FIVE ESTUARIES
OFFSHORE WIND FARM

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ENVIRONMENTAL STATEMENT

VOLUME 5, REPORT 4: REPORT TO INFORM APPROPRIATE ASSESSMENT (CLEAN)

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In preparation of this document Five Estuaries Wind Farm Ltd has made reasonable efforts to ensure that the content is accurate, up to date and complete for purpose.

Revision	Date	Status/Reason for Issue	Originator	Checked	Approved
B	Oct-24	Deadline 1	GoBe	GoBe	VE OWFL

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FIGURES

DEFINITION OF ACRONYMS

Term	Definition
AA	Appropriate Assessment
AADT	Annual Average Daily Traffic
ADD	Acoustic Deterrence Device
AEoI	Adverse Effect on Integrity
AONB	Area of Outstanding Natural Beauty
AoS	Area of Search
BDMPS	Biologically Defined Minimum Population Scales
BEIS	Department for Business, Energy, and Industrial Strategy
BTO	British Trust for Ornithology
CBRA	Cable Burial Risk Assessment
CoCP	Code of Construction Practice
CGR	Counterfactual of Population Growth Rate
CfD	Contract for Difference
CI	Confidence Interval
CMS	Construction Methods Statement
CO	Conservation Objectives
CRM	Collision Risk Modelling
CSIP	Cable Specification and Installation Plan
CV	Coefficient of Variation
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DEP	Dudgeon Extension Project
DESNZ	Department for Energy Security and Net Zero
DML	Deemed Marine License
EACN	East Anglia Connection Node
EC	European Commission
ECC	Export Cable Corridor
ECOW	Ecological Clerk of Works

Term	Definition
EDR	Effective Deterrent Radius
EIA	Environmental Impact Assessment
EMF	Electromagnetic Frequencies
EPP	Evidence Plan Process
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
EUNIS	European Union Nature Information System
FCS	Favourable Conservation Status
FFC	Flamborough and Filey Coast
FID	Flight-Initiated Disturbance
FLL	Functionally Linked Land
GIS	Geographical Information Systems
GPS	Geographical Positioning System
GS	Grey Seal
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
HHA	Harwich Haven Authority
HHM SSSI	Holland Haven Marshes Special Site of Scientific Interest
HP	Harbour Porpoise
HPAI	Highly Pathogenic Avian Influenza
HRA	Habitats Regulation Assessment
HVAC	High Voltage Alternating Current
HS	Harbour Seal
IAQM	Institute of Air Quality Management
ICES	International Council on Exploration of the Sea
IFCA	Inshore Fisheries and Conservation Authority
IGE	Inner Gabbard East
IMO	International Maritime Organisation

Term	Definition
INIS	Invasive Non-Indigenous Species
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
IRZ	Impact Risk Zone
IWMF	Integrated Waste Management Facility
JNCC	Joint Nature Conservation Committee
KM	Kilometre
LSE	Likely Significant Effect
MCA	Maritime and Coastguard Agency
mCRM	Migratory Collision Risk Modelling
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
ML	Marine Licence
MLW	Mean Low Water
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MU	Management Unit
NE	Natural England
NF OWF	North Falls OWF
NRMM	Non-Road Mobile Machinery
NSIP	Nationally Significant Infrastructure Project
NVC	National Vegetation Classification
OESEA	Offshore Energy SEA
OLEMP	Outline Landscape and Ecological Management Plan
ONSS	Onshore Substation
OSP	Offshore Substation Platform
OWEZ	Offshore Windpark Egmond aan Zee
OWF	Offshore Wind Farm
PA 2008	Planning Act 2008

Term	Definition
PCW	Phocids
PEA	Preliminary Ecological Appraisal
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PTS	Permanent Threshold Shift
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
RIS	Ramsar Information Sheet
RLB	Red Line Boundary
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCA	Special Conservation Area
SCI	Special Conservation Interest
SCOS	Special Committee on Seals
SeaMaST	Seabird Mapping and Sensitivity Tool
SEI	Supplementary Environmental Information
SEL	Sound Exposure Level
SEP	Sheringham Shoal Extension Project
SIP	Site Integrity Plan
SMP	Seabird Monitoring Programme
SNCBs	Statutory Nature Conservation Bodies
SNS	Southern North Sea
SoS	Secretary of State
SOSS	Strategic Ornithological Support Services
SSC	Suspended Sediment Concentrations
SSSI	Site of Special Scientific Interest
SPA	Special Protection Area
SPP	Scour Protection Plan
STC	System-Operator Transmission-Owner Code
TCCs	Temporary Construction Compounds

Term	Definition
TCE	The Crown Estate
TJB	Transition Joint Bay
TTS	Temporary Threshold Shift
UNCLOS	The United Nations Convention on the Law of the Sea
UXO	Unexploded Ordnance
VE	Five Estuaries
VE OWFL	Five Estuaries Offshore Wind Farm Limited
VERs	Valued Ecological Receptors
VHF	Very High Frequency
VMP	Vessel Management Plan
WeBS	Wetland Bird Survey
WTG	Wind Turbine Generator
ZoI	Zone of Influence

GLOSSARY OF TERMS

Term	Definition
VE	The Project. Refer to as Five Estuaries Offshore Wind Farm (VE) and refer to VE thereafter.
The Applicant	Refer to as Five Estuaries Offshore Wind Farm Limited (The Applicant) and refer to them as 'the Applicant' thereafter.
EIA	Environmental Impact Assessment
PEIR	Preliminary Environmental Information Report. The PEIR was written in the style of a draft Environmental Statement (ES) and formed the basis of statutory consultation. Following that consultation, the PEIR documentation has been updated into the final ES that is accompanying the application for the Development Consent Order (DCO).
ES	Environmental Statement (the documents that collate the processes and results of the EIA).
HRA	Habitats Regulations Assessment. HRA is the process, not to be confused with the RIAA, which is the document.
Critical Level	The concentration of an air pollutant above which adverse effects on ecosystems may occur based on present knowledge.
Critical Load	Deposition flux of an air pollutant below which significant harmful effects on sensitive ecosystems do not occur, according to present knowledge.
Array areas	The areas where the WTGs will be located. These should be referred to as the northern and southern arrays to differentiate them.
Export Cable Corridor (ECC)	The area(s) where the export cables will be located. Refer to either the offshore or onshore ECC.
Onshore ECC	The Onshore ECC is the working area for the onshore cable construction
Landfall	The area where the Export Cables come ashore and transition from the marine environment to the terrestrial environment.
Essex County Council	The councils name should be written in full and capitalised. N.B. All council names should be spelt in full.

Term	Definition
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial, resulting from the activities associated with the construction, operation and maintenance, or decommissioning of the project.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact in question with the sensitivity of the receptor in question, in accordance with defined significance criteria.
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.
Maximum Design Scenario (MDS)	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Development Consent Order	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 the Department for Energy Security and Net Zero (DESNZ).
Substation Zone	The area in which the final onshore substation (OnSS) footprint will be located.
TCC	Temporary Construction Compounds (TCC) associated with onshore cable works.
code	The new NGET substation. This will be subject to a separate DCO application submitted by NGET as part of a wider NGET DCO project (Norwich to Tilbury HV network reinforcement).
AoS	Area of Search
AONB	Area of Outstanding Natural Beauty
Cefas	Centre for Environment, Fisheries and Aquaculture Science (NB: Cefas is an acronym but is commonly pronounced as a word so is not capitalised)
Ons	Code of Construction Practice
Defra	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero

Term	Definition
HDD	Horizontal Directional Drilling is a trenchless crossing technique.
NF OWF	North Falls Offshore Wind Farm
Norwich to Tilbury HV network reinforcement	Norwich to Tilbury high voltage network reinforcement (Formally East Anglia Green Energy Enablement (GREEN)), part of The Great Grid Upgrade.
nm	Nautical mile
OnSS	Onshore Substation
OSP	Offshore Substation Platform
PINS	The Planning Inspectorate
Order Limits	The extent of development including all works, access routes, TCCs, visibility splays and discharge points. (Not Red Line Boundary (RLB))
SSC	Suspended Sediment Concentration
TJB	Transition Joint Bay, where the offshore cables are jointed to the onshore circuits
Trenchless crossing technique	In most instances where a crossing constraint is encountered a trenchless crossing technique, such as HDD (or another trenchless crossing techniques) will be used.
UXO	Unexploded Ordnance (not UXB)
WTG	Wind Turbine Generator

1 EXECUTIVE SUMMARY

1.1.1 This document comprises the Report to Inform Appropriate Assessment (RIAA) for the Five Estuaries Offshore Wind Farm (OWF), (hereafter referred to as VE) which is a proposed extension project to the operational Galloper OWF off the southeast coast of England. VE is a Nationally Significant Infrastructure Project (NSIP) under Section 15(3) of the Planning Act 2008 (as amended) (PA 2008) and therefore consented through a Development Consent Order (DCO). The Applicant for the DCO is Five Estuaries Offshore Wind Farm Limited (hereafter 'the Applicant').

1.1.2 This RIAA has been drafted to provide the Secretary of State (SoS) with the information necessary to undertake a Habitats Regulations Assessment (HRA) as part of the determination process for the DCO for VE. As such, this RIAA (and associated appendices) presents the potential for the proposed project to cause a Likely Significant Effect (LSE), and where an LSE cannot be ruled out, whether an Adverse Effect on Integrity (AEoI) can be ruled out for the project alone and in-combination with other plans and projects.

1.1.3 This document is structured to align with the HRA process, including relevant information used in the assessment.

1.1.4 The screening section of the report provides a summary of the LSE screening phase undertaken for VE, with full details of the screening presented within the updated HRA screening report, submitted alongside the RIAA.

1.1.5 Those sites (which include transboundary sites) for which an LSE cannot be screened out, have been subsequently taken forward for further consideration of the potential for an AEoI. A summary of the site information for those sites is presented in Section 10 and Volume 5, Report 4, Annex 4.4 of the RIAA, with this information (designated features, status of the site, status of the features) being used to inform the assessment of potential effects from VE alone and in-combination with other plans and projects.

1.1.6 The assessment of the potential for an AEoI is carried out in two parts, the first being an assessment of the potential for the VE development alone to result in an adverse effect, drawing on the Maximum Design Scenario (Section 7.4) for VE. The assessment alone (presented in Section 11) does consider mitigation (as detailed in Section 8) and is able to conclude that there would be no AEoI as a result of the construction, operation and decommissioning from VE alone. There is also no AEoI during the construction, operation and decommissioning of VE in-combination with other plans and projects for all designated sites, apart from two sites during operation:

- Alde-Ore Estuary SPA - lesser black-backed gull (*Larus fuscus*) feature (collision during the Operation & Maintenance (O&M) phase); and
- Alde-Ore Estuary Ramsar - lesser black-backed gull (*Larus fuscus*) feature (collision risk during the O&M phase).

1.1.7 It is therefore VE's position that there is a requirement to progress beyond HRA Stage 2, based on a RIAA conclusion of an AEoI for the Alde-Ore Estuary SPA and the Alde-Ore Estuary Ramsar. In response to consultation undertaken (Section 6) and in line with the requirements of PINS Advice Note Ten[1], the Applicant has provided a 'shadow' Derogation Case (Volume 5, Report 5: HRA Derogation Case). This document provides the necessary information to inform the SoS's HRA derogation process, as required under Article 6(4) of the Habitats Directive.

