornsea Four	137.0	2.0	139.0	1d
Dudgeon Extension Project	24.0	46.0	70.0	2
Sheringham Shoal Extension Project	10.0	18.0	28.0	2
Rampion 2	-	-	-	2
Berwick Bank	0.0	0.0	0.0	2
Five Estuaries	-	-	-	2
Dogger Bank South (East and West)	-	-	-	2
Dogger Bank D	-	-	-	2
The Project	175.0	9.6	184.6	2
All Projects Total	**1,148.0**	**169.6**	**1,317.6**	**-**

Breeding Bio-season

11.4.124 The in-combination number of breeding adults attributed to FFC SPA at risk of displacement from OWFs, including the Project, during the breeding bio-season is 1,148 (1,148.0). The predicted consequent mortality, based on 50% displacement and 1% mortality, is six (5.7) breeding adults.

11.4.125 Based on the latest SMP population count undertaken in 2018 which was 4,279 breeding adults, with an annual baseline mortality of 261 breeding adults per annum. The addition of six mortalities would represent a 2.199% increase in baseline mortality, the Project contributes less than one (0.9) individual representing a 0.336% increase in baseline mortality.

Non-breeding Bio-season

11.4.126 The in-combination number of individuals at risk of displacement from OWFs, including Outer Dowsing, that have been apportioned to FFC SPA is 170 (169.6) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is less than one (0.8) individual.

11.4.127 Assessing the potential impact to the FFC SMP population during the non-breeding bio-season, the addition of less than one individual would represent a 0.325% increase in baseline mortality, of which the Project contributes less than one (0.05) mortality, representing a 0.018% increase in baseline mortality.

Annual Total

11.4.128 The in-combination number of puffins predicted to be displaced from all OWFs, including the Project, is 1,318 (1,317.6) individuals per annum. The predicted displacement consequent mortality, based on 50% displacement and 1% mortality, is seven (6.6) individuals.

11.4.129 Assessing the potential impact to the FFC SMP population, the addition of seven mortalities would represent a 2.524% increase in baseline mortality, of which the Project contributes less than one (0.9) mortality, representing a 0.354% increase in baseline mortality.

11.4.130 Though the impact exceeds a 1% increase in baseline mortality, it is considered highly unlikely that impacts will result in an AEOI of the puffin feature at the FFC SPA. Based on SMP population counts, the population has increased by 63.633% between 2000 and 2018, with a 48.628% increase between 2017 and 2018 alone, rising from 2,878 to 4,279. Considering the impacts from the Project in-combination with other projects, the loss of seven individuals would represent a loss of less than 0.5% (0.164%) of the current population.

11.4.131 In addition to this, the contribution of less than one mortality from the Project alone is not considered to be a material contribution to existing mortalities, with the mortality representing <0.1% of the most recent population count.

11.4.132 Although the in-combination impacts resulting from displacement exceed a 1% increase in baseline mortality, based on the evidence provided above and the current increasing population, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population, with the Project alone also making no material contribution to the existing in-combination mortalities.

11.4.133 **It is therefore concluded that the in-combination predicted puffin mortality due to displacement in the O&M phase would not adversely affect the integrity of the FFC SPA.**

Table 11.33: in-combination displacement consequent mortalities for puffin at the FFC SPA.

Bio-season	Abundance of adults apportioned to the FFC SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Breeding	1148.0	5.7	3.4 – 80.4	3.268	1.961 – 45.758	2.199	1.319 – 30.787
Non-breeding	169.6	0.8	0.5 – 11.9	0.483	0.290 – 6.760	0.325	0.195 – 4.548
Annual Total	**1317.6**	**6.6**	**4.0 – 92.2**	**3.751**	**2.251 – 52.518**	**2.524**	**1.514 – 35.335**

Table 11.34: in-combination displacement matrix for adult puffin attributed to the FFC SPA across all bio-seasons, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	13	26	40	53	66	79	92	105	119	132
20	3	5	13	26	53	79	105	132	158	185	211	237	264
30	4	8	20	40	79	119	158	198	237	277	316	356	395
40	5	11	26	53	105	158	211	264	316	369	422	474	527
50	7	13	33	66	132	198	264	330	395	461	527	593	659
60	8	16	40	79	158	237	316	395	474	554	633	712	791
70	9	18	46	92	185	277	369	461	554	646	738	830	923
80	11	21	53	105	211	316	422	527	633	738	844	949	1,054
90	12	24	59	119	237	356	474	593	712	830	949	1,068	1,186
100	13	26	66	132	264	395	527	659	791	923	1,054	1,186	1,318

Flamborough and Filey Coast SPA –Gannet

11.4.134 Gannet has been screened in for the assessment of the O&M phase to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4).

11.4.135 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (315.2km) plus 1SD (194.2km) of gannet from the FFC SPA based on data from Woodward *et al*. (2019). Since gannets range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the return migration and post-breeding migration bio-seasons. Projects included within the in-combination assessment are presented in Table 11.35 below.

11.4.136 During the breeding bio-season it is considered that potential displacement impacts on gannets from FFC SPA may be attributed more highly to offshore windfarms within areas of sea within foraging distance from this breeding colony. In order to assess the potential in-combination impacts on gannet from multiple offshore windfarms, information was compiled on the seasonal abundance of gannets measured at each offshore windfarm site (plus 2km buffer). The seasonal gannet abundances were then subjected to a process of attribution to FFC SPA (Appendix 4).

11.4.137 Outside of the breeding bio-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. This apportionment is based on calculating the proportion of the breeding adults within the UK North Sea and English Channel BDMPS population that can be attributed to the FFC SPA as defined by Furness (2015), based on the data within that report (Appendix 4). Following this approach to apportionment the proportion of the BDMPS populations from FFC SPA during return migration and post-breeding migration bio-seasons were estimated to be 6.23% and 4.84%, respectively, which has been agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England 2020) and for this project through the evidence plan process (Table 5.2 Table 5.2).

11.4.138 The total numbers presented in Table 11.35 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Windfarm Extension Projects RIAA (Royal HaskoningDHV, 2022). The following amendments were made to the values presented:

- Updated totals from Hornsea Four following DCO application submission (Ørsted, 2022);
- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);

- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time the Project is predicted to be operation; and
- Inclusion of values from the Project.

11.4.139 As per evidence presented in Section 10.4, a displacement rate of 70% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on gannet. However, based on SNCB advice (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented inTable 11.36. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.37.

11.4.140 Table 11.35 below presents the abundance of gannets as attributed to FFC SPA within all other offshore windfarms and their 2km buffers for consideration in this in-combination assessment. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.35: Seasonal mean peak abundances of gannets attributed to the FFC SPA from OWFs used to determine in-combination displacement impacts.

Project	Seasonal population at risk of displacement				Tier
	Migration-free breeding	Post-breeding migration (Autumn)	Return migration (Spring)	Annual total	
Beatrice	0.0	0.0	0.0	0.0	1a
Blyth Demonstration Site	-	-	-	0.0	1a
Dudgeon	53.0	1.2	0.7	54.9	1a
East Anglia One	161.0	174.6	4.7	340.3	1a
EOWDC	0.0	0.2	0.0	0.2	1a
Galloper	0.0	43.5	17.1	60.6	1a
Greater Gabbard	0.0	3.3	6.5	9.8	1a
Gunfleet Sands	0.0	0.6	0.6	1.2	1a
Hornsea Project One	671.0	33.3	15.5	719.8	1a
Humber Gateway	-	-	-	0.0	1a
Hywind	0.0	0.0	0.0	0.0	1a
Kentish Flats	-	-	-	0.0	1a
Kentish Flats Extension	0.0	0.6	0.0	0.6	1a
Lincs	-	-	-	0.0	1a
London Array	-	-	-	0.0	1a
Lynn and Inner Dowsing	-	-	-	0.0	1a
Methil	0.0	0.0	0.0	0.0	1a
Race Bank	92.0	1.5	1.8	95.3	1a
Rampion	0.0	28.3	0.0	28.3	1a
Scroby Sands	-	-	-	0.0	1a
Sheringham Shoal	47.0	1.5	0.1	48.6	1a
Teesside	0.5	0.0	0.0	0.5	1a
Thanet	-	-	-	0.0	1a
Westermost Rough	-	-	-	0.0	1a

Project	Seasonal population at risk of displacement				Tier
	Migration-free breeding	Post-breeding migration (Autumn)	Return migration (Spring)	Annual total	
Kincardine	0.0	0.0	0.0	0.0	1a
Triton Knoll	211.0	0.7	1.5	213.2	1a
Hornsea Project Two	457.0	54.7	7.7	519.4	1b
Moray East	0.0	14.0	2.0	16.0	1b
Neart na Gaoithe	0.0	26.5	17.4	43.9	1b
Seagreen Alpha	0.0	14.0	9.0	23.0	1b
Seagreen Bravo	0.0	18.0	12.0	30.0	1b
Dogger Bank A and B	577.5	98.3	24.4	700.2	1b
Sofia	641.0	24.0	15.0	680.0	1b
Dogger Bank C	484.0	18.0	14.0	516.0	1c
East Anglia Three	412.0	60.9	32.5	505.4	1c
Firth of Forth Alpha and Bravo	0.0	31.9	20.6	52.5	1c
Hornsea Three	844.0	47.0	32.5	923.5	1c
Inch Cape	0.0	33.7	13.1	46.8	1c
Moray West	0.0	21.1	8.9	30.0	1c
East Anglia ONE North	149.0	22.5	2.7	174.2	1c
East Anglia TWO	192.0	42.8	11.9	246.7	1c
Norfolk Boreas	1229.0	82.7	32.6	1344.3	1d
Norfolk Vanguard	271.0	117.7	27.1	415.8	1d
Hornsea Four	597.3	38.3	25.0	660.6	1d
Dudgeon Extension Project	319.8	16.5	2.9	339.2	1d
Sheringham Shoal Extension Project	17.6	14.1	0.7	32.4	1d
Rampion 2	0.0	3.7	2.8	6.5	2
Berwick Bank	54.8	30.0	10.8	95.6	2
Five Estuaries	-	-	-	-	2

Project	Seasonal population at risk of displacement				Tier
	Migration-free breeding	Post-breeding migration (Autumn)	Return migration (Spring)	Annual total	
Dogger Bank South (East and West)	-	-	-	-	2
Dogger Bank D	-	-	-	-	2
The Project	419.1	8.2	10.7	438.0	2
All Projects Total	**7900.6**	**1,127.9**	**384.8**	**9413.3**	**-**

Breeding Bio-season

11.4.141 The in-combination number of breeding adults attributed to FFC SPA at risk of displacement from OWFs, including Outer Dowsing, during the breeding bio-season is 7,901 (7,900.6). The predicted consequent mortality, based on 70% displacement and 1% mortality, is 55 (55.3) breeding adults.

11.4.142 Based on a citation population of 16,938 breeding adult gannets at FFC SPA and an annual background mortality of 1,372 breeding adults per annum, the addition of 55 displacement consequent mortalities would represent a 4.031% increase in baseline mortality, of which the Project contributes three (2.9) individuals, representing a 0.129% increase in baseline mortality.

11.4.143 As the population of gannets has increased significantly 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 26,784 breeding adults, with an annual baseline mortality of 2,170 breeding adults per annum. The addition of 55 mortalities would represent a 2.549% increase in baseline mortality, of which the Project contributes three (2.9) individuals, representing a 0.029% increase in baseline mortality.

Non-breeding Bio-season

11.4.144 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to FFC SPA is 1,128 (1,127.9) individuals in the post-breeding migration bio-season, and 385 (384.8) individuals in the return migration bio-season.

11.4.145 The predicted displacement consequent mortality, based on 70% displacement and 1% mortality, is eight (7.9) individuals in the post-breeding migration bio-season, and three (2.7) individuals in the return migration bio-season.

11.4.146 Considering the potential impact to the FFC citation population during the post-breeding migration bio-season, the addition of eight individuals would represent a 0.574% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.004% increase in baseline mortality. During the return migration bio-season, the addition of three mortalities would represent a 0.197% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.004% increase in baseline mortality.

11.4.147 Assessing the potential impact to the more recent FFC SMP population during the post-breeding migration bio-season, the addition of eight individuals would represent a 0.363% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.003% increase in baseline mortality. During the return migration bio-season, the addition of three mortalities would represent a 0.124% increase in baseline mortality, of which the Project contributes less than one (0.1) mortality, representing a 0.003% increase in baseline mortality.

Annual Total

11.4.148 The in-combination number of gannets predicted to be displaced from all OWFs, including the Project, is 9,413 (9,413.3) individuals per annum. The predicted displacement consequent mortality, based on 70% displacement and 1% mortality, is 66 (65.9) individuals.

11.4.149 Considering the potential impact to the FFC citation population, the addition of 66 mortalities would represent a 4.803% increase in baseline mortality, of which the Project contributes three (3.0) mortalities, representing a 0.132% increase in baseline mortality.

11.4.150 Assessing the potential impact to the more recent FFC SMP population, the addition of 66 mortalities would represent a 3.037% increase in baseline mortality, of which the Project only contributes three (3.0) mortalities, representing a 0.030% increase in baseline mortality.

11.4.151 Though the in-combination impacts exceed a 1% increase in baseline mortality, the expected impacts are not expected to impact the integrity of the gannet feature at the FFC SPA. As presented in the PVA analysis for the Dudgeon and Sheringham Shoal extension project RIAA (Royal HaskoningDHV, 2022), a worst case scenario of 400 mortalities per annum (based on combined displacement and collision mortalities, and not incorporating macro-avoidance into collision estimates) would reduce population growth rate by up to 1.9% compared with the unimpacted scenario. Considering the FFC SPA, the gannet population is considered to be robust, with a population growth rate of 12% between 1985 and 2017. In comparison, the average annual growth rate of gannet colonies is 1.8% (based on over 90 years of data). The FFC gannet population is therefore considered robust enough to allow the conservation objective to sustain this level of mortality. Considering the impacts from displacement only resulting from the Project in-combination with other projects, the predicted annual mortality of 66 individuals represents just 16.5% of the total number of individuals upon which this PVA analysis was based on. Based on this, the impacts resulting from displacement from the Project in-combination with other projects will not impact the integrity of the gannet feature of the FFC SPA.