1.1.8 Due to the disparate location of VE's proposed compensatory measures for *Larus fuscus,* an additional HRA has been commissioned for that part of the project and annexed to this report (Volume 5, Report 4, Annex 5: Lesser Black Backed Gull Compensatory Area Habitats Regulation Assessment).

1.1.9 While the Applicant has conceded an AEoI for the Alde-Ore Estuary SPA and Ramsar site, the shadow HRA derogation case also includes consideration of the Flamborough and Filey Coast SPA (FFC SPA) for kittiwake (*Rissa tridactyla*), razorbill (*Alca torda*) and guillemot (*Uria aalge*) features, and the Margate and Long Sands SAC for sandbank features. Although this RIAA concludes no AEoI for these sites, they are included in the shadow HRA derogation case, on a 'without prejudice' basis, in the event that the Secretary of State (SoS) were to disagree with these conclusions.

1.1.10 The shadow HRA derogation case and supporting documents have been prepared and submitted with the RIAA. These documents do not form part of the RIAA and instead provide the necessary information for the next stages of the HRA process (as referenced in Section 4.6 of this report).

[1] https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-ten/

2 INTRODUCTION

2.1.1 This document has been produced to inform the HRA process for VE. It provides information to enable the competent authority (in this case the SoS for Department for Energy Security and Net Zero (DESNZ)), to undertake an appropriate assessment (AA) of VE with respect to its potential to have an AEoI on European and Ramsar sites of nature conservation importance, alone or in-combination.

2.2 BACKGOUND TO THE PROJECT

2.2.1 VE will be situated approximately 37 km from the Suffolk coastline (at its closest point) see Figure 2.1, and will consist of the following:

- Northern and southern array areas (collectively known as the array areas);
- An offshore Export Cable Corridor (ECC) within which micrositing of the offshore export cable will take place; and

2.2.2 Onshore Order Limits which encompass the landfall, onshore Export Cable Corridor (onshore ECC) two Substation Search Areas (SSAs) (including the final Onshore Substation (OnSS) and the Temporary Construction Compounds (TCCs).

2.2.3 A proposed maximum of 79 Wind Turbine Generators (WTGs) will be installed within the array areas, with a minimum blade tip height above mean high water spring (MHWS) of 28 m and a maximum blade tip height above MHWS of 395 m. Electricity generated will be transported to the coastline via a maximum of 200 km of inter-array cables and up to 196 km of offshore export cables, each in their own trenches within the overall offshore ECC. Where the offshore export cables make landfall, the onshore export cables will continue to transport electricity underground to the OnSS which will connect to the National Grid's East Anglia Connection Node (EACN).

360000
380000
400000
420000
440000
5780000
5760000
5740000
5720000
N

LEGEND

- Project Order Limits
- Galloper OWF

0 2.5 5 10
Kilometers

Data Sources:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Five Estuaries Order Limits

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 2.1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:400,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

2.3 PURPOSE OF THE RIAA

2.3.1 The Habitats Regulations guidance on the assessment of plans and projects significantly affecting Natura 2000 sites, identifies a staged process to the assessment. Together, these stages are referred to as the HRA, in order to clearly distinguish the whole process from the second stage within it, which is referred to as the AA.

2.3.2 This report, together with the HRA Screening Report (Volume 5, Report 4.2 HRA Screening Report), (hereafter referred to as the 'Screening Report') provides information relevant to the consultation process for VE, by providing the information required for an HRA to be carried out for the project.

2.3.3 This document has been produced as part of the overall HRA process for VE and draws on the Screening Report. Screening was originally undertaken in 2021 and issued to consultees in September 2021. Consultation was undertaken at the Preliminary Environmental Impact Report (PEIR) stage, and the document was further updated to align with the ES. A summary of the consultation process to date (including post-screening) with detail on comments received and how/ where these are addressed is provided in Section 6 of the Screening Report and Section 6 of this report.

2.3.4 This document summarises the conclusions on the potential for a LSE, as concluded in the Screening Report with respect to the conservation objectives of the screened in European and Ramsar sites. Where potential for LSE cannot be ruled out this report determines the potential for an AEoI alone and/ or in-combination to occur as a result of VE.

2.3.5 Due to the disparate location of VE's proposed compensatory measures for lesser black-backed gull (*Larus fuscus*), an additional HRA has been commissioned for that part of the project and annexed to this report (Volume 5, Report 4, Annex 5: Lesser Black Backed Gull Compensatory Area HRA).

2.4 PROJECT LITERATURE

2.4.1 This RIAA has not been prepared in isolation, but instead follows a suite of documents prepared as part of the Environmental Statement (ES). Key documents issued 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 here. For ease of reference, and to minimise repetition, the main sources of project literature (including relevant ES chapters, technical reports etc.) for the current report are as follows:

- Volume 6, Part 1, Chapter 1: Introduction;
- Volume 6, Part 1, Chapter 2: Policy and Legislation;
- Volume 6, Part 1, Chapter 4: Site Selection and Consideration of Alternatives;
- Volume 6, Part 2, Chapter 1: Offshore Project Description;
- Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes;
- Volume 6, Part 2, Chapter 4: Offshore Ornithology;
- Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology;

- Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology;
- Volume 6, Part 2, Chapter 7: Marine Mammal Ecology;
- Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation;
- Volume 6, Part 3, Chapter 9: Airborne Noise and Vibration;
- Volume 6, Part 3, Chapter 10: Air Quality;
- Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report;
- Volume 6, Part 5, Annex 4.1: Offshore Ornithology Technical Report;
- Volume 6, Part 5, Annex 4.2: Seabird Abundance by Month;
- Volume 6, Part 5, Annex 4.3: Seabird Densities by Month;
- Volume 6, Part 5, Annex 4.4: Seabird Abundances by Survey;
- Volume 6, Part 5, Annex 4.5: Seabird Densities by Survey;
- Volume 6, Part 5, Annex 4.6: Seabird Peak Seasonal Abundances;
- Volume 6, Part 5, Annex 4.7: Seabird Peak Seasonal Densities;
- Volume 6, Part 5, Annex 4.8: Collision Risk Modelling Inputs and Outputs;
- Volume 6, Part 5, Annex 4.9: Seabird Distributions Recorded in Aerial Surveys;
- Volume 6, Part 5, Annex 4.10: CRM Comparison of Modelling Results;
- Volume 6, Part 5, Annex 4.11: Design Based Bootstrap Variance Estimates;
- Volume 6, Part 5, Annex 4.12: Digital Video Aerial Surveys of Seabirds and Marine Mammals at VE Annual Report March 2010 to February 2021;
- Volume 6, Part 5, Annex 4.13: Digital Video Aerial Surveys of Seabirds and Marine Mammals at VE Annual Report March 2019 to February 2020;
- Volume 6, Part 5, Annex 4.14: Migratory Bird Collision Risk Modelling;
- Volume 6, Part 5, Annex 4.15: Apportioning Note;
- Volume 6, Part 5, Annex 4.16: Population Viability Analysis
- Volume 6, Part 5, Annex 6.1: Fish and Shellfish Ecology Technical Baseline Report;
- Volume 6, Part 5, Annex 6.2: Underwater Noise Technical Assessment; and
- Volume 6, Part 5, Annex 7.1: Marine Mammals Baseline Characterisation.

2.4.2 It is noted in Advice Note 10 (PINS, 2022) that the Environmental Impact Assessment (EIA) and HRA apply differently to decision making, with the ES informing the decision (its findings must be taken into consideration) whereas the DCO can only be made if the decision-maker has followed the stages prescribed by the Habitats Regulations 2017 (see Section 4.6). Therefore, the information contained in the above chapters and documents has been used to inform the assessments made here in the RIAA, but with the RIAA following the prescribed stages and with the distinct legal and evidentiary requirements of the Habitats Regulations followed.

2.5 IMPLICATIONS OF PREVIOUS DECISIONS

2.5.1 Several OWF projects have been granted a DCO by successfully going through the derogation process following a conclusion by the SoS that AEoI could not be ruled out. The first OWF project in the UK whose HRA required progression beyond 'Stage 2' was Hornsea Project Three (Hornsea Three), and it was granted development consent on the 31 December 2020. The AEoI identified from Hornsea Three was on kittiwake at the FFC 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.'

2.5.2 Subsequent to the Hornsea Three decision, several other OWF projects have been consented with similar compensation requirements for ornithology (as a result of in-combination collision mortalities) and/or subtidal sandbank habitats (as a result of the project alone and in-combination permanent loss associated with cable protection), including Norfolk Boreas, Norfolk Vanguard, East Anglia ONE North, East Anglia Two, Hornsea Four, and Dudgeon and Sheringham Extension Projects (Table 2.1). These projects were given development consent on the 10 December 2021, the 11 February 2022, the 31 March 2022 (both East Anglia projects), the 12 July 2023, and the 17 April 2024 respectively.

2.5.3 These projects all identified the following AEoIs:

- Norfolk Boreas and Norfolk Vanguard:
  - lesser black-backed gulls at the Alde-Ore Estuary SPA/Ramsar;
  - kittiwake at the FFC SPA; and
  - Annex 1 reef and sandbank at the Haisborough, Hammond and Winterton SAC.
- Hornsea Four :
  - kittiwake and guillemot at the FFC SPA.
- East Anglia ONE North: and East Anglia Two:
  - lesser black-backed gull at the Alde-Ore Estuary/Ramsar;
  - kittiwake at the FFC SPA; and
  - red-throated diver at the Outer Thames Estuary SPA/Ramsar.
- Dudgeon and Sheringham Extension:
  - kittiwake and guillemot at the FFC SPA; and
  - sandwich tern at both the North Norfolk Coast and Greater Wash SPA.

2.5.4 As was the case for Hornsea Three, Norfolk Boreas, Norfolk Vanguard, East Anglia ONE North, East Angila Two, Hornsea Four, and Dudgeon and Sheringham Extensions 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.'

2.5.5 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 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.'

2.5.6 Paragraph 17.56 of the East Anglia ONE North Decision letter;

'The Secretary of State is satisfied that the necessary compensatory measures to ensure that the overall coherence of the National Site Network can be secured with regards to The Flamborough and Filey Coast SPA kittiwake feature; and the Alde-Ore Estuary SPA lesser black-backed gull feature.'

2.5.7 paragraph 17.56 of the East Anglia Two Decision letter;

The Secretary of State is satisfied that the necessary compensatory measures to ensure that the overall coherence of the National Site Network can be secured with regards to The Flamborough and Filey Coast SPA kittiwake feature; and the Alde-Ore Estuary SPA lesser black-backed gull feature.

2.5.8 paragraph 7.18 of the Hornsea Four SoS Decision letter;

'Having considered the overall planning balance, and having concluded that it is possible to secure a package of measures that would provide compensation for the effects of the Proposed Development and to ensure the overall coherence of the UK NSN, the Secretary of State concludes that the significant benefits associated with the Proposed Development in contributing to the urgent need for low-carbon energy infrastructure of the type proposed outweigh the harms identified, and therefore concludes that consent should be granted to the Proposed Development.'

2.5.9 and paragraphs 7.7 and 7.8 of the Dudgeon and Sheringham Extensions SoS decision letter;

'The Secretary of State has concluded that it is possible to secure a package of measures that would provide compensation for the effects of the Proposed Development and to ensure the overall coherence of the UK NSN (see section 5 above and the HRA that has been published alongside this letter).

For the reasons given in this letter, the Secretary of State concludes that the benefits of the Proposed Development outweigh its adverse impacts and that the requirements of the Habitats Regulations are met.'

2.5.10 These projects were 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.

2.5.11 Additionally, the Round 4 Plan HRA undertaken by The Crown Estate (TCE) concluded an AEoI for kittiwake for the FFC 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.

2.5.12 Further, the SPAs for which compensation has been required (for the above three OWF proposals) have direct relevance to VE, given the potential connectivity between the site features and the location of the array areas. For SACs, relevance is inferred given that the subtidal sandbank habitat is common between the sites listed in Table 9.1 and Margate and Long Sands SAC (see Sections 9.1 and 9.2).

2.5.13 Given the precedent set by these projects, as presented in Table 14.1 and the conclusions drawn within this RIAA, the project has drafted a shadow HRA derogation case. This case is presented for the lesser black-backed gull feature of the Alde-Ore Estuary SPA and Ramsar site as a conceded case based on the conclusion of AEoI, however the case is presented on a **without prejudice** basis for the guillemot, razorbill and kittiwake features of the FFC SPA, and sandbank feature of the Margate and Long Sands SAC sites.

Table 2.1 Projects consented with ecological compensation requirements of relevance to VE[2]

Project	Ornithology			Benthic	
	Flamborough and Filey Coast SPA	Alde-ore Estuary SPA and Ramsar	Outer Thames Estuary SPA	Wash and North Norfolk Coast SAC	Haisborough, Hammond and Winterton SAC
Hornsea Three	Kittiwake (collision mortalities in-combination)	-	-	Sandbank (habitat loss, alone and in-combination)	-
Hornsea Four		-	-	-	-
Norfolk Boreas		Lesser black-backed gull (collision mortalities in-combination)	-	-	Sandbank (habitat loss, alone and in-combination)
Norfolk Vanguard			Red throated diver (disturbance/displacement, in-combination)	-	-

[2] Relevance taken as either VE connectivity with site or similarity of features

Project	Ornithology			Benthic	
Dudgeon and Sheringham Extensions	Kittiwake (collision mortalities in-combination)	-	-	-	-

3 STRUCTURE OF THE RIAA

3.1.1 This document is set out in several stages that mirror the HRA process, with the overall structure of the document summarised below:

- Section 1: Executive Summary. Providing a high-level overview of the report;
- Section 2: 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 3: Structure of the RIAA. Providing an overview of the structure of the document and section headings;
- Section 4: 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 5: Roles and Responsibilities. Identifying key individuals and organisations with a role in the HRA process;
- Section 6: Consultation. Summarising the consultation undertaken, with whom, when, the issues raised, how and where these have been addressed. Including the Evidence Plan and the need for transboundary consultation;
- Section 7: Project Overview. Drawing on the information presented in relevant chapters of the ES, providing the maximum design scenario for each receptor group including temporal and spatial aspects;
- Section 8: Mitigation. To include project specific mitigation included per receptor group;
- Section 9: HRA Screening. Summarising the conclusions of screening;
- Section 10: Summary of Designated Sites. Summarising site-specific information for all designated sites screened in;
- Section 11: Assessment of Adverse Effect Alone. Determination of whether the project alone will result in an adverse effect;
- Section 12: Assessment of Adverse Effect In-Combination. Determination of whether the project in-combination with other plans and projects will result in an adverse effect;
- Section 13: Transboundary Statement;
- Section 14: Conclusion of the Assessment. Summarising the conclusions on adverse effect, alone and/ or in-combination; and
- Section 15: References.

4 LEGISLATION AND POLICY GUIDANCE

4.1 LEGISLATIVE CONTEXT AND GOVERNMENT POLICY

4.1.1 The Habitats 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 the 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 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'.

4.1.2 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, with waters beyond 12 nm, to the extent of the British Fishery Limits and UK Continental Shelf Designated Area, covered under The Conservation of Offshore Marine Habitats and Species Regulations 2017 (collectively referred to here 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.

4.1.3 UK Government policy (ODPM Circular 06/2005) states that internationally important wetlands designated under the Convention on Wetlands 1971, called the Ramsar Convention (Ramsar sites) are afforded the same protection as SPAs and SACs for the purpose of considering development proposals that may affect them. The Government also affords the same level of protection to potential SPAs (pSPAs) and candidate SACs (cSACs) and to sites identified, or required, as compensatory measures for adverse effects on any of the above sites, through planning policy such as the National Planning Policy Framework.

4.1.4 Further guidance can be found within the UK National Policy Statements (NPSs). These are statements produced by DESNZ which form the basis of policies relating to the mitigation of, and adaption to, climate change. There are 6 Energy NSPs:

- Overarching NPS for Energy (EN-1);
- NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2);
- NPS for Renewable Energy Infrastructure (EN-3);
- NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4);
- NPS for Electricity Networks Infrastructure (EN-5); and
- NPS for Nuclear Power Generation (EN-6).

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

4.2 EU EXIT REGULATIONS

4.2.1 The UK left the European Union (Brexit) on Exit Day, 31 January 2020, followed by Completion Day on 31 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 VE (noting that the HRA process will now look to the National Site Network and not Natura 2000).

4.3 ENERGY ACT 2003

4.3.1 The UK Energy Bill was introduced into the House of Lords in July 2022, resulting in the Energy Act 2023, which gained royal assent on 26 October 2023.

4.3.2 Part 13 Chapter 1 covers offshore wind electricity generation, enabling the delivery of strategic compensation for adverse environmental effects, the marine recovery fund, and the potential to amend the approach to the assessment of adverse effects.

4.4 CASE LAW AND RECENT EXAMPLES

4.4.1 Specific case law of note includes recent rulings by the European Court of Justice (ECJ), referred to here as Sweetman II or 'People over Wind', and Holohan. The People over Wind ruling relates 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 these rulings have been taken into consideration during preparation of the Screening Report and the RIAA.

4.4.2 Additionally, as discussed in Section 2.5 recent consents awarded to five offshore wind projects (Hornsea Project Three, Norfolk Boreas, Norfolk Vanguard, East Anglia ONE North and East Anglia TWO) have included decisions of relevance to the VE project.

4.5 GUIDANCE DOCUMENTS

4.5.1 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 overall guidance on the 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 RIAA. This includes documents specific to individual topics (and that may be applied to technical reports and / or ES chapters that underpin the RIAA) up to and including documents that advise on overall HRA process. Some of the key guidance documents considered are listed below:

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

4.6 THE HRA PROCESS

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

4.6.2 PINS Advice Note 10 (PINS, 2022) 'Habitat Regulations Assessment relevant to national 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 European site. HRA includes a three-stage process, as summarised below:

- 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 of a European site to ascertain if the proposal will adversely affect the integrity of a European site;
- HRA Stage 3 - Derogation: Where it cannot be ascertained that the proposal will not adversely affect the integrity of a European site, alternative solutions must be considered. 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 IROPI. The final part of Stage 3 is the consideration of whether adequate compensatory measures can be secured.

4.6.3 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 1), has been completed for VE alone and a summary of the conclusions are presented in Section 9. Where the Screening process concludes the potential for a LSE, then there is a requirement for an AA (Stage 2). Stage 1 Screening for VE has identified the possibility of LSE for certain features and effects. The required Stage 2 AA will be conducted by the SoS, with the information necessary to inform that assessment provided here in the RIAA.

4.6.4 The integrity of a site has been defined in guidance as the coherence of the site's main ecological structure and function across the whole of its area, which enables it to sustain the habitat, complex of habitats and/ or populations of species for which the site has been designated (EC, 2001). An AEoI is likely to be one which prevents the site from meeting its conservation targets and making the same contribution to favourable conservation status as it did at the time of designation.

4.6.5 PINS Advice Note 10 (PINS, 2022) includes a number of points to be considered at Stage 2 and as such they have been considered in this RIAA. These are defined as follows (including the section where each is considered):

- Evidence about the project's impacts on the integrity of protected sites (consideration of adverse effect alone is presented in Section 11);
- A description of any mitigation measures proposed which avoid or reduce each impact, and any residual effect (mitigation measures, which apply to the assessment of integrity but not during screening, are set out in Section 8 and

throughout Sections 11 and 12, with conclusions on adverse effect summarised in Section 14);

- 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 8 and throughout Sections 11 and 12), with conclusions on adverse effect summarised in Section 14);
- Identification of any factors that might affect the certainty of mitigation implementation;
- A statement as to which (if any) effects constitute an adverse impact on the integrity of European 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 Section 14); and
- Evidence to demonstrate that the Applicant has fully consulted and had regard to comments received by the relevant Statutory Nature Conservation Bodies (SNCBs) during pre-application consultation (consultation is described in Section 6).

4.6.6 Stage 3 is only required where a conclusion of AEoI is drawn following Stage 2.

5 ROLES AND RESPONSIBILITIES

5.1.0 As established, the purpose of a RIAA is to provide the information to the Competent Authority (in this case the SoS for DESNZ), incorporating the outcome of consultation with the relevant SNCBs (in this case Natural England and Joint Nature Conservation Committee (JNCC)). 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. Wider consultation (including the role of the Evidence Plan Process (EPP)) is discussed below in Section 6.3.

6 CONSULTATION

6.1 CONSULTATION SUMMARY

6.1.1 Extensive consultation has been ongoing for VE, with the Scoping Report and Habitat Regulations Assessment (HRA) Screening Report publicly issued in October 2021. Therefore, consultation was undertaken specifically regarding the HRA process. All relevant stakeholders who were issued the Scoping Report and Screening Report in October 2021 are listed below:

- Centre for Environment, Fisheries and Aquaculture Science (Cefas);
- East Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB);
- East Suffolk County Council;
- Environment Agency;
- Essex County Council;
- Essex Wildlife Trust;
- Marine Management Organisation (MMO);
- Natural England (NE);
- NatureScot;
- Royal Society for the Protection of Birds (RSPB);
- Suffolk County Council;
- Suffolk Wildlife Trust;
- Tarmac Marine;
- Tendring District Council; and
- The Wildlife Trust.

6.1.2 Of the above, NatureScot noted that they do not intend to provide a response and the following consultees made general, non-technical comments only on the HRA Screening Report and/ or deferred to NE:

- MMO;
- Suffolk County Council;
- East Suffolk Council;
- Environment Agency.

6.1.3 Consultation on the Scoping Report and Screening Report (complete, with all comments received and how these have been taken into account) is summarised in Table 5.1 to Table 5.6 of the HRA Screening Report. For brevity, the information presented in those tables is not repeated here.

6.1.4 Meetings of the HRA-relevant Expert Topic Groups (ETG) complete, with all comments received until PEIR are summarised and considered within the following relevant aspect chapter tables (and are also not repeated here):

- Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes;
- Volume 6, Part 2, Chapter 4: Offshore Ornithology;
- Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology;

- Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology;
- Volume 6, Part 2, Chapter 7: Marine Mammal Ecology;
- Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation.

6.1.5 Consultation since the Preliminary Environmental Information Report (PEIR) included the above consultees. With regard to Onshore Biodiversity and Nature Conservation NE were the only consultee with further comments relevant to this topic. A summary of the comments from NE is provided in Table 6.1 below:

6.2 TRANSBOUNDARY CONSULTATION

6.2.1 PINS Advice Note 10 (PINS 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…'*. That position was reiterated by Department of Energy and Climate Change (DECC) in their 2016 guidance on transboundary impacts on Natura 2000. DECC (2016) went on to say that *'the format and extent of transboundary consultation is for the applicant to agree with the Planning Inspectorate'*.