11.4.152 In addition to this conclusion, it should also be noted that the assessment is already considered precautionary in nature, based on mean peaks which overestimate the abundance of individuals present in the area throughout the whole season, while also not accounting for the fact that individuals are likely to have been double counted across multiple projects within similar areas, thus further over-inflating predicted impacts.

11.4.153 Although the in-combination impacts resulting from displacement exceed a 1% increase in baseline mortality, given the evidence provided above, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population.

11.4.154 **It is therefore concluded that the in-combination predicted gannet mortality due to displacement in the O&M phase would not adversely affect the integrity of the FFC SPA**.

Table 11.36: In-combination displacement consequent mortalities for gannet at the FFC SPA.

Bio-season	Abundance of adults apportioned to the FFC SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1% mortality	70% displacement, 1% mortality	60-80% displacement, 1% mortality	70% displacement, 1% mortality	60-80% displacement, 1% mortality
Migration-free breeding	7900.6	55.3	47.3 – 63.2	4.031	3.455 – 4.607	2.549	2.185 – 2.913
Post-breeding migration	1,127.9	7.9	6.8 – 9.0	0.574	0.492 – 0.656	0.363	0.311 – 0.415
Return migration	384.8	2.7	2.3 – 3.1	0.197	0.169 – 0.225	0.124	0.107 – 0.142
Annual Total	**9,413.2**	**65.9**	**56.5 – 75.3**	**4.803**	**4.117 – 5.489**	**3.037**	**2.603 – 3.471**

Table 11.37: In-combination displacement matrix for gannet at the FFC SPA, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	9	19	47	94	189	283	377	472	566	660	755	849	943
20	19	38	94	189	377	566	755	943	1,132	1,320	1,509	1,698	1,886
30	28	57	141	283	566	849	1,132	1,415	1,698	1,981	2,264	2,547	2,830
40	38	75	189	377	755	1,132	1,509	1,886	2,264	2,641	3,018	3,396	3,773
50	47	94	236	472	943	1,415	1,886	2,358	2,830	3,301	3,773	4,244	4,716
60	57	113	283	566	1,132	1,698	2,264	2,830	3,396	3,961	4,527	5,093	5,659
70	66	132	330	660	1,320	1,981	2,641	3,301	3,961	4,622	5,282	5,942	6,602
80	75	151	377	755	1,509	2,264	3,018	3,773	4,527	5,282	6,036	6,791	7,546
90	85	170	424	849	1,698	2,547	3,396	4,244	5,093	5,942	6,791	7,640	8,489
100	94	189	472	943	1,886	2,830	3,773	4,716	5,659	6,602	7,546	8,489	9,432

North Caithness Cliffs SPA – Guillemot

11.4.155 Guillemot has been screened in for the assessment of the O&M phase during the non-breeding bio-season to assess the impacts from disturbance and displacement from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the North Caithness Cliffs SPA (presented in Section 10.4).

11.4.156 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. To determine the number of guillemots from the North Caithness Cliffs SPA associated with other OWFs for the relevant non-breeding seasons, the cumulative totals were extracted from the Dudgeon and Sheringham Shoal extension projects (Royal HaskoningDHV, 2022), with total numbers of tier 1 and 2 projects presented in Table 11.38, in addition to numbers presented for Rampion 2 (Wood, 2022) and Berwick Bank (RPS and RoyalHaskoningDHV, 2022).

11.4.157 As per evidence presented in Section 10.4, a displacement rate of 50% and a mortality rate of 1% are presented as the Applicant's approach for the assessment of in-combination impacts on guillemot. However, based on SNCB advice (MIG-Birds, 2022), a displacement range of 30% to 70% and a mortality range of 1% to 10% is also presented in Table 11.39. Results for annual displacement consequent mortalities are also presented in a matrix in Table 11.40.

11.4.158 Table 11.38 below presents the total abundance of guillemots from relevant projects (array area plus 2km buffer), alongside numbers apportioned to the North Caithness Cliffs SPA. It should be noted that these values are highly likely to be overly precautionary, as they are based on seasonal mean peaks added into an annual total.

Table 11.38: Non-breeding season mean peak abundances and abundances apportioned to the North Caithness Cliffs SPA for guillemot from relevant tier one and two projects.

Project	Non-breeding season	
	Total	Apportioned
Tier 1 and 2 projects	256,401.0	10,512.4
Rampion 2	13,020.0	533.8
Berwick Bank	44,171.0	1,811.0
The Project	22,248.0	912.2
Total	335,840.0	13,769.4

11.4.159 The in-combination number of individuals at risk of displacement from OWFs, including the Project, that have been apportioned to the North Caithness Cliffs SPA is 13,769 (13,769.4) individuals in the non-breeding bio-season. The displacement consequent mortality, based on 50% displacement and 1% mortality is 69 (68.8) individuals.

11.4.160 Considering the potential impact to the North Caithness Cliffs citation population of 38,300 breeding adults with a baseline mortality of 2,336 individuals per annum, the addition of 68 mortalities would represent a 2.947% increase in baseline mortality, of which the Project contributes five (4.5) mortalities, representing a 0.194% increase in baseline mortality.

11.4.161 Assessing the potential impact to the more recent North Caithness Cliffs SMP population of 25,745 breeding adults with a baseline mortality of 1,570 individuals per annum, the addition of 68 mortalities would represent a 4.384% increase in baseline mortality, of which the Project contributes five (4.5) mortalities, representing a 0.191% increase in baseline mortality.

11.4.162 Though the percentage increase exceeds 1%, it is considered that the estimated impact will not have a measurable impact on the guillemot feature of the North Caithness SPA owing to several elements of precaution in the assessment. Though the apportioned number of individuals to the East Caithness Cliffs SPA in the non-breeding season is 4.1% (Appendix 7.1.4), this number is considered an overestimate based on available data. Based on three years of tracking data of guillemots at multiple east coast Scottish colonies presented by Buckingham *et al*. (2022), the Project is considered well outside of the core foraging areas of guillemots from these colonies, including the neighbouring East Caithness Cliffs SPA, and therefore the number of birds from the BDMPS overlapping with projects in the southern North Sea is considered to be measurably less than 4.1%. In addition, the use of mean peaks within the assessment results in an overestimate of density, assuming that the peak number of individuals recorded in one month is reflective of abundance throughout the season.

11.4.163 Alongside the precautionary nature of the assessment, the impacts on guillemots at the North Caithness Cliffs SPA resulting from the Project alone are considered to be *de minimis*. Any contribution from the Project to existing in-combination impacts are therefore considered immaterial.

11.4.164 Based on this evidence, the Project in-combination with other projects is not considered having a measurable impact on the guillemot feature of the North Caithness Cliffs SPA**.**

11.4.165 **It is therefore concluded that the in-combination predicted guillemot mortality due to displacement in the O&M phase would not adversely affect the integrity of the North Caithness Cliffs SPA.**

Table 11.39: in-combination displacement consequent mortalities for guillemot at the North Caithness Cliffs SPA.

Bio-season	Abundance of adults apportioned to the North Caithness Cliffs SPA (array area plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality	50% displacement, 1% mortality	30-70% displacement, 1-10% mortality
Non-breeding	13,769	68.8	41.3 – 963.9	2.947	1.768 – 41.256	4.385	2.630 – 61.375

Table 11.40: in-combination displacement matrix for guillemot attributed to the North Caithness Cliffs SPA in the non-breeding bio-season, with light blue shading representing the displacement and mortality range advocated for by SNCBs, and dark blue representing the Applicant's approach.

Annual	Mortality Rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	14	28	69	138	275	413	551	688	826	964	1,102	1,239	1,377
20	28	55	138	275	551	826	1,102	1,377	1,652	1,928	2,203	2,478	2,754
30	41	83	207	413	826	1,239	1,652	2,065	2,478	2,891	3,305	3,718	4,131
40	55	110	275	551	1,102	1,652	2,203	2,754	3,305	3,855	4,406	4,957	5,508
50	69	138	344	688	1,377	2,065	2,754	3,442	4,131	4,819	5,508	6,196	6,885
60	83	165	413	826	1,652	2,478	3,305	4,131	4,957	5,783	6,609	7,435	8,261
70	96	193	482	964	1,928	2,891	3,855	4,819	5,783	6,747	7,711	8,674	9,638
80	110	220	551	1,102	2,203	3,305	4,406	5,508	6,609	7,711	8,812	9,914	11,015
90	124	248	620	1,239	2,478	3,718	4,957	6,196	7,435	8,674	9,914	11,153	12,392
100	138	275	688	1,377	2,754	4,131	5,508	6,885	8,261	9,638	11,015	12,392	13,769

Collision Risk

11.4.166 The potential for the Project in-combination with other projects to result in an AEoI resulting from collision impacts has been considered in relation to the following designated site and the relevant features:

- Flamborough and Filey Coast SPA; gannet and kittiwake; and
- North Norfolk Coast SPA; Sandwich tern.

11.4.167 An overview of the screening process for collision impacts in the O&M phase is presented in Table 11.41 below. The sites that have been screened out are due to the assessment alone concluding a trivial and inconsequential level of effect, that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination impact.

Table 11.41: Summary of the sites and features considered for collision risk assessment during the O&M phase for the Project in-combination

Site	Feature	Bio-season	Screened In/Out
North Norfolk Coast SPA	Sandwich tern	Breeding and non-breeding	In
FFC SPA	Kittiwake	Breeding and non-breeding	In
	Gannet	Breeding and non-breeding	In
	Herring gull (**assemblage feature**)	Breeding and non-breeding	Out
Alde-Ore Estuary SPA	Lesser Black-backed Gull	Breeding and non-breeding	Out
Coquet Island	Sandwich tern	Non-breeding	Out
	Common tern	Non-breeding	Out
Farne Island SPA	Kittiwake	Breeding and non-breeding	Out
	Sandwich tern	Non-breeding	Out
Scottish sites			
Buchan Ness to Collieston Coast SPA	Kittiwake	Non-breeding	Out
Calf of Eday SPA	Kittiwake	Non-breeding	Out
Copinsay SPA	Kittiwake	Non-breeding	Out
East Caithness Cliffs SPA	Kittiwake	Non-breeding	Out
Fair Isle SPA	Kittiwake	Non-breeding	Out
Forth Islands (UK) SPA	Kittiwake; Gannet	Non-breeding	Out
Foula SPA	Kittiwake	Non-breeding	Out
Fowlsheugh SPA	Kittiwake	Non-breeding	Out

Site	Feature	Bio-season	Screened In/Out
Hermaness, Saxa, Vord and Valla Field SPA	Kittiwake	Non-breeding	Out
Hoy SPA	Kittiwake	Non-breeding	Out
Marwick Head SPA	Kittiwake	Non-breeding	Out
North Caithness Cliffs SPA	Kittiwake	Non-breeding	Out
Noss SPA	Kittiwake	Non-breeding	Out
Rousay SPA	Kittiwake	Non-breeding	Out
St Abb's Head SPA	Kittiwake	Non-breeding	Out
Sumburgh Head SPA	Kittiwake	Non-breeding	Out
Troup, Pennan and Lion's Heads SPA	Kittiwake	Non-breeding	Out
West Westray	Kittiwake	Non-breeding	Out

11.4.168 The assessments provided within this draft RIAA for the remaining site and features to be assessed for collision risk in-combination include a number of assumptions that contribute to the predicted impacts and potential effects being considered overly precautionary, including:

- The population within other offshore windfarm 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 mean maximum foraging range is very precautionary, considering that many of offshore windfarm array areas and their buffers are beyond a reasonable distance to assume to be regularly used by screened gannet and kittiwake from the FFC SPA, and Sandwich tern from the North Norfolk Coast SPA; and
- Not accounting for additional non-breeding adults within the North Sea that contribute to the population within the offshore windfarms considered within this in-combination assessment throughout the year.

Flamborough and Filey Coast SPA – Kittiwake

11.4.169 Kittiwake has been screened in for the assessment of the O&M phase to assess the impacts from collision from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4 and Appendix 7.1.1).

11.4.170A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (156.1km) plus 1SD (144.5km) of kittiwake from the FFC SPA based on data from Woodward *et al*. (2019). Since kittiwakes range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the return migration and post-breeding migration bio-seasons. Projects included within the in-combination assessment are presented in Table 11.42 below. Collision numbers were based on those presented for the Dudgeon and Sheringham Shoal Extension projects (Royal HaskoningDHV, 2022), with following amendments were made to the values presented:

- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);
- The removal of Hornsea Three kittiwake mortality rate from in-combination assessments due to being fully compensated for;
- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time the Project is predicted to be operation; and
- Inclusion of values from the Project, corrected for 70% macro-avoidance as per Natural England guidance (Parker *et al*., 2022).

Table 11.42: in-combination collision mortalities for kittiwake attributed to the FFC SPA.

Project	Seasonal population at risk of collision				Tier
	Migration-free breeding	Post-breeding migration	Return Migration	Annual Total	
Beatrice	0	0.4	2.1	2.5	1a
Blyth Demonstration Site	0	0.1	0.1	0.2	1a
Beatrice Demonstrator	0	0.1	0.1	0.2	1a
Dudgeon	-	-	-	0	1a
East Anglia One	0	6.3	2.5	8.8	1a
EOWDC	0	0.2	0.1	0.3	1a
Galloper	0	1.1	1.7	2.8	1a
Greater Gabbard	0	0.6	0.6	1.2	1a
Gunfleet Sands	-	-	-	0	1a
Hornsea Project One	26.5	2.2	1.1	29.8	1a
Humber Gateway	1.4	0.1	0.1	1.6	1a
Hywind	0	0.1	0.1	0.2	1a
Kentish Flats	0	0.1	0.1	0.2	1a
Kentish Flats Extension	0	0	0.1	0.1	1a
Kincardine	0	0.4	0.1	0.5	1a
Lincs, Lynn & Inner Dowsing	0.5	0.1	0.1	0.7	1a
London Array	0	0.1	0.1	0.2	1a
Methil	0	0	0	0	1a
Race Bank	1.4	0.9	0.3	2.6	1a
Rampion	0	1.5	1.5	3	1a
Scroby Sands	-	-	-	0	1a
Sheringham Shoal	-	-	-	0	1a
Teesside	0	0.9	0.1	1	1a
Thanet	0	0	0	0	1a
Westermost Rough	0.1	0	0	0.1	1a
Hornsea Project Two	9.7	0.4	0.1	10.2	1a

Project	Seasonal population at risk of collision				Tier
	Migration-free breeding	Post-breeding migration	Return Migration	Annual Total	
Triton Knoll	17.9	5.5	2.4	25.8	1a
Moray East	0	0.1	1	1.1	1b
Neart na Gaoithe	0	2.2	0.2	2.4	1b
Seagreen Alpha & Bravo	0	12.3	12.9	25.2	1b
Dogger Bank A & B	40.6	5.3	15.5	61.4	1b
Dogger Bank C & Sofia	19.2	3.6	11.3	34.1	1c
Firth of Forth Alpha and Bravo	0	12.3	12.9	25.2	1c
East Anglia Three	0	2.7	2	4.7	1c
Hornsea Three	0	0	0	0	1c
Inch Cape	0	8.8	3.3	12.1	1c
Moray Firth (EDA)	0	0.1	1	1.1	1c
Moray West	0	0.9	0.4	1.3	1c
East Anglia ONE North	0	0	0	0	1c
East Anglia TWO	0	0	0	0	1c
Norfolk Boreas	0	0	0	0	1c
Norfolk Vanguard	0	0	0	0	1c
Hornsea Four	51.2	0.5	0.2	51.9	1d
Dudgeon Extension Project	5.6	0.2	0.1	5.9	1d
Sheringham Shoal Extension Project	0.5	0	0	0.5	1d
Rampion 2	0	0.1	0.4	0.5	2
Berwick Bank	0.5	9.7	13.7	23.9	2
Five Estuaries	-	-	-	-	2
Dogger Bank South (East and West)	-	-	-	-	2
Dogger Bank D	-	-	-	-	2
The Project	12.5	1	3.6	17.1	2
All Projects Total	**187.6**	**80.9**	**91.9**	**360.4**	-

Breeding Bio-season

11.4.171 The number of kittiwakes from FFC SPA predicted to be subject to collision resultant mortality from the Project in-combination with all other projects in the migration-free breeding bio-season is 188 (187.6) breeding adults.

11.4.172 When considering the potential impact of this loss to the FFC SPA citation population, this prediction of 188 breeding adults suffering collision consequent mortality would represent a 0.768% increase in baseline mortality, of which the Project alone contributes an increase of 13 (12.5) predicted breeding adult mortalities equating to an increase of 0.051% in baseline mortality.

11.4.173 Considering the impact on the more recent FFC SMP count, the loss of 188 breeding adults would represent a 1.247% increase in baseline mortality, of which the Project alone contributes an increase of 13 (12.5) predicted breeding adult mortalities equating to an increase of 0.083% in baseline mortality.

Non-Breeding Bio-season

11.4.174 The number of kittiwakes from FFC SPA predicted to be subject to collision resultant mortality, from the Project and all other projects, in the return migration bio-season is 92 (91.9) adults and in the post-breeding migration bio-season is 81 (80.9) adults.

11.4.175 When considering the potential impact of this loss to the FFC SPA citation population, the addition of 92 adult mortalities would represent a 0.376%% in baseline mortality in the return migration bio-season, of which the Project alone contributes an increase of seven (7.2) predicted breeding adult mortality equating to an increase of 0.015% in baseline mortality. During the post-breeding migration bio-season, the addition of 92 adult mortalities would represent a 0.376% increase in baseline mortality, of which the Project alone contributes an increase of one (1.0) predicted adult mortality equating to an increase of 0.004% in baseline mortality.

11.4.176 When considering the potential impact of this loss to the more recent 2017 colony count for kittiwake, then the addition of 92 breeding adult mortalities in the return migration bio-season would represent a 0.611% increase in baseline mortality, of which the Project alone contributes an increase of seven (7.2) predicted breeding adult mortality equating to an increase of 0.024% in baseline mortality. During the post-breeding migration bio-season the addition of 81 adult mortalities would represent a 0.538% increase in baseline mortality, of which the Project alone contributes an increase of one (1.0) predicted breeding adult mortality equating to an increase of 0.007% in baseline mortality.

Annual Total

11.4.177 The total number of kittiwakes from FFC SPA predicted to be subject to collision mortality per annum from the Project in-combination with other projects is 360 (360.4). The predicted consequent baseline mortality increase of the citation population is estimated at 1.475% across all bio-seasons per annum, of which the Project alone contributes an increase of 17 (17.1) predicted breeding adult mortalities equating to an increase of 0.070% in baseline mortality per annum. The predicted consequent baseline mortality increase of the more recent 2017 colony count is estimated at 2.395% across all bio-seasons per annum, of which the Project alone contributes an increase of 11 (11.1) predicted breeding adult mortalities equating to an increase of 0.114% in baseline mortality per annum across all bio-seasons. Given the in-combination increase in baseline mortality exceeds 1%, further consideration to these impacts is given below.

11.4.178 Any decline in the kittiwake population observed since the population was designated for FFC SPA is most likely due to the effects of a combination of climate change and high fishing effort depleting sandeel stocks (Frederiksen *et al.,* 2004, Cook *et al.,* 2014, Carroll *et al*., 2017) and cannot be attributed to offshore windfarm development. A PVA analysis undertaken for the East Anglia TWO OWF, concluded that an in-combination impact of 400 mortalities would not trigger a risk of population decline at the FFC SPA.

11.4.179 **While it is noted that the in-combination impacts are estimated at 360 birds per annum, reduced from previous totals following incorporation of kittiwake compensation for multiple projects, the Project cannot, at this stage, rule out a conclusion of adverse effect on integrity in-combination to the kittiwake feature at FFC SPA in the O&M phase. Following the conclusion of ongoing engineering and survey works, the potential for an AEoI will be re-evaluated for the final RIAA.**

11.4.180 However, it is noted that the SoS has concluded an AEoI (in-combination) at the FFC SPA due to collision mortality for recently consented OWF projects within the southern North Sea. Therefore, in case the SoS draws a conclusion of AEoI, the Project shall develop a 'without prejudice' (Article 6(4)) derogation case for kittiwake at FFC SPA. As part of this process the Project is currently investigating a range of options for Project alone and strategic level compensation measures. Further assessment, in the form of PVA will be provided post-PEIR to further determine the population consequences of the in-combination impacts.

Flamborough and Filey Coast SPA – gannets

11.4.181 Gannet has been screened in for the assessment of the O&M phase to assess the impacts from collision risk from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the FFC SPA (presented in Section 10.4).

11.4.182 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (315.2km) plus 1SD (194.2km) of gannet from the FFC SPA based on data from Woodward *et al*. (2019). Since gannets range further outside of the breeding season, consideration was also given to other project within the wider UK North Sea and English Channel BSMPS area during the return migration and post-breeding migration bio-seasons. Projects included within the in-combination assessment are presented in Table 11.43 below. Collision numbers were based on those presented for the Dudgeon and Sheringham Shoal Extension projects (Royal HaskoningDHV, 2022), with following amendments were made to the values presented:

- Inclusion of values from the Rampion 2 draft RIAA (Wood, 2022);
- Inclusion of values from the Berwick Bank draft RIAA (RPS and Royal HaskoningDHV, 2022);
- Removal of Beatrice Demonstrator as the Project will be decommissioned by the time Outer Dowsing is predicted to be operation; and
- Inclusion of values from the Project, corrected for 70% macro-avoidance as per Natural England guidance (Parker *et al*., 2022).

Table 11.43: in-combination collision mortalities for gannet attributed to the FFC SPA.

Project	Seasonal population at risk of collision				Tier
	Migration-free breeding	Post-breeding migration	Return migration	Annual total	
Beatrice	0	2.3	0.6	2.9	1a
Blyth Demonstration Site	0	0.1	0.2	0.3	1a
Dudgeon	22.3	1.9	1.2	25.4	1a
East Anglia One	3.4	6.3	0.4	10.1	1a
EOWDC	0	0.3	0	0.3	1a
Galloper	0	1.5	0.8	2.3	1a
Greater Gabbard	0	0.4	0.3	0.7	1a
Gunfleet Sands	-	-	-	0	1a
Hornsea Project One	11.5	1.5	1.4	14.4	1a
Humber Gateway	1.9	0.1	0.1	2	1a
Hywind	0	0	0.1	0.1	1a
Hywind 2 Demonstration	0	0	0.1	0.1	1a
Kentish Flats	0	0	0.1	0.1	1a
Kentish Flats Extension	-	-	-	0	1a
Kincardine	0	0	0	0	1a
Lincs, Lynn & Inner Dowsing	2.3	0.1	0.1	2.5	1a
London Array	0	0.1	0.1	0.2	1a
Methil	0	0	0	0	1a
Race Bank	33.7	0.6	0.3	34.5	1a
Rampion	0	3.1	0.1	3.2	1a
Scroby Sands	-	-	-	0	1a
Sheringham Shoal	14.1	0.2	0	14.3	1a
Teesside	2.4	0.1	0	2.5	1a
Thanet	0	0	0	0	1a
Hornsea Project Two	7	0.7	0.4	8	1a
Triton Knoll	26.8	3.1	1.9	31.8	1a

Project	Seasonal population at risk of collision				Tier
	Migration-free breeding	Post-breeding migration	Return migration	Annual total	
Westermost Rough	0.2	0	0	0.2	1b
Moray East	0	1.7	0.6	2.3	1b
Neart na Gaoithe	0	2.3	1.4	3.7	1b
Seagreen Alpha & Bravo	0	2.4	4.1	6.5	1b
Dogger Bank A & B	40.6	4	3.4	48	1b
Dogger Bank C & Sofia	7.4	0.5	0.7	8.6	1c
East Anglia Three	4.8	1.4	0.5	6.7	1c
Firth of Forth Alpha and Bravo	0	2.4	4.1	6.5	1c
Hornsea Three	6	0	0	6	1c
Inch Cape	0	1.4	0.3	1.7	1c
Moray West	0	0.1	0.1	0.2	1c
East Anglia ONE North	12.4	0.5	0.1	13	1c
East Anglia TWO	12.5	1.1	0.2	13.8	1c
Norfolk Boreas	14.2	0.6	0.2	15.1	1c
Norfolk Vanguard	8.2	0.9	0.3	9.4	1c
Hornsea Four	1.3	0	0	1.4	1d
Dudgeon Extension Project	1.4	0.1	0	1.5	1d
Sheringham Shoal Extension Project	0.2	0	0	0.2	1d
Rampion 2	0	16.6	8.9	25.5	2
Berwick Bank	2	0.4	0.1	2.5	2
Five Estuaries	-	-	-	-	2
Dogger Bank South	-	-	-	-	2
Dogger Bank D	-	-	-	-	2
Outer Dowsing	1.4	0.0	0.0	1.6	2
All Projects Total	**238.0**	**58.8**	**33.2**	**330.1**	**-**

Breeding Bio-season

11.4.183 The number of gannets from FFC SPA predicted to be subject to collision resultant mortality from the Project in-combination with all other projects in the migration-free breeding bio-season is 238 (238.0) breeding adults.

11.4.184 When considering the potential impact of this loss to the FFC SPA citation population, this prediction of 238 breeding adults suffering collision consequent mortality would represent a 17.347% increase in baseline mortality, of which the Project alone contributes an increase of one (1.4) predicted breeding adult mortality equating to an increase of 0.063% in baseline mortality.

11.4.185 Considering the impact on the more recent FFC SMP count, the loss of 238 breeding adults would represent a 10.970% increase in baseline mortality, of which the Project alone contributes an increase of one (1.4) predicted breeding adult mortality equating to an increase of 0.047% in baseline mortality.

Non-Breeding Bio-season

11.4.186 The number of gannets from FFC SPA predicted to be subject to collision resultant mortality, from the Project and all other projects, in the return migration bio-season is 33 (33.2) adults and in the post-breeding migration bio-season is 59 (58.8) adults.

11.4.187 When considering the potential impact of this loss to the FFC SPA citation population, the addition of 33 adult mortalities would represent a 2.421% in baseline mortality in the return migration bio-season, of which the Project alone contributes an increase of less than one (0.02) predicted breeding adult mortality equating to an increase of 0.001% in baseline mortality. During the post-breeding migration bio-season, the addition of 59 adult mortalities would represent a 4.287% increase in baseline mortality, of which the Project alone contributes an increase of less than one (0.1) predicted breeding adult mortality equating to an increase of 0.001% in baseline mortality.