6.2.2 The RIAA (and Screening Report) provides the information necessary for transboundary consultation on HRA matters for the application, initially through the identification of transboundary sites (see those listed in Table 9.1) where potential Likely Significant Effect (LSE) applies in relation to the Project alone in the Screening Report, followed by consideration of potential LSE in-combination (drawing on recent Examination stages of similar projects in the region and the transboundary projects identified during that process) and the determination of adverse effect alone and/ or in-combination made here within the RIAA.

6.3 THE EVIDENCE PLAN PROCESS

6.3.1 The Evidence Plan Process (EPP) has been managed through a series of ETG meetings. These have been incorporated into this report and the topic specific PEIR chapters and supporting appendices on which the RIAA draws (Section 2.4) and have therefore been considered during the preparation of the RIAA where relevant.

6.3.2 To date, consultation with regards to HRA has been undertaken via ETG meetings under the EPP, described within Volume 6, Part 1, Chapter 3: EIA Methodology of the ES, with various meetings held in October 2020, and throughout 2021-2023. Furthermore, consultation has been carried out through formal submission of the VE Scoping Report. Feedback received through this process has been considered in preparing the HRA documents where appropriate and the topic specific PEIR chapters and supporting appendices on which the RIAA draws (Section 2.4).

6.3.3 The responses received from stakeholders with regards to HRA matters are summarised in Table 6.1, including details of how these have been taken account of. Additional topic specific consultation detail is available in each respective ES chapter.

6.3.4 Consultation has continued to be carried out through the EPP, up until DCO application submission, and will continue as required post-application.

Table 6.1 Summary of consultation relating to HRA

Date and consultation phase/type	Consultation and key issues raised	Comment
February 2020 Pre-scoping ETG meeting	NE advise to utilise the Woodward ., (2019) mean-maximum foraging ranges in the HRA Screening report.	Recommended methodology used
	It was agreed to consider colony specific data where it is available in addition to the Woodward ., (2019) ranges within the RIAA.	Noted and implemented.
	The proposed methodology for the HRA screening of fish was agreed.	Noted and proceeded on this basis.
November 2021 Essex County Council Scoping Opinion	*'We would welcome early sight of the PEA wintering bird surveys to inform the scope of the project level Report to Inform an Appropriate Assessment (Shadow HRA) in relation to any functionally linked land for the coastal SPA & Ramsar sites, particularly at Hamford Water.'*	The results of onshore wintering bird surveys completed are summarised in ES Volume 6, Part 3, Chapter 4: Onshore Biodiversity, Section 4.8, with further details provided in ES Volume 6, Part 5, Annexes 4.6, 4.10, 4.11 and 4.12.
November 2021 PINS Scoping Opinion	*'The ES must describe all the individual forms of damage identified which would lead to significant effects on designated sites.'*	Designated sites and the potential pathways for likely significant effect are identified in Table 9.1.
November 2021 Essex County Council Scoping Opinion	*'The brackets at the end of 3.6.3 listing key project parameters should also list that HDD will be used under Holland Haven Marshes SSSI (as stated in 19.5.7).'*	HDD will be used under Holland Haven Marshes SSSI (Section 11.4).
December 2021	It was agreed that the proposed approach for quantifying displacement of seabirds will utilise the	Agreement on this displacement impact assessment methodology has been reached

Date and consultation phase/type	Consultation and key issues raised	Comment
Post-scoping ETG meeting	Statutory Nature Conservation Bodies (SNCB) metric (% displacement x % mortality).	during the consultation process. Methodology is described in ES Volume 6, Part 2 Chapter 4: Offshore Ornithology Section 4.11.
	British Trust for Ornithology (BTO) flight data will be used to inform the Collision Risk Modelling (CRM).	The Option 2 variant of the Band (2012) model has been used for calculating collision rates, which uses BTO flight data. This is consistent with the Natural England (2022a) Interim Advice on updated Collision Risk Modelling parameters.
	Migrant collisions will be considered using the BTO tool produced for the SOSS-05 BTO report (Wright ., 2012)	Potential impacts on migrants, in relation to SPA populations, have been assessed in the RIAA.
December 2021 Post scoping ETG	The potential for barrier effects will be assessed within the marine mammal assessment of disturbance and displacement effected.	Barrier effects have been scoped in, see ES Volume 6, part 2 Chapter 7 Marine Mammal Ecology, Section 7.11.
	The potential for Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) arising from operational noise will be assessed.	Operational noise impacts have been assessed, see ES Volume 6, Part 2, Chapter 7 Marine Mammal Ecology, Section 7.12.
February 2021 Marine Ecology & Processes ETG	It was requested that biotope codes should be converted to the European Union Nature Information System (EUNIS) equivalent.	EUNIS biotopes have been recorded using the new 2022 biotope codes (EUNIS, 2022).
November 2021 MMO, Scoping Opinion	MMO raised concerns regarding the offshore cable route having a small overlap with the Margate and Long Sands SAC. They confirmed that a small adjustment to the route would prevent any overlap with the site if practicable.	The Project has considered the guiding principles of site selection using a proportionate approach taking into account all relevant constraints, see ES Volume 6, Part 1, Chapter 4: Site selection and Alternatives.

Date and consultation phase/type	Consultation and key issues raised	Comment
		The conservation objectives for all designated sites are referred to within this RIAA, however, due to the small footprint of VE, no AEoI is predicted. VE have progressed a without prejudice derogation case for this site, including compensation options for potential impacts to the features of the Margate and Long Sand SAC. Furthermore, ES Volume 6, Part 2, Chapter 5: Benthic Ecology, Section 5.10 and 5.11 provides a thorough assessment of the impacts to protected features. This impact has been screened into the RIAA (Section 11)
November 2021 NE, Scoping Opinion	NE advised for the impact of accidental pollution to be scoped into the HRA assessment due to regular pollution reports concerning leaks and spillages from support vessels and Wind Turbine Generators (WTGs).	This impact has been screened into the RIAA (Section 11).
November 2021 NE, Scoping Opinion	NE stated that for all Annex I habitats there must be clear demonstration of how impacts will be avoided, reduced, and mitigated. In addition, cable protection should also be avoided in areas identified for reef	Pre-construction surveys will be undertaken to determine the location, extent and composition of any habitats of principal importance and/or Annex I and impacts to the features will be avoided as far as reasonably

Date and consultation phase/type	Consultation and key issues raised	Comment
	management. There will need to be an assessment of the impacts for Margate and Long Sands SAC.	practicable. VE have progressed a without prejudice derogation case for this site, including compensation options for potential impacts to the features of the Margate and Long Sand SAC. ES Volume 6, Part 2, Chapter 5: Benthic Ecology, Section 5.10 and 5.11 provides a thorough assessment of the impacts to protected features. The assessment of Margate and Long Sands SAC is presented within Section
November 2021 NE, Scoping Opinion	NE advised the assessment to include impacts on SPA designations where the benthic habitats serve as supporting habitats for SPA bird features, including the Outer Thames Estuary SPA as several of the supporting habitats for Red-throated diver are present within the Area of Search (AoS).	An assessment of SPA designations with regards to the benthic habitats acting as supporting habitats for bird features has been included in ES Volume 6, Part 2, Chapter 5: Benthic Ecology, Section 5.10 and 5.11. The Outer Thames Estuary (OTE) SPA is assessed within Section 11.4.

Date and consultation phase/type	Consultation and key issues raised	Comment
November 2021 NE, Scoping Opinion	NE is happy to see the clarification regarding the approach that will be used in generating the design-based abundance/density estimates, 95% confidence intervals and levels of precision that will be used in impact assessments. NE is satisfied with the method proposed for calculating the 95%confidence intervals in the method statement. The values from this method should be presented alongside the values using the HiDef transect based approach to clearly see how they differ. NE request confirmation in writing from HiDef that this approach is appropriate for their survey data.	Noted. Methodology for calculating density and abundance is presented in Volume 6, Part 5, Annex 4.1: Offshore Ornithology Technical Report. Confirmation from HiDef relating to the appropriateness of approach was provided on 24 March 2022 via email (and reproduced in the Ornithology Method Statement).
	NE welcomes the use of adjustment rates for adjusting availability bias for auks.	This process has been used for estimating abundance and densities of auk species for the purposes of assessment (see Volume 6, Part 5, Annex 4.1: Offshore Ornithology Technical Report for details).
	Assessment of effects Natural England recommends the use of the stochastic CRM for the basic model (i.e. Options 1 and 2), but not the extended model (Options 3 and	Option 2 of the Band (2012) model has been used to estimate the collision rates for all species (see ES Volume 6, Part 5, Annex 4.3: Offshore Ornithology Collision Risk Modelling

Date and consultation phase/type	Consultation and key issues raised	Comment
	4), as there are no agreed upon suitable avoidance rates for the extended, stochastic model. If the deterministic model is to be used, NE recommends that uncertainty around key input parameters is captured by undertaking multiple runs.	for details). The largest contributor to variation in collision estimates is seabird density, which typically has a CV (coefficient of variation) an order of magnitude greater than those for bird dimensions and flight speed and four orders of magnitude greater than that due to variation in avoidance rates. Therefore, since variations in collision predictions are overwhelmingly due to variations in seabird density only that measure has been used to derive upper and lower estimates in the collision modelling.
	Species biometric values for seven species are laid out in the Natural England (2022) Best Practice for Data Analysis document (gannet, kittiwake, lesser black-backed gull, herring gull, greater black-backed gull, little gull, sandwich tern). The values match those contained in Table 1 of the Method Statement, except the flight speed of little gull, where NE recommends the use of 12.2. For the species not included in the Best Practice document, the BTO values are suitable for the CRM.	The species' biometrics used for collision risk calculations are consistent with those recommended by Natural England (2022), including for little gull. See Table 20 of ES Volume 6, Part 5, Annex 4.8: Collision risk modelling inputs and outputs for details.
	NE recommends following the guidance for displacement matrices laid out in the Natural England (2022) Best Practice for Data Analysis document.	The Natural England (2022) matrix-based methodology for assessing displacement impacts has been used. ES Volume 6, Part 2, Chapter 4: Offshore Ornithology Section 4.11.
June 2022	The findings of the SPA review should be fully taken into account for any surveys or decisions associated	HDD will be used under Holland Haven Marshes SSSI. Great Holland Pits LoWS will

Date and consultation phase/type	Consultation and key issues raised	Comment
RSPB response to Preliminary Ecological Appraisal (PEA) consultation	with the VE potential cable route. Holland Haven Marshes SSSI and Great Holland Pits LoWS should be avoided where possible. Main concerns relate to direct loss and disturbance of this habitat and its dependent species.	be avoided. Effects on SPA bird species have been considered within ES Volume 6, Part 3, Chapter 4: Onshore Biodiversity, Section Sections 4.11 to 4.14 and in this RIAA (Sections 11.6 and 12.6).
June 2022 NE response to PEA consultation	NE advised consideration of potential impacts to functionally linked habitats supporting SPA species.	Effects on SPA bird species have been considered within ES Volume 6, Part 3, Chapter 4: Onshore Biodiversity, Section Sections 4.11 to 4.14 and in this RIAA (Sections 11.6 and 12.6).
November 2022 Pre-PEIR onshore ecology ETG	With respect to SPA bird species NE reiterated that the: *'onshore scoping area should be based on the potential for species to be present in the area, the Impact Risk Zone (IRZ) for designated sites, ecology, and a consideration of FLL.'*	Effects on SPA bird species have been considered within ES Volume 6, Part 3, Chapter 4: Onshore Biodiversity, Section Sections 4.11 to 4.14 and in this RIAA (Sections 11.6 and 12.6).
November 2022 Pre-PEIR onshore ecology ETG	NE has concerns regarding the location of the landfall HDD) compound in close proximity to Holland Haven Marshes Special Site of Scientific Interest (HHM SSSI), which supports wintering and breeding birds and Fisher's Estuarine Moth, which are designated features of nearby SAC, and SPA/Ramsar sites. We advise that the landfall compound should be sited to cause the least disturbance to these designated features and any impacts avoided or mitigated. Furthermore, careful consideration should be given to seasonal	Landfall is located away from Holland HHM SSSI in the final route decision. Scenario 1 is that the same Temporary Construction Compounds (TCCs) and haul roads are used for NF OWF and VE undertakes additional onshore cable trenching and ducting works for NF OWF. This will reduce construction activities across the two projects.