11.4.188 When considering the potential impact of this loss to the more recent 2017 colony count for gannet, then the addition of 33 breeding adult mortalities in the return migration bio-season would represent a 1.531% increase in baseline mortality, of which the Project alone contributes an increase of less than one (0.02) predicted breeding adult mortality equating to an increase of 0.0.001%% in baseline mortality. During the post-breeding migration bio-season the addition of 59 adult mortalities would represent a 2.711% increase in baseline mortality, of which the Project alone contributes an increase of less than one (0.01) predicted breeding adult mortality equating to an increase of 0.001% in baseline mortality.

Annual Total

11.4.189 The total number of gannets from FFC SPA predicted to be subject to collision mortality per annum from the Project in-combination with other projects is 330 (330.1). The predicted consequent baseline mortality increase of the citation population is estimated at 24.060% across all bio-seasons per annum, of which the Project alone contributes an increase of less than two (1.6) predicted breeding adult mortalities equating to an increase of 0.065% in baseline mortality per annum. The predicted consequent baseline mortality increase of the more recent 2017 colony count is estimated at 15.215% across all bio-seasons per annum, of which the Project alone contributes an increase of less than two (1.6) predicted breeding adult mortalities equating to an increase of 0.015% in baseline mortality per annum across all bio-seasons.

11.4.190 Though the percentage increase in baseline mortality exceeds 1%, this conclusion is considered highly over-precautionary. Recent advice from Natural England has advocated for the application of macro-avoidance correction factors to CRM outputs of 0.65 to 0.85. Applying macro-avoidance to in-combination impacts for all projects presented in Table 11.43 would reduce the total estimated collision mortality to between 50 (49.5) and 116 (115.5) mortalities per annum. This would represent a 3.609% - 8.421% increase in baseline mortality for the citation population, and a 2.282% - 5.325% increase in baseline mortality for the more recent SMP count.

11.4.191 The annual population growth of the gannet feature at FFC SPA has been recorded at 12% between 1985 and 2017. The predicted reduction in growth rate estimated by Sheringham Shoal and Dudgeon Extension Projects was a maximum of 0.9% per annum, when including macro-avoidance. Therefore, the population is robust enough to sustain this level of additional mortality.

11.4.192 Additionally, the contribution from the Project alone is considered to be *de minimis*, representing less than two gannet mortalities and less than a <0.1% increase in baseline mortality for both the citation and SMP populations. Therefore, based on this Project is not considered having a measurable impact on the gannet feature of the FFC SPA.

11.4.193 **Taking into consideration the now accepted macro-avoidance behaviour, the population trend and the *de minimis* contribution from the Project, it is therefore concluded that the in-combination impact predicted gannet mortality due to collision in the O&M phase would not adversely impact the conservation objectives of the gannet feature of the FFC SPA.**

North Norfolk Coast SPA – Sandwich tern

11.4.194 Sandwich tern has been screened in for the assessment of the O&M phase to assess the impacts from collision from the Project in-combination with other OWFs in relation to the conservation objectives for this species as a feature of the North Norfolk Coast SPA (presented in Section 10.4).

11.4.195 A range of proposed, consented, under-construction, and operational OWFs in UK waters in the North Sea and English Channel were screened in for the in-combination assessment, based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of the Project. During the breeding season projects were screened in if they were within the mean-maximum foraging range (34.3km) plus 1SD (23.2km) of Sandwich tern from the North Norfolk Coast SPA based on data from Woodward *et al*. (2019). Since Sandwich terns range further outside of the breeding season, consideration was also given to other projects within the wider UK North Sea and English Channel BSMPS area during the return migration and post-breeding migration bio-seasons. Projects included within the in-combination assessment are presented in Table 11.44 below.

11.4.196 Collision numbers were based on those presented for the Dudgeon and Sheringham Shoal (Royal HaskoningDHV, 2022). However, these numbers do not reflect the most recent SNCB guidance for this species. The in-combination assessment for Dudgeon and Sheringham Shoal presents numbers based on avoidance rates ranging from 0.980 to 0.993, though most recent guidance recommends the use of 0.991. A conversion factor was therefore used to calculate collision estimates based on an avoidance rate of 0.991. Additionally, since some project presented in the in-combination assessment have now been constructed, it is noted that the as-built parameters differ to those which were consented. Therefore, two scenarios of collision risk are presented:

- Scenario A: using consented turbine parameters; and
- Scenario B: using as-built turbine parameters (where relevant).

11.4.197 It should be noted that the Dudgeon and Sheringham Shoal extension projects concluded an AEoI on Sandwich tern alone and in-combination, and therefore it is presumed, subject to the final decision by the SoS on these projects, that they will be required to compensate fully for this impact. To reflect this assumed compensatory requirement, impacts resulting from these projects have been defined as zero.

Table 11.44: in-combination collision risk for breeding adult Sandwich terns at the North Norfolk Coast SPA using consented (scenario A) and as-build (scenario B) parameters.

Project	0.980 avoidance rate	0.993 avoidance rate	0.991 avoidance rate
Scenario A (consented parameters)			
Dudgeon Offshore Wind (DOW)	40.1	14.0	18.0
Race Bank	89.6	31.4	40.3
Sheringham Shoal Offshore Wind (SOW)	16.9	5.9	7.6
Triton Knoll	17.8	6.2	8.0
DEP	0.0	0.0	0.0
SEP	0.0	0.0	0.0
Outer Dowsing	-	-	0.5
Total	164.4	57.4	74.5
Scenario B (as-built parameters)			

Project	0.980 avoidance rate	0.993 avoidance rate	0.991 avoidance rate
Dudgeon Offshore Wind (DOW)	33.3	11.7	15.0
Race Bank	30.3	10.6	13.6
Sheringham Shoal Offshore Wind (SOW)	16.9	5.9	7.6
Triton Knoll	6.1	2.1	2.7
DEP	0.0	0.0	0.0
SEP	0.0	0.0	0.0
Outer Dowsing	-	-	0.5
Total	86.6	30.3	39.5

11.4.198 Based on the consented parameters (Scenario A), an estimated 75 (74.5) Sandwich terns from the North Norfolk Coast SPA are estimated to be subject to collision mortality per annum, of which the Project contributes less than one (0.5) individuals.

11.4.199 Considering the impacts on the North Norfolk Coast SPA citation population of 7,400 breeding adults with an annual mortality of 755 individuals per annum, the addition of 75 mortalities would represent a 9.868% increase in baseline mortality, of which the Project contributes less than one (0.5) individual, representing a 0.063% increase in baseline mortality. However, considering the as-built parameters (Scenario B), the in-combination impact is reduced to a 5.229% increase in baseline mortality.

11.4.200 Considering the impacts on the more recent SMP population count of 14,588 breeding adults with a background mortality of 1,488 individuals per annum, the addition of 79 mortalities would represent a 5.005% increase in baseline mortality, of which the Project contributes less than one (0.5) individual, representing a 0.073% increase in baseline mortality. However, considering the as-built parameters (Scenario B), the in-combination impacts is reduced to a 2.653% increase in baseline mortality.

11.4.201 The distances to the Project array area from two largest Sandwich tern colonies within the North Norfolk Coast SPA (Scolt Head Island = 77.0km and Blakeney Point = 69.7km) exceeds the mean-maximum foraging range +1SD (57.5km), therefore the majority of Sandwich terns detected within the array are unlikely to be breeding birds. Consequently, the approach taken to apportion all breeding season impacts to birds from North Norfolk Coast SPA is considered highly precautionary.

11.4.202 Though the assessed impact on Sandwich tern at the North Norfolk Coast SPA exceeds a 1% increase in baseline mortality, the highly precautionary contribution from the Project is considered *de minimis* (0.5 mortalities per annum) to the re-established baseline for in-combination impacts.

11.4.203 **Therefore, the Project in-combination with other projects is not considered to adversely affect the conservation objectives of the Sandwich tern feature of the North Norfolk Coast SPA in the O&M phase**. Additional assessment in the form of PVA will be undertaken post-PEIR to re-affirm this conclusion.

Combined displacement and collision

Flamborough and Filey Coast SPA – Gannet

11.4.204 As gannet has been assessed for the impacts of both displacement and collision, consideration is also given to the combined total of these impacts in relation to the conservation objectives of the gannet feature of the FFC SPA (Appendix 7.1.1).

11.4.205 The predicted annual in-combination impacts are collated from information presented in the displacement in-combination analysis (Table 11.35) and collision in-combination analysis (Table 11.43). Total mortalities resulting from these impacts are presented in Table 11.45 below.

Table 11.45: Annual in-combination combined collision and displacement mortality of gannet at the FFC SPA, incorporating 0%, 65%, 70% and 85% macro-avoidance.

Bio-season	Displacement mortality (based on 70% displacement and 1% mortality)	Collision mortality	Combined mortality
Annual total (not incorporating macro-avoidance for collision)	65.9	330.1	396.0
Annual total (incorporating 65% macro-avoidance for collision mortalities)	65.9	115.5	181.4
Annual total (incorporating 70% macro-avoidance for collision mortalities)	65.9	99.0	164.9
Annual total (incorporating 85% macro-avoidance for collision mortalities)	65.9	49.5	115.4

11.4.206 The total number of predicted gannet mortalities as a result of both collision and displacement is 396 (396.0) individuals per annum. Based on a citation population of 16,938 breeding adults and a baseline mortality of 1,372 individuals per annum, the addition of 396 mortalities would represent a 29.863% increase in baseline mortality. Considering the more recent 2017 SMP population count of 26,784 breeding adults and a baseline mortality of 2,170 individuals per annum, the addition of 396 mortalities would represent a 18.253% increase in baseline mortality.

11.4.207 Incorporating a 65% to 85% macro-adjustment into collision mortalities for projects included in the in-combination assessment reduces the predicted annual gannet mortalities to 115 (115.4) – 181 (181.4) mortalities per annum. Considering the impact on the citation population, this would represent a 8.411% - 13.222% increase in baseline mortality. Based on the more recent 2017 SMP count, this would represent a 5.319% - 8.361% increase in baseline mortality. Of this, the Project contributes a total of 4.5 gannets representing a *de minimis* increase in baseline mortality of 0.045%.

11.4.208 Though the in-combination impacts exceed a 1% increase in baseline mortality, the expected impacts are not expected to affect the integrity of the gannet feature at the FFC SPA. As presented in the PVA analysis presented for the Dudgeon and Sheringham Shoal Extension projects RIAA (Royal HaskoningDHV, 2022), a worst case scenario of 400 mortalities per annum (based on combined displacement and collision mortalities, and not incorporating macroavoidance into collision estimates) would reduce population growth rate by up to 1.9% compared with the unimpacted scenario. Considering the FFC SPA, the gannet population is considered to be robust, with a population growth rate of 12% between 1985 and 2017. In comparison, the average annual growth rate of UK gannet colonies is 1.8% (based on over 90 years of data). The FFC gannet population is therefore considered robust enough to allow the conservation objective to sustain this level of mortality.

11.4.209 Therefore, although the in-combination impacts resulting from combined displacement and collision exceeds a 1% increase in baseline mortality, it is considered that the level of additional impact would be indistinguishable from natural fluctuations in the population.

11.4.210 **It is therefore concluded that the in-combination predicted gannet mortality due to combined displacement and collision in the O&M phase would not adversely affect the integrity of the gannet feature of the FFC SPA.**

11.5 Migratory Fish

11.5.1 The potential for LSE in-combination from the Project with regard to migratory fish is summarised in Section 8.2, with the in-combination assessment presented below.

11.5.2 Information to inform the Project alone assessment for migratory fish is provided in section 10.5 which assesses the effects of underwater noise on two sites (Humber Estuary SAC and River Derwent SAC) during construction, decommissioning, operation, and maintenance.

11.5.3 Table 11.1 above highlights the Projects which have been screened in for the in-combination assessment for migratory fish, these can be summarised into three main types of projects:

- Offshore windfarms - both planned and consented;
- Aggregate and disposal areas; and
- Cable projects.

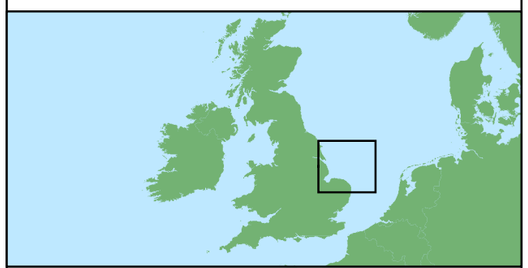
11.5.1 Figure 11.2 shows the location of the Projects considered in-combination for the benthic and intertidal ecology assessments.

11.5.2 Underwater noise is the only impact that has been screened in for the Project alone assessment (and concluded no AEoI); however several other effects were identified at screening which were not considered to have any effect from the Project alone. Based on the distance from the Project to the Humber Estuary SAC (53.1 km to the array area, 18.5 km to the offshore ECC, and 17.1 km to the onshore ECC) and the River Derwent SAC (129.8 km to the array area, 100.3 km to the offshore ECC and 95.8 km to the onshore ECC), it is considered that there is no pathway for effect for any of the effects considered aside from underwater noise. Therefore, these effects are not assessed in-combination, with no in-combination AEoI assumed for these effects.

300000
350000
400000
450000
500000
6000000
5950000
5900000
5850000
N
Hornsea
Project Four
(HOW04)
Hornsea
Project Three
(HOW03)
Dudgeon
Extension
Dudgeon
Extension
Sheringham
Shoal Extension
Norfolk
Boreas

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Offshore Wind Farms



Coordinate System: WGS 1984 UTM Zone 31N

0 20 40 km

Scale: 1:750,000

Plans and Projects Considered for Migratory Fish

Figure 11.4

OUTER DOWSING OFFSHORE WIND

Date: 05/05/2023
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Construction and decommissioning

11.5.3 The potential for an AEoI in-combination as a result of effects on migratory fish during construction and decommissioning relates to the sites and effects listed above. As for the AA alone, the potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

Underwater Noise

11.5.4 The potential for an AEoI in-combination as a result of underwater noise on migratory fish during construction and decommissioning relates to the following designated sites and the relevant features. The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

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

11.5.5 Of the Projects identified in Table 11.1 above, those with the potential for an in-combination effect with the Project with respect to underwater noise are limited to those with potential for a temporal overlap of the construction phases (specifically piling or, if known, UXO or seismic surveys).

11.5.6 Timeframes for decommissioning are not certain for most projects and therefore an assessment of the potential for an in-combination effect during decommissioning cannot be made at this time. However, it can be concluded that the potential for an effect during the decommissioning phase would be less than that during construction and would in any case be assessed in line with the regulatory requirements at the time.

11.5.7 As highlighted in the assessment of AEoI for the Project alone, there are a number of potential sources of underwater noise associated with the 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); and
- Geophysical and seismic survey -planned geophysical/seismic survey included within the screening range (where that information is in the public domain).

11.5.8 It is of note that vessel disturbance is considered separately, as is operational noise.

11.5.9 The potential for underwater noise to result during construction of the Project, together with the sensitivity of sea and river lamprey to such noise, has been discussed in Section 10.5 as part of the Project alone assessment, with that information not repeated here.

11.5.10 The assessment of the in-combination effects is made for both sea lamprey and river lamprey together as they are the same sensitivity group (Group 1), and both the effects and conclusions are the same for both species at both of the SAC sites.

Potential for an in-combination effect on sea lamprey and river lamprey from underwater noise

11.5.11 It is considered that assessing underwater noise in-combination impacts on sea lamprey within 100 km of the Project is considered a highly precautionary buffer upon which to include projects within the area. However, if in-combination effects on sea and river lamprey were to occur, the activities presenting the highest risk are pile driving activities during the construction phase of some OWF. Specifically, based on the screening range and the timeline of projects this would include the following projects:

- Norfolk Boreas;
- Hornsea Project Three;
- Hornsea Project Four;
- Sheringham Shoal Extension; and
- Dudgeon Extension.

11.5.12 It is considered that in-combination risks of mortality or potential mortal injury or recoverable injury of sea lamprey and river lamprey from piling noise would not be expected to occur as a result of the Project and the Projects listed above due to the small range within which potential injury effects would be expected (i.e., predicted to occur within < 100m of piling activity). Given that the distances between the OWF projects are larger than the mortality and injurious impact ranges from piling (the closest project, Dudgeon Extension, is approximately 13 km away), there is no overlap of injurious impacts considered. Due to the small impact ranges for mortality or injurious impacts, it is reasonable to conclude that very low numbers of sea and river lamprey that would be associated with the sites will be exposed to the impact even when at sea, including as a result of in-combination effects. Therefore, in-combination risks of injurious impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.13 With respect to TTS impacts, it is considered that in-combination risks from piling noise would not be expected to occur as a result of the Project and the Projects listed above due to the range within which potential injury effects would be expected (i.e., predicted to occur within 10 km of piling activity). Given that the distances between the OWF projects are larger than the injury impact ranges from piling (the closest project, Dudgeon Extension, is approximately 13 km away), there is no overlap of TTS impacts considered. Due to the small impact ranges for TTS, it is reasonable to conclude that very low numbers of sea and river lamprey that would be associated with the sites will be exposed to the impact even when at sea, including as a result of in-combination effects. Therefore, in-combination risks of TTS impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.14 With regard to the in-combination behavioural effects associated with underwater noise as a result of Norfolk Boreas, Hornsea Project Three, Hornsea Project Four, Sheringham Shoal Extension, Dudgeon Extension and the Project, the assessment considers all phases of the Projects that overlap either temporally or spatially with the proposed works. As with the alone assessment for sea lamprey and river lamprey presented in Section 10.5, the in-combination assessment of whether behavioural changes could cause an AEoI on the Humber Estuary SAC and River Derwent SAC focuses on whether in-combination impacts could compromise the maintenance of the size of the site-specific lamprey populations.

11.5.15 Norfolk Boreas OWF (Vattenfall, 2019), Hornsea Project Three OWF (Ørsted, 2018), Hornsea Project Four OWF (Ørsted, 2021), and Sheringham Shoal and Dudgeon OWF Extensions (Equinor, 2022) all concluded within their HRAs that they would have no effects alone or in-combination with either the Humber Estuary SAC or River Derwent SAC based on the distances the Project(s) and the site.

11.5.16 Behavioural effects on sea lamprey and river lamprey as a result of piling noise are predicted to be dependent on the nature of the receptors, with larger impact ranges predicted for fish with a swim bladder compared to those without. Lamprey do not have a swim bladder, so therefore are not considered to have high sensitivity to underwater noise and therefore behavioural effects are anticipated to be limited. Between piling events, fish may resume normal behaviour and distribution, as evidenced by work of McCauley *et al*. (2000) which showed that fish returned to normal behavioural patterns within 14 to 30 minutes after the cessation of seismic airgun firing. Therefore, due to the long distances between projects, and between projects and sites, alongside the reduced sensitivity of the species, the noted behavioural response, and recovery from noise impacts, it is considered that in-combination behavioural impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.17 Therefore, it is concluded that there is no AEoI to the conservation objectives for the Humber Estuary SAC and River Derwent SAC from the Project in-combination with identified plans and projects and therefore, subject to natural change, the populations of sea and river lamprey will be maintained in the long-term with respect to underwater noise associated with the construction and decommissioning phase.

O&M

Underwater Noise

11.5.18 The potential for an AEoI in-combination as a result of underwater noise on migratory fish during O&M relates to the following designated sites and the relevant features.

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

11.5.19 Underwater noise levels during the operational phase are predicted to be considerably lower than those of the construction phase, being limited to noise from operational turbines and maintenance vessel traffic. The sources for operation noise are described within Section 10.5.

11.5.20 The assessment in-combination is made for both sea lamprey and river lamprey together as the effects and conclusions are the same for both species and at both sites.

Potential for an in-combination effect on sea lamprey and river lamprey from underwater noise

11.5.21 It is considered that assessing underwater noise in-combination impacts on sea and river lamprey within 100 km of the Project is considered a highly precautionary buffer upon which to include projects within the area. Specifically, based on the screening range and the timeline of projects this would include the following projects:

- Norfolk Boreas;
- Hornsea Project Three;
- Hornsea Project Four;
- Sheringham Shoal Extension; and
- Dudgeon Extension.

11.5.22 It is considered that in-combination risks of mortality or potential mortal injury or recoverable injury of mortality of sea lamprey and river lamprey from piling noise would not be expected to occur as a result of the Project and the Projects listed above due to the small range within which potential injury effects would be expected (i.e., predicted to occur within a few meters of each turbine). Given that the distances between the OWF projects are larger than the injury impact ranges from operation (the closest project of those considered, Dungeon Extension, is approximately 13 km away), there is no overlap of injurious impacts considered. Due to the small impact ranges for injurious impacts, it is reasonable to conclude that very low numbers of sea and river lamprey that would be associated with the sites will be exposed to the impact even what at sea, including as a result of in-combination effects. Therefore, in-combination risks of injurious impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.23 With respect to TTS impacts, it is considered that in-combination risks from operational noise would not be expected to occur as a result of the Project and the Projects listed above due to the range within which potential injury effects would be expected (i.e., predicted to occur within a few meters of each turbine). Given that the distances between the OWF projects are larger than the injury impact ranges from operation (the closest project, Dungeon Extension, is approximately 13 km away), there is no overlap of TTS impacts considered. Due to the small impact ranges for TTS, it is reasonable to conclude that very low numbers of sea and river lamprey that would be associated with the sites will be exposed to the impact even when at sea, including as a result of in-combination effects. Therefore, in-combination risks of TTS impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.24 With regard to the in-combination behavioural effects associated with underwater noise as a result of Norfolk Boreas, Hornsea Project Three, Hornsea Project Four, Sheringham Shoal Extension, Dudgeon Extension and the Project, the assessment considers all phases of the Projects that overlap either temporally or spatially with the proposed works. As with the alone assessment for sea lamprey and river lamprey presented in Section 10.5, the in-combination assessment of whether and behavioural changes could cause an AEoI on the Humber Estuary SAC and River Derwent SAC focuses on whether in-combination impacts could compromise the maintenance of the size of the site-specific lamprey populations.

11.5.25 Norfolk Boreas OWF (Vattenfall, 2019), Hornsea Project Three OWF (Ørsted, 2018), Hornsea Project Four OWF (Ørsted, 2021), and Sheringham Shoal and Dudgeon OWF Extensions (Equinor, 2022) all concluded within their HRAs that they would have no effects alone or in-combination with either the Humber Estuary SAC or River Derwent SAC based on the distances the Project(s) and the site.

11.5.26 Additionally, studies of very low frequency sound (similar to that produced by the operation of turbines) have indicated that consistent deterrence from the source is only likely to occur at particle accelerations equivalent to a free-field sound pressure level of 160dB re 1µPa (RMS) (Sand *et al.,* 2001). This is higher than the noise levels reported in the open literature for operational windfarms measured at a number of ranges, all within a few hundred metres of the turbine (Nedwell *et al.,* 2007a; Edwards *et al.,* 2007; Betke *et al.,* 2004, see also Wahlberg and Westerberg, 2005 and Madsen *et al.,* 2006). The particle acceleration resulting from an operational wind turbine has also been measured by Sigray *et al.,* (2011) with the resultant levels being considered too low to be of concern for behavioural reactions from fish. Furthermore, the particle acceleration levels measured at 10m from the turbine were comparable with hearing thresholds. Whilst limited, the available data provides an indicator that operational wind turbines are unlikely to result in disturbance of fish except within very close proximity of the turbine structure, as postulated by Wahlberg and Westerberg (2005). Considering the operational turbine noise of the windfarm and any associated service vessels, the ambient noise levels within the site would be expected to be lower than those present in the vicinity of nearby shipping lanes.

11.5.27 Therefore, due to the conclusions from other projects, the distances between projects, and between projects and sites, alongside the noted noise levels generated by turbines and the lack of response from fish, it is considered that in-combination behavioural impacts are not expected to manifest at levels that could compromise the extent, distribution, structure, and function of the habitats, structure and function of the species, supporting processes, or the population and distribution of the species.

11.5.28 Therefore, it is concluded that there is no AEoI to the conservation objectives for the Humber Estuary SAC and River Derwent SAC from the Project in-combination with identified plans and projects and therefore, subject to natural change, the populations of sea and river lamprey will be maintained in the long-term with respect to underwater noise associated with the O&M phase.

11.6 Onshore Ecology

11.6.1 The HRA Screening report identified relevant NSIP projects to be included within the in-combination assessment, as detailed in Section 8.2. Non-NSIP projects considered in the in-combination assessment are detailed within Table 11.46 although these are specifically 'major development' projects as defined by the Town and Country Planning (Development Management Procedure) Order 2015. Smaller developments do not need consideration as they are too small to exert an effect on the qualifying interest features of the identified designated sites. Major development projects included in the assessment are::

- The winning and working of minerals or the use of land for mineral-working deposits;
- Waste development;
- The provision of dwellinghouses, where:
  - The number of dwellinghouses to be provided is ten or more; or
  - The development is to be carried out on a site having an area of 0.5 hectares or more.
- The provision of a building or buildings where the floor space to be created by the development is 1,000 m^2 or more; or Development carried out on a site having an area of 1 hectare or more.

Table 11.46: Non-NSIP applications considered within the onshore in-combination assessment

Code	Development type	Project	Status	Details
Lincolnshire County Council				
1	Minerals 9km W of Humber Estuary SPA and Ramsar	EIA/36/22 (Lincolnshire)	EIA Scoping opinion	Manby Airfield, Manby. **Proposal** - For an anaerobic digestor and fertiliser production plant.
North Lincolnshire District Council				
2	Housing 8km S of Humber Estuary SPA and Ramsar	PA/2020/554	Not yet determined	Land between 57-71 Brigg Road, Messingham, DN17 3QX. Application for approval of reserved matters, appearance, landscaping, layout & scale, pursuant to outline application PA/2020/554 for 92 dwellings
3	Housing 5km SE of Humber Estuary SPA and Ramsar	PA/2022/1628	Not yet determined.	Land south of Moorwell Road, Yaddlethorpe, Bottesford. Application for approval of reserved matters (appearance, landscaping, layout and scale) pursuant to outline application PA/2019/1782 dated 03/04/2020 for a residential development of up to 200 dwellings.
4	Housing 15km SE of Humber Estuary	PA/2022/1408	Appeal Not yet determined	Land rear of Southdown House, Grayingham Road, Kirton in Lindsey, DN21 4EL. Outline planning permission for a residential development of up to 28 dwellings.