Date and consultation phase/type	Consultation and key issues raised	Comment
	sensitivities of waterbirds using HHM SSSI and adjacent areas throughout the year. We also advise that, now that the landfall zone has been selected and the onshore cable corridor refined, the assessment in the ES /RIAA should be updated to reflect this selection/refinement. Lastly, we encourage VE to continue exploring options for sharing and aligning construction activities and infrastructure onshore with North Falls, as far as is reasonably practicable, in order to minimise environmental impacts and disturbance to sensitive habitats, species and soils.	
Section 42 Comments RSPB 15/06/2023	RSPB note the conclusion that the potential for an adverse effect on integrity (AEOI) for Lesser Black Backed Gulls (LBBGs) from the Alde-Ore Estuary Special Protection Area (SPA) cannot be ruled out. Given the assessment presented in the RIAA and its supporting documents and the conclusions of the Secretary of State in respect to other OWFs in regard to this species and linkages to the Alde-Ore Estuary SPA, it is their position that the proposal would cause an AEOI. They would welcome clarification from VE that we accept that an AEOI cannot be ruled out. In this context, RSPB request further engagement on the development of the required compensation measures for LBBGs.	VE acknowledge that an AEOI cannot be ruled out for lesser black-backed gull and as such have submitted a full derogation case.
Section 42 Comments RSPB	The aim of the pre-application phase should be to secure any compensation measure, not only to	Noted, VE have sought to progress and secure compensation measures as far as

Date and consultation phase/type	Consultation and key issues raised	Comment
15/06/2023	develop the proposal. This includes relevant licences and consents to provide the necessary confidence to the Examining Authority and, subsequently, Secretary of State. RSPB request that there are detailed discussions on how the compensation requirements are calculated in order to reach agreement in advance of an application being submitted.	possible during the pre-application phase, whilst ensuring the option to use strategic and/or collaborative compensation measures is retained. We are in on going engagement with the RSPB on the compensation measures.
Section 42 Comments RSPB 15/06/2023	RSPB are broadly content with the selection of predator fencing as a possible compensation option to explore further.	Noted and further discussions and agreement through the ETG and stakeholder meetings have been undertaken.
Section 42 Comments RSPB 15/06/2023	RSPB consider the habitat creation option should explicitly be expanded to include habitat restoration (and possibly shift emphasis to this depending on local circumstances). They consider habitat restoration in areas currently occupied by LBBGs to have a greater chance of more predictable success than de nouveau habitat creation. They request scientific evidence on the use of habitat creation as a specific LBBG conservation measure to inform whether or not this is appropriate to rely on as a compensation measure.	Noted, the compensation measures now refer to habitat restoration rather than creation. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	The consideration of potential compensation locations (for either approach) should examine all potential limiting factors to successful breeding and recruitment operating at the location. This is to ensure critical factors are not missed by a focus only	Site selection has also looked into factors restricting breeding and recruitment at sites outside of AOE SPA after advice from Natural England/RSPB at the ETG/stakeholder meetings. Through this process a potential

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	on predation or the availability of suitable habitat. In this context, the use of predator fencing as a compensation measure for the Norfolk Projects, EA1N and EA2 is not yet proven to succeed and did not take account of other factors limiting breeding success in the Alde-Ore Estuary SPA.	compensation measure at Outer Trial Bank (OTB) has been identified and included within the application. Nonetheless, it is considered that predator control at AOE SPA remains a suitable compensation measure for VE. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document.
Section 42 Comments RSPB 15/06/2023	Site selection will need to give careful consideration to avoiding conflicts with other nature conservation interests, especially those for which, for example, a SSSI or SPA may have been designated.	Noted, the site selected at the AOE SPA have been chosen after consultation with landowners/managers and site surveys. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	RSPB raise concerns over the ability to calculate the benefit of each of these measures, especially habitat creation, given the lack of detailed research in this area.	Noted, habitat creation will be removed as a measure. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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		& Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	The spatial approach to the search hierarchy should be revisited to consider giving greater priority to locations that do not expose any breeding LBBGs arising from the compensation measure to the same or similar risk of collision with offshore windfarms. For this reason, RSPB question the removal of potential locations on the basis of low or no connectivity with the Alde-Ore Estuary SPA.	Noted, following advice at the ETG other sites away from the AOE SPA have been considered with a proposed measure at OTB included in the Application as well as the measure at the AOE. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	RSPB would welcome greater pre-application engagement on LBBG compensation in general given our experience in managing colonies of this species. This would include engagement on selection of measures, potential locations, design, management, monitoring and adaptive management.	Noted, RSPB have been consulted during the planning of the compensation measure for both AOE and OTB.

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Section 42 Comments RSPB 15/06/2023	Adaptive management should be linked to possible risks of failure associated with the specific measure in the chosen location and be ecologically credible and appropriate.	Noted, adaptive management measures have been included. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Plans for monitoring and adaptive management should be prepared during the pre-application phase as part of the application, to be incorporated into an implementation and monitoring plan as part of the application.	Noted, adaptive management plans have been included in the IMP. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	The use of shelters and rafts as possible compensation measures should be ruled out as unproven, unless VE are able to provide substantial scientific evidence that demonstrates their effectiveness for LBBG.	Noted, use of shelters and rafts has not been considered. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB	RSPB request that any approach to RSPB reserves for up-to-date information is made centrally via the	Noted.

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15/06/2023	lead RSPB contacts on the Five Estuaries project. This is to ensure appropriate co-ordination of an RSPB response. We will then undertake to contact relevant site managers.	
Section 42 Comments RSPB 15/06/2023	RSPB note the conclusion in this paragraph that the potential for an adverse effect on integrity (AEOI) for Lesser Black Backed Gulls (LBBGs) at the Alde-Ore Estuary SPA cannot be ruled out. Given the assessment presented in the RIAA and its supporting documents and the conclusions of the Secretary of State in respect to other OWFs in regard to this species and linkages to the Alde-Ore Estuary SPA, it is our position that the proposal would cause an AEOI. They would welcome clarification from VE that the project accept that an AEOI cannot be ruled out. This would be in line with a similar approach adopted by other developers in relation to in-combination impacts on kittiwakes from the Flamborough and Filey Coast SPA in light of the Secretary of State's conclusions on previous developments.	VE acknowledge that an AEOI cannot be ruled out for lesser black-backed gull and as such has prepared a full derogation case.
Section 42 Comments RSPB 15/06/2023	RSPB note the conclusion in this paragraph that in the event the Secretary of State is minded to confirm a DCO for the project that derogation would be required and compensatory measures provided. It is their position that effective compensatory measures would be required to be secured, and they discuss further below the suitability of the currently	Noted, compensatory measures have been secured as far as possible prior to submission, with input from stakeholders.

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	suggested compensatory measures. RSPB would welcome further engagement on this.	
Section 42 Comments RSPB 15/06/2023	The final stage is not to “develop” compensation measures but to “secure” compensation measures. This is a significant difference in approach and level of requirement prior to any application.	Noted, VE have secured compensation measures as far as possible prior to submission.
Section 42 Comments RSPB 15/06/2023	As noted in RSPB comments on the RIAA above, they request clarification over whether Five Estuaries adopt the position that recent developers have with kittiwakes and Flamborough and Filey Coast SPA and accept that an in-combination AEOI cannot be ruled out for LBBG and the Alde-Ore Estuary SPA and therefore that compensation is required? This would remove any uncertainty on this aspect in future discussions. Currently, paragraph 1.1.5 is couched in terms of “likely to be” AEOI in line with conclusions in the RIAA.	VE acknowledge that an AEOI cannot be ruled out for lesser black-backed gull and as such have prepared a full derogation case.
Section 42 Comments RSPB 15/06/2023	RSPB note the conclusions of the shortlisting exercise for compensation options (presumably with Natural England), which has concluded that the main options are: - Predator exclusion fencing around existing colony; and - Habitat creation (with emphasis on land adjacent to the SPA). They accept that appropriate predator fencing is proven to be an effective method in reducing predation of breeding LBBGs i.e. in an appropriate	Noted, habitat restoration rather than creation is the measure that has been taken forward. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.

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	location where predation has been proven to be a limiting factor. However, they would welcome further information on the evidence base in respect of habitat creation as a method to increase breeding populations of LBBG (as opposed to other species) in a predictable manner. This could be in the form of specific case studies that set out where, when and how habitat creation has been targeted at breeding LBBG, the rate of colonisation, breeding success and recruitment.	
Section 42 Comments RSPB 15/06/2023	RSPB note that calculating the compensation requirement is to be based on demographic data from Horswill and Robinson (2015). While this is a good starting point, they strongly recommend local information is used where possible to make the calculation as location specific as possible. For example, the RSPB has productivity information for the LBBG colony at Havergate Island in the Alde-Ore Estuary SPA. They request that there are detailed discussions on how the compensation requirements are best calculated so that agreement can be reached in advance of DCO submission.	Noted, local demographic data from nearby colonies have been considered in the compensation requirements. See Chapter 6, Part 5, Annex 4.15: Apportioning Note.
Section 42 Comments RSPB 15/06/2023	RSPB consider important additional context has been omitted from this section. It should include information that several of the UK's major LBBG SPA colonies have suffered significant declines i.e. the Alde-Ore Estuary SPA, Morecambe	Noted, more up to date information has been obtained.

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	Bay and Duddon Estuary SPA and Bowland Fells pSPA colony. The first two are c.90% declines. Bowland is recovering now that culling has paused, but up to date information on its current status is required. They recommend obtaining up to date information on the current status of the Ribble Estuary SPA/Ramsar site from Natural England who manage the National Nature Reserve which supports the SPA colony.	See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	This focuses solely on conclusions in Davis *et al* (2018) that relate to predation. That same report also considered other potential limiting factors at each colony, variously including cattle, habitat quality, disturbance in addition to mammalian predation.	Noted, all relevant factors have been considered. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	As each colony will have its own set of limiting factors, it is important to take a rounded approach to ensure all such factors are known and, in this context, the relative importance of predation understood. Otherwise, it would be possible to miss a more important limiting factor e.g. food supply.	Noted, all relevant factors have been considered. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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Section 42 Comments RSPB 15/06/2023	The precedent of Norfolk Projects and EA1N/2 should not be relied on at this point in time as it is premature. Fencing has only been installed in early spring 2023 so it is still in its first season. The RSPB has made clear in its various submissions to those schemes that there are other factors at play in the Alde-Ore Estuary in addition to predation, and set out its concerns that a narrow focus on predation may not be enough. For example, productivity at Havergate Island has declined in recent years and predation and habitat quality/availability are not limiting factors at that site. This is in addition to the ongoing concern that the compensation for the Norfolk Projects and EA1N/2 is located in an area known to expose breeding LBBG to collision risk with offshore wind farms.	Noted, all relevant factors have been considered during the pre-implementation phase. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document Compensation measures are recommended to have connectivity to the affected SPA, hence the locations of the sites selected in relation to the AOE SPA.
Section 42 Comments RSPB 15/06/2023	RSPB understand the challenge with obtaining up to date colony counts. They are conscious that the results of the most recent national seabird census should be made available later this year. When this information is available it should be used to update relevant colony counts to give an up to date understanding of the conservation status of each.	Colony count data has been updated following the most recent census being made available. Table 11.12, Table 11.26outline the most recent colony counts used.
Section 42 Comments RSPB 15/06/2023	RSPB request that any approach to RSPB reserves for up-to-date information is made centrally via the lead RSPB contacts on the Five Estuaries project to ensure appropriate co-ordination of an RSPB	Noted.

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	response. We will then undertake to contact relevant site managers.	
Section 42 Comments RSPB 15/06/2023	2.4.3.1 & 2.4.3.3: RSPB recommend that any such review needs to request information on any other factors thought to be limiting breeding success and colony size at the relevant location, in addition to predation. This will ensure all factors are considered in subsequent site selection stages as predation may not be the critical limiting factor at the colony level.	Noted, consultation with stakeholders has been carried out throughout the process.
Section 42 Comments RSPB 15/06/2023	2.4.3.3: factors to be considered in assessing feasibility should also include relevant consents and licences to install fencing as this will be central to identifying any potential showstoppers or causes of significant delay. This should not be left to Stage 5 (2.4.3.5).	Noted, the compensation measure is included with the Applicant's DCO order limits, providing the necessary security of deliverability. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	2.4.3.4: RSPB question the ability easily to quantify the expected benefit of any such proposal as (i) there is little research on these measures in respect of fledging, recruitment etc; (ii) any benefit will be highly site specific and (iii) needs detail on all current pressures etc affecting breeding success including food supply etc.	Noted, consultation with stakeholders will be carried out when producing the implementation monitoring plan post-consent.

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Section 42 Comments RSPB 15/06/2023	Compensation for breeding seabirds due to offshore wind farm impacts challenges the normal spatial search hierarchy for compensation due to the strong likelihood of ongoing exposure to the same adverse impacts. Therefore, RSPB question the priority being placed on compensation proximity to the Alde-Ore Estuary SPA given that it is proximity of the SPA to the offshore wind farms that is giving rise to an AEOI and the need for compensation due to collision risk. Further discussion is needed on this, as priority arguably should be given to locations that are NOT within Mean-Max Foraging Range (MMF)/MMF+1SD of any offshore wind farms. If this is not possible (i.e. all locations are at risk), then the impact of those offshore wind farms on a potential compensation location would need to be built into the compensation requirement calculations.	Connectivity to the effected SPA has been key to previous measures and advice. A site away from the AOE SPA has been selected as an alternative compensation measure alongside the AOE site. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document and Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Stakeholder engagement The RSPB would welcome greater pre-application engagement by the Applicant on this and its other LBBG compensation issues given our experience with managing SPA colonies for this species and dealing with the various pressures they face.	Noted, RSPB has attended ETGs and stakeholder meetings.
Section 42 Comments RSPB 15/06/2023	The RSPB would welcome involvement in pre-application development of the monitoring plan in respect of both this and the habitat creation measure.	Agreed, although it is now a habitat restoration measure rather than creation.

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Section 42 Comments RSPB 15/06/2023	The RSPB recommends that an adaptive management plan is developed in the pre-application phase as part of the application to be incorporated into the implementation and monitoring plan with the application documents. Adaptive management measures should be linked to the possible risks of failure with the particular measure and be ecologically credible and appropriate. Therefore, we question the role of bycatch reduction as listed. Greater monitoring should form part of the monitoring plan aspects rather than being seen as an adaptive management measure. Unless built in as an integral part of the measure itself, breeding habitat creation would be a de nouveau compensation measure in the context of predator management and therefore should not be seen as an adaptive management measure in this context. With respect to the Marine Recovery Fund, it is currently unclear how this fund will operate and whether any measures implemented under it will be relevant to the delivery of LBBG compensation.	Noted, adaptive management plan has been considered in the implementation and monitoring plan. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Suggest title explicitly extends consideration to include habitat restoration where there is a need for improved management of existing, degraded habitat, including if the current management is unsuitable e.g. through excess grazing. Restoration	Agreed and amended. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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	is mentioned later, but it would be useful to be more explicit on scope in the title.	
Section 42 Comments RSPB 15/06/2023	RSPB strongly question the role of artificial shelters for this species and recommend it is withdrawn. We cannot perceive of a conservation benefit. To the RSPB's knowledge: - The use of shelters for LBBG chicks has not been tested; - Shelters would only be relevant if predation is by a species that cannot get under shelters. As LBBG chicks get quite big it is likely that any shelter of a suitable size for LBBG chicks would be vulnerable to likely predators which would be strong enough to flip it over; - Shelters work for the smaller terns as they protect them from relevant predators that are not able to flip the shelter. You suggest that published evidence of artificial shelters for this species is "limited". Could you provide the references to the evidence you have discovered for review?	Agreed, reference to shelters removed. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	A particular issue (common to this and predator fencing) is the quality of the available food supply to support the proposed increase in colony. Therefore, an understanding of current productivity should be a starting point and critical analysis of the potential reasons for limited breeding success at a	Agreed, local and recent productivity levels have been assessed. Compensation requirements have been assessed on two fronts, using national productivity rates (Horswill *et al*) and local productivity rates from the AOE SPA.

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	site in case this points to reasons in addition to existing habitat quality and/or availability.	
Section 42 Comments RSPB 15/06/2023	Same concerns as per para 2.4.5.	As above.
Section 42 Comments RSPB 15/06/2023	Same comment as per para 2.4.9.	As above.
Section 42 Comments RSPB 15/06/2023	Same comments as per monitoring section in section 2.	As above.
Section 42 Comments RSPB 15/06/2023	The RSPB recommends that an adaptive management plan is developed in the pre-application phase as part of the application to be incorporated into the implementation and monitoring plan with the application documents. Adaptive management measures should be linked to the possible risks of failure with the particular measure and be ecologically credible and appropriate.	Adaptive management measures are outlined in the LBBG IMP. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Depending on the local situation, it is probable that predator fencing would be required anyway to improve the likelihood of success of a habitat creation/restoration measure.	Agreed, amended. See Environmental Statement: Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.

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Section 42 Comments RSPB 15/06/2023	With regard to connectivity of the listed sites to the Alde-Ore estuary, consideration should be made of the natal philopatry and breeding site fidelity of Lesser Black-Backed Gull, both of which will vary on a site by site basis and will influence the propensity of the birds to colonise a potential compensation area. This will also influence whether any birds that do breed at a compensation site will return to breed there in subsequent seasons and whether any chicks fledged there subsequently return to breed. As such, a review of any available information should be carried out.	Available information has been reviewed. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	As set out in RSPB's comments on the Ecological Evidence note, the RSPB raises a concern regarding the focus on connectivity to the Alde-Ore Estuary SPA. While proximity to the adversely effected SPA is the normal starting point for a compensation measure, that must be approached with major caution in the context of a development (Offshore Wind Farm) which will place any such breeding birds at risk of the same collision as has given rise to the need for compensation. Careful consideration should be given to giving greater weight to areas with no or low risk of collision with OWFs (if such exist).	Another site away from the AOE SPA, Outer Trial Bank, has also been included following the site-selection process. Site surveys were carried out at Steepholm as well but deemed to be less suitable than the AOE and OTB sites. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.

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Section 42 Comments RSPB 15/06/2023	RSPB would welcome clarification of the exclusion of sites on the basis of “no connectivity”. Is this tied to connectivity to the Alde-Ore Estuary SPA? For reasons set out elsewhere, we consider this raises concerns as this may be too restrictive in searching for potential locations that reduce the risk of birds being exposed to offshore wind collision.	Following consultation sites with little or no connectivity have been considered. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Careful consideration will need to be given to avoiding conflicts with other nature conservation interests e.g. increase in predation risk to breeding avocets etc at RSPB Boyton Marshes reserve (established to support SPA species displaced from RSPB Havergate by the LBBG colony displaced from Orfordness). RSPB raise serious questions over the reference to the use of rafts and consider it should be deleted. Based on considerable experience, we are confident that LBBGs do not use rafts. The species closely associated with the use of rafts are Common Terns and Black-headed Gulls.	Noted, sites have been selected to avoid conflict where possible. Noted, the use of rafts has been removed.
Section 42 Comments RSPB	Agree. SPA colony is in process of recovery so not suitable.	Noted.

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Section 42 Comments RSPB 15/06/2023	Agree - not suitable.	Noted.
Section 42 Comments RSPB 15/06/2023	As LBBG is not a qualifying species of this SPA (or the underlying SSSI) the creation of nesting habitat creation within the SPA (and SSSI) would not be related to site management. This raises a red flag in terms of potentially damaging impacts on existing SPA/SSSI habitat for existing qualifying interests. RSPB note the age of the data relating to breeding LBBG within Hamford Water. The latest information we have been able to source is from the Essex Bird Report 2018, which notes that there was no detailed count but that 213 nests were detected in a mixed colony with Herring Gulls. This suggests the species has declined in this location. Re the Bathside Bay Container Terminal Little Oakley compensation site: the priority here is for non-breeding waterbird interest and, in respect of benefits to breeding birds, species of priority within the context of the Hamford Water SPA/SSSI e.g. ringed plover. Therefore, encouragement of breeding LBBG would be inappropriate,	Noted, Hamford Water SPA is no longer considered. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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	notwithstanding the lack of confidence in ensuring LBBG colonisation of habitat in a new area.	
Section 42 Comments RSPB 15/06/2023	Without specific detail on the areas of land adjacent to the SPA being considered, it is difficult to comment. However, in respect of farmland adjacent to the SPA, it is important to note that this SPA is one of those identified in the 2016 UK SPA Review for boundary review in respect of adjacent farmland that supports SPA species. Therefore, any such land could be considered potential SPA land and measures affecting it would likely require appropriate assessment.	Noted, this site no longer being considered. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB 15/06/2023	Low potential is agreed, but on the basis that the SPA colony has access to suitable habitat already.	Noted.
Section 42 Comments RSPB 15/06/2023	RSPB assume this is within the Solway Flats and Marshes SPA/Ramsar site. Based on previous consideration of this site for another reason, we consider this should be kept on the list of potential options. The existing colony has suffered significant historic declines (likely due to an inappropriate grazing regime) and may be worth investigating further to understand the reasons for those declines and the potential to restore it.	Noted, other locations discussed during the ETG and deemed more suitable than this location. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments RSPB	We assume the reference to “the bank” is to the Outer Trial Bund which current supports somewhere between 1,000-3,000 pairs each of LBBG and	Noted, following stakeholder discussions with Natural England and the RSPB this site has

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15/06/2023	Herring Gull. Based on our understanding, we are not aware of any additional management measures that would increase the numbers of LBBG breeding in this location. Any proposal to increase the population of LBBG within The Wash SPA/Ramsar site would need to be assessed for its potential impacts on breeding SPA interests including Common Tern and Little Tern, as well as SSSI features.	been taken forward as a possible location for compensation measures See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Lesser Black-backed Gulls are adaptable, occupying a variety of natural and urban habitats. Predation and food availability are the key drivers of population changes and distribution. Avoiding predation affects colony location in particular, and perhaps also the habitat selection of the nest site within the colony. Food availability will influence whether breeding takes place (through the condition of the adult female) and is also important in determining the outcome of the breeding attempt. Breeding is often in mixed colonies with Herring Gulls. *Larus fuscus graellsii* is the subspecies present in the UK.	Noted.
Section 42 Comments RSPB 15/06/2023	Nest sites • Nests are generally located on a solid surface, usually on the ground although sometimes on flat or gently sloping roofs, especially those topped with shingle or colonised by lichens and mosses (Rock 2005). Both coastal and inland sites are used.	Noted, this information was used to help in the site selection and habitat restoration measures.