Code	Development type	Project	Status	Details
5	Housing 13km S of Humber Estuary	PA/2022/1307	Approval of reserved matters	Land off Applefields, Wrawby. Application for approval of reserved matters (appearance, landscaping, layout and scale) pursuant to outline application PA/2017/674 dated 13/09/2019 for 22 dwellings.
6	Housing 8km W of Humber Estuary	PA/2022/628	Split Decision	Hybrid application comprising full planning permission to erect 32 dwellings and outline planning permission for 85 dwellings.
7	Housing 3km SE of Humber Estuary	PA/SCR/2022/1	Screening opinion issued	land off Burringham Road. EIA screening request relating to the erection of 599 dwellings.
8	100m from Humber Estuary	PA/2022/77	Not yet determined	Planning permission to erect 28 dwellings
9	2.5km S of Humber Estuary	PA/2021/2151	Appeal Not yet determined	Outline planning permission for a residential development of up to 390 dwellings. Land west of Brigg Road and south of Horkstow Road, Barton upon Humber.
NE Lincolnshire District Council				
10	3.5km W of Humber Estuary	DM/1028/20/NMA	Non-Material Amendment - Accepted	Non Material Amendment following application DM/0651/19/REM (Reserved matters application for the erection of 50 dwellings. Land At Larkspur Avenue Larkspur Avenue Healing North East Lincolnshire.
East Lindsey District Council				

Code	Development type	Project	Status	Details
11	500m W of Greater Wash	S/153/01314/22	EIA not required	Residential development of up to 522 dwellings. Land on the north side of Church Lane, Skegness.
12	13km NW of Wash	S/169/02610/21	EIA note required	Braybrook House, Main Road, Stickney, Boston, Lincolnshire, PE22 8AY. Outline erection of a foodhall/shop, 4 no. industrial units and 50 no. residential dwellings.
Boston Borough Council				
13	2km N of Wash	B/22/0370	Not Yet Determined	41, Church Green Road, Fishtoft. Proposed residential development of 41 affordable dwellings.
14	2km N of Wash	B/22/0366	Not Yet Determined	Erection of 74 dwellings. Land North of Slippery Gowt Lane, Boston.
15	3km NW of Wash	B/21/0413	Not Yet Determined	Re-plan and re-design of the housing layout within phases 2 & 3 (154 dwellings) on parts of the site previously approved under B/18/0039 (for the erection of up to 195 dwellings); including provision of 13 additional units (to create a combined total of 208 dwellings). Land at Middlegate Road West, Frampton.
16	3.5km N of Wash	B/21/0475	Favourable with conditions	Outline application for the erection of 35 no. dwellings. Land north of Old Main Road, Old Leake, Boston, PE22 9HR.

Code	Development type	Project	Status	Details
17	3.5km N of Wash	B/21/0349	Favourable with conditions	Development of up to 135 dwellings of affordable housing. Land at Toot Lane, Boston.
South Holland District Council				
18	1km W of Wash	PE-00049-22	EIA Screening - confirmed	Request for EIA scoping opinion in respect of proposed wind turbine and solar development. Land north and south of Main Road and east of Dawsmere Road, Gedney Drove End.
Kings Lynn and West Norfolk Council				
19	1km E of Wash	22/00929/FM	Awaiting decision	Development of 61 housing with care apartments, 39 care ready bungalows and 60 residential dwellings together with community facilities and services and associated landscaping, highway works and associated infrastructure. Land S of Hunstanton Commercial Park and E of Kings Lynn Road, Hunstanton, Norfolk.
20	11km SW of Wash	22/00768/OM	Awaiting decision	Outline Application: Proposed Residential Development of up to 40 Dwellings. KGB Transport 44 St Johns Road, Tilney St Lawrence, Norfolk, PE34 4QJ.
21	3.5km S of Wash	22/00111/F	Application Permitted	Variation of Condition 1 attached to Planning Permission 17/01632/RMM: Residential development for 40 dwellings.

Code	Development type	Project	Status	Details
				Fosters Sports Ground, Clenchwarton, Kings Lynn, Norfolk, PE34 4BP.
North Norfolk Council				
22	13km S of Greater Wash	PF/21/1990	Pending consideration (July 2021)	Construction of 38 residential dwellings with associated infrastructure and landscaping. Land Off Norwich Road, Corpusty, Norfolk.
23	1km S of Greater Wash	PF/19/1028	Pending Consideration (June 2019)	Erection of 30 residential dwellings. Land At Back Lane, Roughton.
East Riding of Yorkshire Council				
34	1.2 km N of Humber Estuary	22/04002/STPLF	Pending Consideration	Erection of 54 dwellings. Land south and east Of Dovecote Tranby Park, Jenny Brough Lane, Hessle.
35	2 km N of Humber Estuary	22/03861/STPLF	Pending consideration	Erection of 166 dwellings. Land north east Of 6 Broadacre Park, Brough.
36	300 m N of Humber Estuary	21/03132/STPLF	Pending consideration	Erection of 119 dwellings Land west of Blasket Road, Ferriby High Road, North Ferriby.
37	1.6 km N of Humber Estuary	22/03465/STOUT	Outline application	Outline - Erection of up to 120 dwellings. Land and premises at Common Lane, Welton.
38	10 km N of Humber Estuary	22/01208/STPLF	Pending consideration	Construction of solar photovoltaic development.

Code	Development type	Project	Status	Details
				Land north, east And west Of Carr Plantation, Ferry Road, Wawne.
39	2.5 km N of Humber Estuary	23/00760/STPLFE	Pending consideration	Installation and operation of a Solar Farm. Land south and west Of Froghall Farm, Wyton Road, Preston.
40	8 km N of Humber Estuary	22/02775/STPLF	Pending consideration	Construction of a 49.99MW Solar Farm. Land West Of Benningholme Grange Farm, Kidhill Lane, Benningholme.

11.6.2 Local plans of the following nearby locations which have been screened in were reviewed to assess the potential of allocations being 'major developments' for the in-combination assessment:

- East Lindsey District Council;
- South-East Lincolnshire; and
- Kings Lynn and West Norfolk.

11.6.3 Details of the allocations identified are provided in Table 11.47.

Table 11.47: Review of local plans and allocations of 'major development' size for inclusion in in-combination assessment

Reference	Local plan	Allocation type	Approximate distance and direction from the nearest designated site	Approximate distance and direction from the onshore PEIR boundary
24 - Holbeach Food Enterprise Zone	SE Lincs	Employment	11 km W	6 km SE
25 - Kirton Distribution Park	SE Lincs	Employment	4 km NW	3 km NW
26 - Lincs Gateway, Spalding	SE Lincs	Employment	13 km SW	5 km SW
27 - Clay Lake, Splading	SE Lincs	Employment	13 km SW	5 km SW
28 - Boston Sou006	SE Lincs	Sustainable Urban Extension	4 km N	3.5 km N
29 - Boston Wes002	SE Lincs	Sustainable Urban Extension	5 km N	4.5 km N
30 - Spalding Vernatts	SE Lincs	Sustainable Urban Extension	13 km SW	5 km SW
31 - Holbeach West	SE Lincs	Sustainable Urban Extension	8 km S	6 km S
32 - Boston Distributor Road	SE Lincs	Highways	5 km N	4.5 km N
33 - Spalding Western Relief Road	SE Lincs	Highways	13 km SW	5 km SW

Construction and decommissioning

11.6.4 The potential for undermining conservation objectives from the project alone during decommissioning is *de minimus*, as the habitats that have been identified as most sensitive (those in use by SAC, SPA and Ramsar site features) are located away from the OnSS, where the majority of decommissioning activity will take place. Moreover, none of the identified projects are expected to be undertaking decommissioning at a similar time to the Project. Based primarily on the location of the OnSS options, there will be no AEoI of the designated sites identified due to decommissioning.

11.6.5 An assessment of the potential for AEoI was undertaken, considering whether construction of the Project was likely to occur at the same time as, or in succession with, the identified projects and based on the location of those projects (refer to Table 11.489).

Table 11.48: Non-NSIP applications considered within the onshore in-combination assessment

Project	Potential for in-combination effect Y/N	Project Details
BAEF	Y	South of Boston, by The Haven. DCO application submitted 2021, to be decided July 2023.
Heckington Fen Solar Park	N	DCO application submitted in 2023. Located 17km north-west of the Project, to the west of Boston.
Transition to Integrated Gas and Renewable Energy (TIGRE) Project 1	N	Located entirely offshore, more than 12nm. Gas fired power station connecting into an offshore substation.
Triton Knoll Electrical System	N	The works, which commenced in September 2018, involved laying 57km of 220kV underground cable from the project's landfall location near Anderby Creek to the newly constructed Triton Knoll Onshore Substation near Bicker Fen. Completed October 2021.
TKOWF	N	Offshore construction commenced in January 2020, 20 miles off the coast of Lincolnshire. Turbine commissioning was successfully completed in January 2022.
Hornsea Project Four	Y – Humber Estuary only	Decision phase of the DCO process following the close of Examination in August 2022. Onshore cable route in East Yorks.
Hornsea Project Three	N	Offshore windfarm. Has received DCO.
Hornsea Project Two	N	Operational offshore windfarm.
Hornsea Project One	N	Operational offshore windfarm.
Able Marine Energy Park	N	320 ha of developable land and 1300m of new deep water quays, specifically designed for the offshore wind sector. On the south bank of the Humber Estuary. DCO issued in 2013 and site is operational.
Able Marine Energy Park – Material Change 1	N	To move an area (referred to as "Mitigation Area A" in the 2014 Order) proposed for ecological mitigation to a new site. Change granted.
Able Marine Energy Park – Material Change 2	N	To alter the alignment of the quay, removing the specialist berth at the southern end of the quay and setting back the quay line at the northern end, creating a barge berth. The Application also seeks changes to the 2014 Order to allow amendments to dredging and

Project	Potential for in-combination effect Y/N	Project Details
		sediment disposal patterns arising from the new quay alignment, and the option of a more efficient construction methodology, identified during the design process. Proposed changes have been authorised.
South Humber Bank Energy Centre	N	The construction and operation of an energy from waste plant of up to 95 megawatts gross capacity. DCO granted in 2021. The project website advises that construction of SHBEC will commence as early as 2022. The construction phase is expected to last for approximately 36 months, with the EfW power station entering operation in 2025.
A160-A180 Port of Immingham Improvement	N	The project would widen the existing single carriageway section of the A160 to dual carriageway. Granted in 2015.
Dogger Bank South Offshore Windfarms (East and West)	Y – Humber Estuary only	Offshore of East Yorkshire. Onshore study area north of Hull. Plan to publish the PEIR around Spring 2023.
Humber Low Carbon Pipelines	Y – Humber Estuary only	New onshore pipeline infrastructure to transport the captured carbon emissions from the region's industrial emitters for safe storage in the North Sea, and enable industries to fuel-switch from fossil fuels to low-carbon hydrogen. PEIR submitted 2022.
North Killingholme Power Project	N	The proposal is for a new thermal generating station that will operate either as a Combined Cycle Gas Turbine (CCGT) plant or as an Integrated Gasification Combined Cycle (IGCC) plant, with a total electrical output of up to 470Mwe. Granted in 2014.
River Humber Gas Pipeline Replacement Project	N	The replacement of a natural gas transmission pipeline, housed within a tunnel beneath the Humber Estuary commencing approximately 2 miles north east of Goxhill, North Lincolnshire, terminating approximately 1 mile south east of Paull, East Riding of Yorkshire. Decided 2016.

Project	Potential for in-combination effect Y/N	Project Details
A63 Castle Street Improvement Hull	N	The Scheme comprises improvements to approximately 1.5km of the A63 and connecting side roads in Hull between Ropery Street and the Market Place/Queen Street junction. Granted in 2020.
Medworth Energy from Waste Combined Heat and Power (CHP) Facility	N	An Energy from Waste combined heat and power facility with a maximum gross capacity of 58MW. Examination in 2023. Located ~24 km from the Project and 16 km from the Wash SPA and Ramsar.
1 – Planning application	N	Minerals site at EIA scoping stage. Located 9 km west of Humber Estuary SPA and Ramsar.
2 – Planning application	N	Housing scheme at determination of reserved matter stage. Located 8 km south of the Humber Estuary SPA and Ramsar.
3 – Planning application	N	Housing scheme at determination stage. Located 5 km south-east of the Humber Estuary.
4 – Planning application	N	Housing scheme at appeal stage. Located 15 km south-east of Humber Estuary.
5 – Planning application	N	Housing scheme at determination of reserved matters stage. Located 13 km south of the Humber Estuary SPA and Ramsar.
6 – Planning application	N	Housing scheme at determination stage. Located 8 km south of the Humber Estuary SPA and Ramsar.
7 – Planning application	Y	Housing scheme of up to 599 dwellings at EIA screening stage. Located 3 km south-east of Humber Estuary.
8 – Planning application	Y	Housing scheme (28 dwellings) at determination stage. Located 100m from Humber Estuary.
9 – Planning application	Y	Housing scheme (390 dwellings) at appeal stage. Located 2.5 km south of Humber Estuary.
10 – Planning application	N	Housing scheme – approved. 3.5 km west of Humber Estuary.

Project	Potential for in-combination effect Y/N	Project Details
11 – Planning application	Y	Housing scheme at EIA screening stage (522 dwellings). Located 500 m from the Greater Wash.
12 – Planning application	N	Housing scheme at EIA screening stage (50 dwellings). 13 km west of The Wash.
13 – Planning application	N	Housing scheme at determination stage (50 dwellings). 13 km west of The Wash.
14 – Planning application	Y	Housing scheme at determination stage (74 dwellings). 2 km north of The Wash (at Boston).
15 – Planning application	Y	Housing scheme at determination stage (208 dwellings). 3 km north-west of The Wash.
16 – Planning application	Y	Housing scheme at outline application stage (35 dwellings). 3.5 km north of The Wash.
17 – Planning application	Y	Housing scheme at outline application stage (135 dwellings). 3.5 km north of The Wash.
18 – Planning application	Y	Wind and solar project – EIA screening stage. Located 1 km west of The Wash.
19 – Planning application	Y	Housing scheme at determination stage (160 dwellings). 1 km east of The Wash.
20 – Planning application	N	Housing scheme at outline application stage (40 dwellings). 11 km south-west of The Wash.
21 – Planning application	N	Housing scheme permitted (40 dwellings). 3.5 km south of The Wash.
22 – Planning application	N	Housing scheme at determination stage (38 dwellings). 13 km south of Greater Wash.
23 – Planning application	N	Housing scheme at determination stage (30 dwellings). 1 km south of Greater Wash.
24 – Allocation	N	Food enterprise zone. 11 km west of the nearest designated site.