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	• Habitat at the nest site can vary from open rock, shingle, bare peat or roof, where nests are very visible, to rank vegetation or even bushes. However, dense vegetation is more usually avoided and areas of taller vegetation within a colony are associated with indicators of lower-quality adults suggesting these are less-preferred areas. The most-preferred breeding sites are open with surrounding vegetation (Kim and Monaghan 2005) which may combine the advantages of an open aspect (visibility of potential predators and a drier, sunnier microclimate) with shelter and hiding-places for the chicks once mobile. • A successful colony needs to be safe from flooding (climate-change related increases in storm frequency and sea level rise are affecting colonies such as the Ribble Estuary. Gavin Thomas pers. comm.	See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Predators • site selection by Lesser Black-backed Gulls suggests that areas inaccessible to ground predators are particularly important as colony sites e.g. offshore islands, inland freshwater bodies, cliffs, roofs of buildings (Mitchell *et al*. 2004, Sellers and Shackleton 2011). Foxes caused the abandonment of many coastal colonies on the Dutch coast, driving colonisation of inland sites (Gyimesi *et al*. 2016). Introduced American Mink Mustela vison are considered an important cause of chick mortality	Noted, this information was used to help in the site selection and habitat restoration measures. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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	(Varty and Tanner 2009b) and illicit an attacking response, indicating a threat to chicks and eggs but not to adults (Clode . 2000). • High productivity is reported from studies of urban-nesting gulls (Rock 2005) where roof top nest sites are likely to be free from most predators (although they may be subject to human interventions).	& Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments RSPB 15/06/2023	Food availability • A generalist and opportunistic feeder, Lesser Black-backed Gulls will forage on fishery discards and at rubbish tips (Gyimesi *et al*. 2016) as well as crustaceans and molluscs from the intertidal zone (swimming crabs have been found to be an important at some colonies, Schwemmer and Garthe 2005), terrestrial invertebrates including earthworms (Coulson and Coulson 2010) and small mammals (which may be scavenged rather than hunted, Alfarwi pers. comm.; Gyimesi *et al*. 2016) and birds, especially unfledged chicks of other seabirds (pers. obs). When food availability is low, Lesser Black-backed Gulls will predate chicks of conspecifics (Gareth Fisher pers. comm.). • There is evidence of individual specialization in the use of different food resources (Tyson *et al*. 2015) and also of differences between males and females, with the larger males, spending more time offshore and foraging at fishing trawlers (Camphuysen *et al*.	Noted, this information was used to help in the site selection and habitat restoration measures. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.

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	2015). 14 • There are reports of increasing numbers of Lesser Black-backed Gulls following tractors, e.g. spreading muck and slurry or cutting silage (Gavin Thomas pers. comm.), while supplementary feeding of livestock also presents an opportunity for gulls. Tracking data shows significant use of open-air pig units in some areas (Aaron Howe pers. comm.). • Colonies with access to a variety of food resources are more likely to be resilient to short- and long-term changes in accessibility to particular types of food. • Chicks are preferentially fed high-quality food items such as crustaceans and fish discards, and when access to these is reduced and lower-quality food is fed to chicks, productivity is sometimes seen to be reduced (Perrins and Smith 2000), although other studies have also found good productivity in terrestrially-feeding birds (Gyimesi *et al*. 2016). • Lesser Black-backed Gulls have been found to feed more at sea than other sympatric gull species (Kubetzki and Garthe 2003; Kim and Monaghan 2006) and are known to be capable of long foraging flights, tracking data indicating a maximum off-shore foraging distance of 533 km (Woodward *et al*., 2019), however time spent away from the colony reduces nest attendance and increases the risk of chicks being predated or chilled (Bukacińska . 1996). • Urban-nesting gulls appear to often forage outside	

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	towns, and it appears that for some, landfill sites are an important foraging resource (Rock 2005). • Botulism, often associated with rubbish tips in warm weather, is not uncommon among Lesser Black Backed Gulls (Mitchell *et al*. 2004) and is linked to some historic population declines such as in the Severn Estuary Region in the late 1970s (Rock 2005). Dependence on low quality food resources such as rubbish tips is likely to make populations more vulnerable to this and other toxins.	
Section 42 Comments RSPB 15/06/2023	Disturbance • Human activity can deter Lesser Black-backed Gulls from using a breeding site, particularly if the presence is persistent or accompanied by destruction of nests and eggs or killing adults (Calladine *et al*. 2006). • Exploitation and persecution by humans is thought to have depressed the population historically, until protective legislation was introduced in the 20th century (Mitchell *et al*. 2004).	Noted, this information was used to help in the site selection and habitat restoration measures. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document. & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments Natural England 28/08/2023	Natural England are concerned that the daily threshold for the SNS SAC is predicted to be exceeded for concurrent piling as well as due to two concurrent high order UXO clearances. Therefore, they are unable to conclude no Adverse Effect on Integrity (AEoI) from the project alone without mitigation being presented and secured.	The mitigation used within the RIAA is the outline piling and UXO MMMPs and the SIP, which have been developed and submitted alongside the ES. All relevant mitigation to ensure no AEoI is detailed within the two outline MMMPs and the SIP. However, it is worth noting that detail around UXO (and

Date and consultation phase/type	Consultation and key issues raised	Comment
	Consequently, they advise that, as a minimum requirement for addressing alone and in-combination impacts, appropriate mitigation should be discussed and agreed through the evidence plan process to ensure that the project alone will not exceed the daily threshold.	therefore the outline UXO MMMP) is provided for information only and is not being licenced within this application. Text has been added to clarify within Section 11 and 12.
Section 42 Comments Natural England 28/08/2023	Natural England advise that habitat loss needs to be included as an impact pathway for all relevant sites. There is a clear overlap with the Southern North Sea Special Area of Conservation (SNS SAC). Habitat loss should be taken through to the Appropriate Assessment stage unless a clear justification can be made that there would be no Likely Significant Effect (LSE) either alone, or in-combination with other projects with footprints within the SNS SAC.	Habitat loss has been added to the RIAA for harbour porpoise at the SNS SAC. Please see Section 9.
Section 42 Comments Natural England 28/08/2023	Natural England provided a number of comments on the Preliminary Environmental Impact Report (PEIR) Volume 6, Part 2, Chapter 7: Marine Mammal Ecology and Underwater noise modelling report and until those comments are addressed, they are not able to agree on the conclusions of the Adverse Effect on Integrity (AEoI) assessments which are based on the information from these reports.	Volume 6, Part 2, Chapter 7: Marine Mammal Ecology has been updated following Natural England comments, and the authors/ technical specialists of the marine mammals chapter have reviewed the RIAA to ensure any relevant comments and changes from the PEIR chapter to ES are reflected in the RIAA throughout.
Section 42 Comments Natural England 28/08/2023	Natural England is concerned with the undeveloped and high-level nature of documents relating to compensatory measures. They highlight the significant difficulties experienced by other projects where compensatory measures have been required.	Noted, the compensatory measures have progressed and details are provided in the application documents.

Date and consultation phase/type	Consultation and key issues raised	Comment
	Designing and siting measures, securing tenure, regulatory or other third-party agreements as well as evidencing likely effectiveness all present significant challenges. Their experience is that there is generally insufficient time to adequately shape, finalise and secure compensatory measures during Examination. Leaving key details regarding the nature, location and implementation of the measures until the Examination could carry a significant consenting risk. Consequently, we advise the Project to use the expert topic group (ETG) meeting process to advance development of compensatory measures prior to submission.	
Section 42 Comments Natural England 28/08/2023	Natural England question the validity of the methodology applied to apportion lesser black-backed gull (LBBG) to Special Protection Area (SPA) colonies during the breeding season. They have concerns regarding the use of the NatureScot (2018) apportioning methodology in all instances, and instead advocate drawing upon multiple sources of information (e.g. tracking data). In particular, they consider that apportioning to the Alde-Ore Estuary SPA using the NatureScot tool may result in potential underestimation of impacts. Where there is evidence to inform likely connectivity, or a lack thereof, this should be also considered in relation to the apportionment of impacts to SPA colonies.	Noted, apportioning amended and agreed with Natural England.

Date and consultation phase/type	Consultation and key issues raised	Comment
Section 42 Comments Natural England 28/08/2023	Overall, Natural England advise that a more precautionary and case-specific approach to apportioning is required for the Project and would welcome further discussions through the Expert Topic Group (ETG) process to define and agree the methodology.	Noted, apportioning amended and agreed with Natural England.
Section 42 Comments Natural England 28/08/2023	The assessment of impacts on RTD within the OTE SPA due to cable installation, construction and Operation & Maintenance (O & M) vessels only considers impacts in terms of mortality, rather than disturbance levels, or reduced habitat availability during the winter period. Furthermore, no mitigation measures have been brought forward to address potential impacts. Therefore, Natural England advise that the submitted RIAA should assess duration and scale of reduced habitat availability over the nonbreeding season and mitigation measures should be brought forward. They advise that the Natural England best practice protocol for minimising vessel disturbance should also be adopted as a minimum requirement.	Noted, the reduced habitat availability has been assessed and the Natural England best practice protocol for minimising vessel disturbance has been adopted.
Section 42 Comments Natural England 28/08/2023	Natural England notes that habitat loss has not been included in the list of impact pathways for any of the sites, despite the overlap with the Southern North Sea Special Area of Conservation (SNS SAC). Habitat loss should be taken through to the appropriate assessment stage unless a clear justification can be made that there would be no	Habitat loss has been added to the RIAA for harbour porpoise at the SNS SAC, please see Section 11.