Project	Potential for in-combination effect Y/N	Project Details
25 – Allocation	Y	Distribution Park. 4 km from nearest designated site and 3 km from the Project PEIR Boundary.
26 – Allocation	N	Employment zone, Spalding. 13 km west of the nearest designated site.
27 – Allocation	N	Employment zone, Spalding. 13 km west of the nearest designated site.
28 – Allocation	Y	Sustainable Urban Extension (SUE), Boston South.
29 – Allocation	Y	SUE, Boston West.
30 – Allocation	N	SUE, Spalding. 13 km west of the nearest designated site.
31 – Allocation	N	SUE, Holbeach. 8 km west of the nearest designated site.
32 - Allocation	Y	Distributor road, Boston.
33 - Allocation	N	Relief road, Spalding. 13 km west of the nearest designated site.
34 – Planning Application	N	Housing scheme at determination stage (52 dwellings). 1.2 km north of Humber Estuary
35 – Planning application	Y	Housing scheme at determination stage. 2 km north of Humber Estuary.
36 – Planning application	Y	Housing scheme at determination stage, 300 m north of Humber Estuary,
37 – Planning application	N	Housing scheme at outline application stage. 1.6 km north of Humber Estuary.
38 – Planning application	N	Solar farm development. 10 km N of Humber Estuary.
39 – Planning application	Y	Solar farm development. 2.5 km N of Humber Estuary.
40 – Planning application	Y	Solar farm development. 8 km N of Humber Estuary.

11.6.6 The projects and plans were then reviewed for their likelihood to have an effect on the relevant designated site, based on Table 11.49 and proximity to the relevant designated sites.

Table 11.49: In-combination effects for identified designated sites for projects and plans onshore.

Project	The Wash SPA and Ramsar and The Wash and North Norfolk SAC	Greater Wash SPA	Gibraltar Point SPA and Ramsar	Humber Estuary SPA, Ramsar and SAC	North Norfolk SPA and Ramsar
BAEF	Y	N	N	N	N
Hornsea Project Four	N	N	N	Y	N
Dogger Bank South Offshore Windfarms	N	N	N	Y	N
Humber Low Carbon Pipelines	N	N	N	Y	N
7 – Planning application	N	N	N	Y	N
8 – Planning application	N	N	N	Y	N
9 – Planning application	N	N	N	Y	N
11 – Planning application	N	Y	N	Y	N
14 – Planning application	Y	N	N	N	N
15 – Planning application	Y	N	N	N	N
16 – Planning application	Y	N	N	N	N
17 – Planning application	Y	N	N	N	N
18 – Planning application	Y	N	N	N	N
19 – Planning application	Y	N	N	N	Y
25 – Allocation	Y	N	N	N	N
28 – Allocation	Y	N	N	N	N
29 – Allocation	Y	N	N	N	N
32 - Allocation	Y	N	N	N	N
35 – Planning application	N	N	N	Y	N
36 – Planning application	N	N	N	Y	N
39 – Planning application	N	N	N	Y	N
40 – Planning application	N	N	N	Y	N

11.6.7 For the onshore in-combination assessment, individual avian features are not assessed. Instead, the key pathway – disturbance, identified during the alone assessment is discussed based on the different habitats used by the different species, this is due to the effects being similar across avian species. Further consideration will be given to the qualifying features of the identified SAC's in a subsequent version of the RIAA once further information and assessment has been undertaken in relation to air and water quality effects from the Project alone.

Avian qualifying features of identified SPAs and Ramsar sites

11.6.8 Boston Alternative Energy Facility is an energy from waste project, generating up to 102 MW of energy, with fuel arriving by ship through The Haven. It will be located within Riverside Industrial Estate on the outskirts of Boston. The DCO application was submitted in March 2021 and the SoS has set a deadline of July 2023 to make the decision. The applicant's HRA concluded no AEoI in relation to The Wash SPA and Ramsar, however subsequently information has been submitted regarding compensatory measures for disturbance to roosting waterbirds at the mouth of The Haven, arising from vessel transits associated with the project. One of the four compensatory option areas partially overlaps with the Project PEIR Boundary, whereas the other three are located >500m from the PEIR Boundary. Those four sites are within agricultural fields, which would be subject to hydrological change to provide alternative roosting habitat for waterbirds. Further consideration will be given to those once it has been confirmed which will be taken forwards. The potential for an in-combination effect relates to disturbance to waterbirds at The Haven. The Project will use trenchless techniques to cross The Haven, thereby avoiding habitat loss and minimising disturbance. Mitigation will be implemented for the Project to further reduce and where possible avoid temporary disturbance at The Haven, including the use of screening and avoiding works during periods of freezing weather.

11.6.9 Planning applications 14-19 are six developments within 3.5km of The Wash, two have been approved, one is awaiting determination, two outline applications with 'favourable with conditions' outcomes and one at EIA Screening stage.

- Application 14 is a non-EIA proposal for 74 dwellings, 2km north of The Wash and no HRA has been undertaken.
- Application 15 is the re-design of an approved plan for 208 dwellings, 3km north of The Wash and no HRA has been undertaken. Natural England advised that the application is not likely to result in significant impacts on statutory designated nature conservation sites.
- Application 16 is a non-EIA outline application for 35 dwellings, 3.5km north of The Wash, and no HRA has been undertaken.
- Application 17 is a proposal for 135 dwellings, 3.5km north of The Wash and no HRA was undertaken. The biodiversity report concluded there would be no risk of significant effects on statutory designated sites. The applicant is in the process of discharging planning conditions.

- Application 18 is a wind and solar project 1km west of The Wash, at EIA Screening stage. Four wind turbines and 16MW solar array are proposed. The planning authority anticipate LSE on The Wash, subject to outcomes of bird surveys, due to risk of collision and/or disturbance particularly from the wind turbines element of the project.
- Application 19 is a proposal for 160 dwellings, 0.8 km west of The Wash. Natural England advise that with mitigation secured, impacts on The Wash SPA and Ramsar and The Wash and North Norfolk SAC can be avoided. Mitigation comprised of a payment to the Norfolk Green Infrastructure and Recreational Impact Avoidance Strategy and provision of on-site green infrastructure. The identified impact pathway within the HRA is recreational disturbance. It has been recommended for approval at planning committee.

11.6.10 Of these six developments, the first four are unlikely to result in LSE on designated sites and are not expected to contribute to in-combination effects with the Project. Application 19 has been approved and has secured mitigation to avoid AEoI from recreational disturbance to The Wash SPA and Ramsar. Whilst this would be an operational phase impact, Application 19 would be expected to be completed by the time of construction for the Project, and therefore have a temporal overlap, however with the mitigation that has been secured it is not expected to contribute to adverse effects on The Wash SPA or Ramsar. Application 18 is at an early stage of development and limited ecological information is available. There is a possibility of temporal overlap in construction of Application 18 with the Project, and therefore there would be potential for an in-combination construction phase disturbance effect on FLL of The Wash SPA and Ramsar.

11.6.11 Allocations 25, 28, 29 & 32 are four projects identified in Local Plans, three of which relate to housing provision and highways work around Boston and one is a distribution park at Kirton. If these projects are taken forwards, potential impact pathways to The Wash SPA and Ramsar include recreational disturbance (housing) and construction phase disturbance (all schemes) to any waterbirds utilising functionally linked farmland habitats. Given no planning applications have been submitted, no details of potential impacts or functional linkage are available at this stage.

11.6.12 Hornsea Four Offshore Windfarm is at the decision phase of the DCO process following the close of Examination in August 2022, with a decision due by July 2023. The landfall is north of Skipsea, with an onshore ECC to an OnSS north of Hull. All potential effects relating to onshore ecology were screened out and therefore it can be excluded from the Project onshore in-combination assessment.

11.6.13 Dogger Bank South Offshore Windfarms (East and West) plan to publish the PEIR around Spring 2023. The proposed landfall is near Skipsea with an onshore ECC to an OnSS north of Hull. Scoping information only is available at this stage. Given that Hornsea Four was able to screen out all potential effects relating to onshore ecology and was in a similar locality, that may also be the case for Dogger Bank South, however HRA Screening is unavailable at this stage.

11.6.14 The Humber Low Carbon Pipelines project proposes new onshore pipeline infrastructure between Drax and Easington, including a tunnel beneath the Humber Estuary. The PEIR has been submitted but no HRA is available at this stage. Given that it is at a similar stage of development to the Project, there is a possibility of temporal overlap of construction works, and therefore potential for in-combination construction phase impacts to features of the Humber Estuary SPA and Ramsar.

11.6.15 Planning applications 7-9, 11, 35 and 36 are housing schemes located within 3 km of the Humber Estuary:

- Application 7 is a proposal for up to 599 dwellings, at EIA screening stage, located 3 km south-east of Humber Estuary. It was determined that EIA is not required. No HRA has been provided.
- Application 8 is a proposal for 28 dwellings, at determination stage, located 100 m from the Humber Estuary. No impacts on European sites were identified in the PEA or Ecology Officer's letter.
- Application 9 is a proposal for 390 dwellings, at appeal stage, located 2.5 km south of the Humber Estuary. One of the reasons for refusal was that insufficient information had been submitted to demonstrate that the proposed development would not have an AEoI of the Humber Estuary SPA and Ramsar site. The shadow HRA identified LSE in relation to recreational disturbance only. Mitigation is proposed in the form of on-site greenspace and access to walking routes away from the designated sites.
- Application 11 is a proposal for 522 dwellings, at EIA screening stage, located 500 m from the Greater Wash. EIA is not required, as no significant environmental effects are anticipated. No HRA is available.
- Application 35 is a proposed housing scheme of 166 dwellings located approximately 2 km to the north of the Humber Estuary. Natural England has requested information for an HRA for the project but that information is not currently available.
- Application 36 is a proposed housing scheme of 119 dwellings located approximately 300 m north of the Humber Estuary. Natural England has requested that the competent authority undertake an HRA for the project and that further information is provided from the applicant regarding potential recreational disturbance and proposed mitigation for loss of FLL.

11.6.16 From those housing applications, Applications 9, 35 and 36 have potential to contribute to an in-combination effect with the Project, on the Humber Estuary SPA. The only impact pathway identified for Application 9 was recreational disturbance (i.e. an operational phase impact) and mitigation measures have been put forward to address that potential impact. Further information is required before HRAs for Applications 35 and 36 can be completed.

11.6.17 A further two solar farm developments were identified with potential impacts on the Humber Estuary SPA:

- Application 39 is a proposed solar farm located approximately 2.5 km north of the Humber Estuary. Natural England has requested further information to inform an HRA, including wintering and passage bird surveys.

- Application 40 is a proposed solar farm located approximately 8 km north of the Humber Estuary. The Nature Conservation Officer concludes that mitigation is insufficient to address loss of FLL for non-breeding waders.

11.6.18 Mitigation for the Project, as detailed in Section 7, includes avoidance of designated ornithological sites, either through route selection or trenchless techniques. Stand-off distances between Anderby Marsh and The Wash SPA and Ramsar at The Haven, and entry and exit pits and associated working areas, will be 300 m and 400 m respectively. Further mitigation to reduce disturbance to birds includes the use of screening to provide a visual and acoustic barrier between construction works and sensitive areas for birds. In sensitive areas, such as at the Landfall and The Haven, the screening will be designed to ensure no line of sight between the sensitive area and construction area. Whilst machinery would be visible above the top of the screening, works at ground level, including personnel on foot, would be screened from view. Further details of the proposed screening will be provided in a subsequent draft of the RIAA, and once further design information is available, including the locations of entry and exit pits, further assessment will be undertaken of potential noise disturbance to birds, taking into account the effect of the noise attenuation screens.

11.6.19 This assessment will therefore need to be updated at the ES stage of the Project, with updates to the identified projects and plans, and following confirmation of further design details for the Project.

O&M

11.6.20 After construction, habitats along the cable route will be reinstated and during routine scheduled operation and maintenance there will be little activity along the onshore ECC. Scheduled monitoring visits to above ground infrastructure will typically occur on an annual basis. These will be comparable to pedestrian/single vehicle access and will not be undertaken in periods of extreme cold weather in accordance with the alone assessment mitigation. Scheduled maintenance and operation, when undertaken with the mitigation recommended in the alone assessment have no pathway to undermine the conservation objectives in-combination with other identified projects, and will have no AEoI of the identified designated sites.

11.6.21 Corrective maintenance has the potential to cause disturbance to avian features when at the Landfall or in proximity to The Haven, as discussed in the alone assessment section. The instances of unscheduled maintenance are expected to be infrequent and affecting discrete areas at any one time, and no further habitat loss is anticipated. With the mitigation incorporated for the Project, as detailed in the alone assessment section, there would be no AEoI on any of the designated sites as a result of the Project during the operational phase in-combination with other identified projects and plans. This assessment will need to be updated at the ES stage of the Project, with updates to the identified projects and plans, and following confirmation of further design details for the Project.

12 Transboundary Statement

12.1.1 The Screening process has identified twelve transboundary sites for assessment, with these sites being as follows (including the relevant designated species screened in):

- Doggersbank (Netherlands) 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);
- Vlakte 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).

12.1.2 At the time of writing this draft RIAA, no consultation on Transboundary Screening has been undertaken. However, it is anticipated that transboundary consultation on the final RIAA and the HRA Screening Report will be undertaken by the Inspectorate on behalf of the SoS following the making of the DCO application.

12.1.3 Consideration of the potential for an AEoI alone has been addressed in Section 10.3 for marine mammals, including in relation to the above sites where marine mammals are highlighted, with all conclusions being that there will be no AEoI. The assessment in-combination with other plans or projects (including transboundary projects) has been addressed in Section 11.3 for marine mammals, with all conclusions similarly being that no AEoI will occur.

12.1.4 It can therefore be concluded that no AEoI exists for a transboundary effect from the Project alone and/or in-combination on any sites designated for marine mammal features in other EEA states.

13 Conclusions of the Assessment

13.1.1 A summary of the assessment is presented below, identifying in Table 13.1 and Table 13.2 the designated sites (together with the relevant feature(s)) screened in for effect in relation to the Project alone and in-combination, including the conclusion on AEoI.

Table 13.1: Conclusions of the assessment for AEoI for all offshore receptor groups

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	O&M	Decommissioning	Construction	O&M	Decommissioning
Subtidal and Intertidal Benthic Ecology								
North Norfolk Sandbanks and Saturn Reef SAC	▪ Reefs; and ▪ Sandbanks which are slightly covered by sea water all of the time	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes.	No potential for AEoI			No potential for AEoI		
Inner Dowsing, Race Bank, and North Ridge SAC	▪ Reefs; and ▪ Sandbanks which are slightly covered by sea water all of the time	▪ Physical habitat loss/disturbance	No potential for AEoI			No potential for AEoI		
		▪ Suspended sediment/deposition	No potential for AEoI			No potential for AEoI		
		▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI			No potential for AEoI		
The Wash and North Norfolk Coast SAC	▪ Sandbanks which are slightly covered by sea water all of the time; ▪ Mudflats and sandflats not covered by seawater at low tide; ▪ Large shallow inlets and bays; ▪ Reefs; ▪ Salicornia and other annuals colonizing mud and sand; and ▪ Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI			No potential for AEoI		
Humber Estuary Ramsar	▪ Dune systems with humid dune slacks, ▪ Estuarine waters; ▪ Intertidal mud and sand flats; ▪ Saltmarshes; and ▪ Coastal brackish/saline lagoons	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI			No potential for AEoI		

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone Construction O&M Decommissioning	Conclusion on Adverse Effect In-combination Construction O&M Decommissioning
Humber Estuary SAC	▪ Estuaries; ▪ Mudflats and sandflats not covered by seawater at low tide; ▪ Sandbanks which are slightly covered by sea water all the time; ▪ Salicornia and other annuals colonizing mud and sand; and ▪ Atlantic salt meadows.	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI	No potential for AEoI
Gibraltar Point Ramsar	▪ Estuarine mudflats; ▪ Sandbanks; ▪ Saltmarsh; and ▪ Dunes	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI	No potential for AEoI
The Wash Ramsar	▪ Saltmarshes; ▪ Estuaries; ▪ Major intertidal banks of sand and mud; ▪ Shallow water; and ▪ Deep channels	▪ Suspended sediment/deposition; ▪ Indirect Pollution; ▪ Accidental Pollution; ▪ INNS; and ▪ Changes to physical processes	No potential for AEoI	No potential for AEoI
Marine Mammals				
Southern North Sea SAC	▪ Harbour porpoise	▪ Underwater noise; ▪ Vessel disturbance; ▪ Collision risk; ▪ Indirect pollution; ▪ Accidental pollution; and ▪ Changes to prey.	No potential for AEoI	No potential for AEoI
Humber Estuary SAC	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI	No potential for AEoI
Humber Estuary Ramsar	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI	No potential for AEoI
The Wash and North Norfolk Coast SAC	▪ Harbour seal (*Phoca vitulina*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI	No potential for AEoI

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	O&M	Decommissioning	Construction	O&M	Decommissioning
Bancs des Flandres SAC	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Doggersbank (Netherlands) SAC	▪ Harbour seal (*Phoca vitulina*); and ▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Klaverbak SCI	▪ Harbour seal (*Phoca vitulina*); and ▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Noordzeekustone SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
SBZ 1 SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
SBZ 2 SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
SBZ 3 SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Vlaamse Banked SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Vlakte van de Raan SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Voordelta SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Waddenzee SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Westerschelde & Saeftinghe SCI	▪ Grey seal (*Halichoerus grypus*)	▪ Underwater noise; ▪ Vessel disturbance; and ▪ Collision risk	No potential for AEoI			No potential for AEoI		
Offshore and Intertidal Ornithology								
Greater Wash SPA	▪ Common scoter; and ▪ Red-throated diver	▪ Disturbance and displacement	No potential for AEoI			No potential for AEoI		

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	O&M	Decommissioning	Construction	O&M	Decommissioning
North Norfolk Coast SPA	▪ Sandwich term	▪ Collision risk	No potential for AEoI			No potential for AEoI		
Flamborough and Filey Coast SPA	▪ Kittiwake; and ▪ Gannet.	▪ Collision risk	No potential for AEoI			▪ No potential for AEoI	▪ No potential for AEoI (gannet) ▪ Potential for AEoI (kittiwake)	▪ No potential for AEoI
	▪ Guillemot; ▪ Razorbill; ▪ Gannet; and ▪ Puffin.	▪ Disturbance and displacement	No potential for AEoI			No potential for AEoI		
Coquet Island SPA	▪ Sandwich tern ▪	▪ Collision risk	No potential for AEoI			No potential for AEoI		
	▪ Puffin	▪ Disturbance and displacement	No potential for AEoI			No potential for AEoI		
Farne Islands SPA	▪ Kittiwake	▪ Collision risk	No potential for AEoI			No potential for AEoI		
Scottish SPAs	▪ Gannet; and ▪ Kittiwake	▪ Collision risk	No potential for AEoI			No potential for AEoI		
	▪ Gannet; ▪ Guillemot; ▪ Razorbill; and ▪ Puffin	▪ Disturbance and displacement	No potential for AEoI			No potential for AEoI		
Migratory Fish								
Humber Estuary Sea SAC	▪ Sea lamprey *Petromyzon marinus*; and ▪ River lamprey *Lampetra fluviatilis*	▪ Underwater Noise	No potential for AEoI			No potential for AEoI		
River Derwent SAC	▪ River lamprey *Lampetra fluviatilis*	▪ Underwater Noise	No potential for AEoI			No potential for AEoI		

Table 13.2: Conclusions of the assessment for AEoI for all onshore receptor groups

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
Onshore Ecology								
Greater Wash SPA	▪ Non-breeding common scoter ▪ Breeding bird species: ▪ Sandwich tern; ▪ Common tern; and ▪ Little tern.	▪ Habitat loss; ▪ Disturbance of birds within the SPA; ▪ Pollution.	No potential for AEoI for little tern and sandwich tern; Further information required for common tern. No AEoI for common scoter from onshore elements of the Project.			No potential for AEoI for little tern and sandwich tern; Further information required for common tern. No AEoI for common scoter from onshore elements of the Project.		
The Wash SPA	▪ Bewick's swan (non-breeding); ▪ Pink-footed goose (non-breeding); ▪ Dark-bellied brent goose (non-breeding); ▪ Shelduck (non-breeding) ▪ Wigeon (non-breeding); ▪ Gadwall (non-breeding); ▪ Pintail (non-breeding); ▪ Common scoter (non-breeding); ▪ Goldeneye (non-breeding); ▪ Oystercatcher (non-breeding); ▪ Grey plover (non-breeding); ▪ Knot (non-breeding); ▪ Sanderling (non-breeding); ▪ Dunlin (non-breeding); ▪ Black-tailed godwit (non-breeding); ▪ Bar-tailed godwit (Non-breeding); ▪ Curlew (Non-breeding); ▪ Redshank (Non-breeding); ▪ Turnstone (Non-breeding); ▪ Common tern (Breeding); ▪ Little tern (Breeding); and	▪ Habitat loss; ▪ Disturbance of birds within and outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed once data is available.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
	▪ Waterbird assemblage							
The Wash Ramsar	▪ Criterion 1 – Saltmarshes, major intertidal banks of sand and mud, shallow water, and deep channels; ▪ Criterion 3 – inter-relationship between saltmarshes, intertidal sand, mudflats, and estuarine waters; ▪ Criterion 5 – Bird assemblages of international importance; ▪ Criterion 6 – Bird species/ populations occurring at levels of international importance: ▪ Species with peak counts in spring/autumn: ▪ Redshank; ▪ Curlew; ▪ Oystercatcher (wintering); ▪ Grey plover (wintering); ▪ Knot (wintering); and ▪ Sanderling. ▪ Species with peak counts in winter: ▪ Black-headed gull; ▪ Eider; ▪ Bar-tailed godwit; ▪ Shelduck; ▪ Dark-bellied brent goose; ▪ Dunlin; ▪ Pink-footed goose;	▪ Habitat loss; ▪ Disturbance of birds within and outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed once data is available.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
	▪ Golden plover; and ▪ Lapwing. ▪ Species with peak counts in spring/autumn: ▪ Black-tailed godwit; andRinged plover.							
The Wash and North Norfolk Coast SAC	▪ 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae); ▪ 1420 Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi); ▪ 1150 Coastal lagoons *Priority feature; and ▪ Otter.	▪ Loss of habitats present within the SAC; ▪ Disturbance to otter. ▪ Habitat loss for otter.	Further information and assessment required in relation to disturbance to otter and air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to disturbance to otter and air and water quality effects.	Further information and assessment required in relation to disturbance to otter and air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to disturbance to otter and air and water quality effects.
Gibraltar Point SPA	▪ Grey plover (Non-breeding); ▪ Sanderling (Non-breeding); ▪ Bar-tailed godwit (Non-breeding); and ▪ Little tern (Breeding).	▪ Habitat loss; ▪ Disturbance of birds outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure.	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed once data is available.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.
Gibraltar Point Ramsar	▪ Onshore Ramsar Features: ▪ Ramsar Criterion 1: Coastal habitats – estuarine mudflats, sandbanks, and saltmarsh; ▪ Ramsar Criterion 2: Red Data book invertebrates – including: ▪ *Haliplus mucronatus* (a water beetle, aquatic)	▪ Habitat loss; ▪ Disturbance of birds outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure. Further information is required to assess	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
	▪ *Brachytron pratense* (hairy dragonfly, aquatic) ▪ Ramsar criterion 5: Waterfowl. ▪ Ramsar criterion 6: Grey plover, sanderling, bar-tailed godwit, dark-bellied brent goose.		impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	once data is available.	supporting breeding populations for non-breeding qualifying features.	qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.		supporting breeding populations for non-breeding qualifying features.
Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC	▪ Annex I habitats: ▪ 2110 Embryonic shifting dunes; ▪ 2120 "Shifting dunes along the shoreline with *Ammophila arenaria* (""white dunes"")"; ▪ 2130 "Fixed coastal dunes with herbaceous vegetation (""grey dunes"")" Priority feature; ▪ 2160 Dunes with *Hippophae rhamnoides*; and ▪ 2190 Humid dune slacks.	Loss of habitats within the SAC, or reduction of habitat quality.	Further information and assessment required in relation to air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to air and water quality effects.	Further information and assessment required in relation to air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to air and water quality effects.
Humber Estuary SPA	▪ Bittern (non-breeding and breeding); ▪ Shelduck (non-breeding); ▪ Marsh harrier (breeding); ▪ Hen harrier (non-breeding); ▪ Avocet (non-breeding and breeding); ▪ Golden plover (non-breeding); ▪ Knot (non-breeding); ▪ Dunlin (non-breeding); ▪ Ruff (non-breeding);	▪ Habitat loss; ▪ Disturbance of birds outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure. Further information is required to assess impacts on qualifying	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed once data is available.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
	▪ Black-tailed godwit (non-breeding); ▪ Bar-tailed godwit (non-breeding); ▪ Redshank (non-breeding); ▪ Little tern (breeding); and ▪ Waterbird assemblage		features and potentially connected and supporting breeding populations for non-breeding qualifying features.		populations for non-breeding qualifying features.	and potentially connected and supporting breeding populations for non-breeding qualifying features.		populations for non-breeding qualifying features.
Humber Estuary Ramsar	Onshore Ramsar Features: ▪ Criterion 1- dune systems and humid dune slacks; ▪ Criterion 5 – assemblages of international importance (waterfowl, non-breeding season); ▪ Criterion 6 – species/populations occurring at levels of international importance: ▪ Shelduck; ▪ Golden plover; ▪ Knot; ▪ Dunlin; ▪ Black-tailed godwit; ▪ Bar-tailed godwit; and ▪ Redshank.	▪ Habitat loss; ▪ Disturbance of birds outside the SPA; ▪ Pollution; ▪ Air quality impacts.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species. Surveys are on-going for breeding bird species and the assessment will be completed once data is available.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss. Further information is required to assess impacts on qualifying features and potentially connected and supporting breeding populations for non-breeding qualifying features.
Humber Estuary SAC	▪ H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks; ▪ H1130. Estuaries; ▪ H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats; ▪ H1150. Coastal lagoons; ▪ H1310. Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand; ▪ H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); ▪ H2110. Embryonic shifting dunes	Pollution from site run-off affecting habitat quality (in-combination only).	Further information and assessment required in relation to air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to air and water quality effects.	Further information and assessment required in relation to air and water quality effects.	No potential for AEoI	Further information and assessment required in relation to air and water quality effects.

Designated Site	Relevant Features	Potential for Effect	Conclusion on Adverse Effect Alone			Conclusion on Adverse Effect In-combination		
			Construction	Operation	Decommissioning	Construction	Operation	Decommissioning
	▪ H2120. Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes); ▪ Shifting dunes with marram ▪ H2130. Fixed dunes with herbaceous vegetation (grey dunes); Dune grassland; and ▪ H2160. Dunes with *Hippophae rhamnoides*; Dunes with sea-buckthorn.							
North Norfolk SPA	Pink-footed goose	▪ Habitat loss; Disturbance of birds outside the SPA;	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.
North Norfolk Ramsar	Pink-footed goose	▪ Habitat loss; ▪ Disturbance of birds outside the SPA;	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss and locations for construction infrastructure.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.	No potential for AEoI for non-breeding species.	AEoI not likely – to be confirmed following refinement of Project design, notably confirmation of areas of habitat loss.

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