Date and consultation phase/type	Consultation and key issues raised	Comment
	Likely Significant Effect (LSE) either alone, or in-combination with other projects with footprints within the SNS SAC.	
Section 42 Comments Natural England 28/08/2023	Natural England provided a number of comments on the Preliminary Environmental Impact Report (PEIR) Volume 6, Part 2, Chapter 7: Marine Mammal Ecology and Underwater noise modelling report and until those comments are addressed, they are not able to agree on the conclusions of the Adverse Effect on Integrity (AEoI) assessments which are based on the information from these reports. Please update the Report to Inform Appropriate Assessment (RIAA) accordingly once Natural England's comments on the PEIR have been addressed.	Volume 6, Part 2, Chapter 7: Marine Mammal Ecology has been updated following Natural England comments, and the authors/ technical specialists of the marine mammals chapter have reviewed the RIAA to ensure any relevant comments and changes from the PEIR chapter are reflected in the RIAA and ES.
Section 42 Comments Natural England 28/08/2023	Natural England advises that the maximum area overlap, not the average, is used to calculate the seasonal habitat loss in the SNS SAC in order to represent the worst-case scenarios. Use maximum spatial area overlap to calculate the seasonal habitat loss.	The maximum overlap has been used on a precautionary basis within the SNS SAC. Please see Section 11.3.
Section 42 Comments Natural England 28/08/2023	Not enough justification has been provided to conclude no AEoI for prey availability for harbour porpoise within the SNS SAC considering that the outcome of the fish assessment concluded moderate significant effects on spawning herring. The submitted RIAA would need to provide more justification in order to exclude AEoI.	Volume 6, Part 2, Chapter 6, Fish and Shellfish Ecology determines no significant effects on spawning herring when utilising the proposed mitigation for the project. Therefore, the approach used within the RIAA to conclude no AEoI for changes to prey of

Date and consultation phase/type	Consultation and key issues raised	Comment
		harbour porpoise within the SAC is considered appropriate.
Section 42 Comments Natural England 28/08/2023	Natural England are concerned that the daily threshold for the SNS SAC is predicted to be exceeded for concurrent piling as well as concurrent monopiling and two high order unexploded ordnance (UXO) clearances. Accordingly, they are unable to conclude no AEOI from the project alone without mitigation being brought forward. As a minimum requirement for addressing impacts on the SNS SAC (alone and in-combination), bring forward appropriate mitigation to ensure that the project alone will not exceed the daily threshold.	The mitigation considered within the RIAA is the SIP which is being developed and has been submitted alongside the ES. All relevant mitigation to ensure no AEoI has been detailed within the SIP. For detail surrounding the mitigation please see Section 8.
Section 42 Comments Natural England 28/08/2023	The conclusion of no AEoI relies on the Marine Mammal Mitigation Plan (MMMP) which have not yet been agreed or seen as in the case of UXO MMMP. Present draft MMMPs for review and discussion as part of the Evidence Plan Process.	An outline UXO specific MMMP is being submitted at DCO application (Volume 9, Report 14.2). It should be noted that UXO clearance would be subject to a separate Marine Licence and the UXO MMMP is provided for information.
Section 42 Comments Natural England 28/08/2023	The in-combination assessment for SNS SAC has only been provided for piling and not UXO clearance. The submitted RIAA should provide sections on the in-combination assessment for UXO clearance.	UXO clearance is considered within the in-combination assessment, Table 12.3 considers both piling disturbance and UXO disturbance as utilise the same 26 km EDR. This is stated within Table 12.3 the potential for effect from a single event (assumed worst case, whether that be monopiles or UXO clearance) per day for VE and the projects assessed in combination with VE."

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Section 42 Comments Natural England 28/08/2023	Natural England notes that their previous advice on the pathways to be screened in for the assessment of potential Likely Significant Effect (LSE) has been considered and included in the updated screening report.	This is noted by the Applicant.
Section 42 Comments Natural England 28/08/2023	Natural England agrees that all relevant national sites for marine mammals have been identified and the appropriate Management Units (MU) have been used.	This is noted by the Applicant.
Section 42 Comments Natural England 28/08/2023	Regarding the transboundary sites for harbour porpoise, a 26 km Effective Deterrence Range (EDR) cannot be used in isolation as a basis for screening out. Instead, all sites within the North Sea MU should be appropriately considered. As previously advised, the relevant authorities for transboundary sites should be consulted. Consider all harbour porpoise sites within the North Sea MU for screening.	This approach of identifying sites and screening them out of assessment on the basis of EDR's aligns with industry standard from other offshore wind farm developments (including Hornsea Project 4). The project has attempted to consult with transboundary consultees on the site selection and screening, with limited responses. In the absence of detailed responses from consultees, the approach used is considered appropriate.
Section 42 Comments Natural England 28/08/2023	Natural England seeks clarification as to why vessel disturbance during the O&M phase was not screened in for Southern North Sea Special Area of Conservation (SNS SAC). Provide justification why this impact pathway was not screened in, considering that there is a potential for disturbance	The assessment has been updated to include vessel disturbance during the O&M phase. Please see Section 9.

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	and vessel collision due to the presence of vessels during the O&M phase.	
Section 42 Comments Natural England 28/08/2023	Natural England notes that habitat loss has not been included in the list of impact pathways for any of the sites, despite the overlap with the SNS SAC. Habitat loss should be taken through to the appropriate assessment stage unless a clear justification can be made that there would be no LSE either alone or in-combination with other projects with a footprint within the SAC. They advise that this is included especially given the location of the project. Add SNS SAC to the list of sites for which Habitat Loss is screened in.	The assessment has been updated to include habitat loss where relevant. Please see Section 9.
Section 42 Comments Natural England 28/08/2023	11.3.30 Natural England provided a number of comments on the Preliminary Environmental Impact Report (PEIR)Volume 6, Part 2, Chapter 7: Marine Mammal Ecology and Underwater noise modelling report and until those comments are addressed, we are not able to agree on the conclusions of the Adverse Effect on Integrity (AEoI) assessments which are based on the information from these reports. Please update the RIAA accordingly once Natural England's comments on the PEIR have been addressed.	Volume 6, Part 2, Chapter 7: Marine Mammal Ecology has been updated following Natural England comments, and the authors/ technical specialists of the marine mammals chapter have reviewed the RIAA to ensure any relevant comments and changes from the PEIR chapter are reflected in the RIAA.
Section 42 Comments Natural England 28/08/2023	11.3.111 It is not clear which area was used to calculate the daily allowance. Please clarify whether the entire area of the SAC was used or the winter	The text in paragraph 11.3.109 has been updated to clarify the values used.

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	area alone. The values used for calculation should be presented clearly in the submitted RIAA.	
Section 42 Comments Natural England 28/08/2023	11.3.113 Natural England advises that the maximum area overlap, not the average, is used to calculate the seasonal habitat loss in the SNS SAC in order to represent the worst case scenarios. As such, the seasonal habitat loss would be 7.4%. Use maximum spatial area overlap to calculate the seasonal habitat loss.	Noted, the assessment has been updated to reflect the maximum area of overlap. Please see Section 11.3.
Section 42 Comments Natural England 28/08/2023	Figure 11.6 and 11.7 Figures appear to be the same. Figure 11.7 should present two high-order UXO clearances. Correction needed in the submitted RIAA.	The figures have been updated to reflect the appropriate two high-order UXO clearance. Please see Figure 11.6 and Figure 11.7.
Section 42 Comments Natural England 28/08/2023	Assessment of adverse effect on integrity alone Southern North Sea SAC (harbour porpoise): For clarity, seasonal disturbance thresholds calculations (worst- and best-case scenarios) for piling and UXO clearance should be presented within a summary table indicating values used for the calculations. Consider presenting these calculations within a table in the submitted RIAA.	Table 11.2 presents the calculations for maximum and minimum (worst-and best-case scenarios) for single and concurrent events within the vicinity of the SNS SAC. This applies to both piling and UXO.
Section 42 Comments Natural England 28/08/2023	11.3.106-107 and 11.3.120 Natural England cannot agree with the conclusion of no AEoI on the viability of harbour porpoise due to potential Permanent Threshold Shift (PTS) (mortality or injury) as a result of pile driving and Unexploded Ordinance (UXO) clearance at VE alone in relation to the SNS SAC,	An outline UXO specific MMMP is being submitted at DCO application (Volume 9, Report 14.1). A draft MMMP was provided for PEIR for discussion, with an updated version submitted alongside the ES.

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	as these outcomes are based on the Marine Mammal Mitigation Plan (MMMP) which have not yet been agreed.	
Section 42 Comments Natural England 28/08/2023	11.3.112, 114, 125, 127 Mitigation will be needed to address the threshold exceedance for concurrent monopiling and two high order UXO clearances (27.2% of the site). Without such mitigation, these statements are not correct: “Therefore, it is concluded that there will not be an AEoI from disturbance during pile driving at VE alone on the Conservation Objective for harbour porpoise for the SNS SAC.” And: “It is not possible for VE alone to exceed the 20% and 10% thresholds of reduction in habitat availability as a result of high-order UXO clearance and an AEoI will not occur as a result of disturbance to harbour porpoise VE alone during construction and decommissioning as a result of high-order UXO clearances”. As a minimum requirement for addressing impacts on the SNS SAC (alone and in-combination), bring forward appropriate mitigation to reduce the disturbance and demonstrate that the project alone will not exceed the daily threshold.	The mitigation relevant to the assessment for the SNS SAC is the Piling and UXO MMMP Volume 9, Report 14.1 and 14.2 respectively) and Site Integrity Plan (SIP) (Volume 9, Report 15). Information on this mitigation is presented and discussed throughout the assessment in Section 11.3. It should be noted that any UXO clearance will be subject to a separate Marine Licence and UXO MMMP is provided for information.
Section 42 Comments Natural England 28/08/2023	11.3.128-129 This section does not provide information on the assessment for the prey availability, yet it concludes no AEoI for impacts on prey for harbour porpoise from the SNS SAC.	A cross reference has been added to the “changes to prey” assessment as undertaken within paragraphs 11.3.186 to 11.3.190. The changes to prey assessment concludes no

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	Provide more information on the assessment for prey in the submitted RIAA.	AEoI and therefore the conclusions presented within Sections 11.3.171 to 11.3.172.
Section 42 Comments Natural England 28/08/2023	11.3.133 The literature relevant to vessel disturbance is wrongly cited in this section on vessel collision risk. Provide relevant literature for this assessment in the submitted RIAA.	The references used for the harbour porpoise collision risk assessment (Heinänen and Skov, 2015) was supporting information around the impact of vessels however as it is not fundamental to the assessment this text has been removed. Please see Section 11.3.
Section 42 Comments Natural England 28/08/2023	11.3.176 A correction factor needs to be applied to estimate the seal population associated with the Wash and North Norfolk SAC (WNNC SAC), in order to ensure a more accurate assessment. It is the project's responsibility to determine the reference population as accurately as possible in the ES. It is not acceptable to rely on an inaccurate reference population to conclude no AEoI. Apply the appropriate correction factor to estimate the population size of common seals in the WNNC SAC, taking into account the seal counts at haul out sites and at-sea data. Update the assessment for the submitted RIAA.	Noted. Section 11.3 has been updated to align with the marine mammal ES chapter with oversight from technical specialists, therefore it is considered that the reference populations and scalars are now up to date.
Section 42 Comments Natural England 28/08/2023	11.3.288 SCOS (2021) report would be more appropriate reference for estimating the Humber Estuary SAC population size as it is newer than Russel *et al* (2016). SCOS (2021) assumes that 23.9% of the population was counted at the hauled out thus based on the latest counts, the Humber Estuary population is 16,306. Briefing papers (BP)	Noted. Section 11.3. has been updated to align with the Marine Mammal Ecology ES chapter (Volume 6, Part 2, Chapter 7) with oversight from technical specialists, therefore it is considered that the reference populations and scalars are now up to date.

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	21/03 and BP 21/06 in SCOS (2021) provide more information on Humber Estuary SAC. Use newer reference to estimate grey seal population size at the Humber Estuary SAC in the submitted RIAA.	
Section 42 Comments Natural England 28/08/2023	12.3.3 Natural England provided a number of comments on PEIR Volume 6, Part 2, Chapter 7: Marine Mammal Ecology relating to the assigned magnitude and sensitivity scores and the resulting significance of the assessment. Thus, if any potential significance of the impact from VE alone has been re-assessed as higher than negligible, it needs to be added to the in-combination assessment and included in Table 12.2. Update the in-combination assessment with the submitted RIAA where relevant. upon consideration of our comments on the PEIR Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.	Volume 6, Part 2, Chapter 7: Marine Mammal Ecology has been updated and outcomes used in the ES. The authors/ technical specialists of the marine mammals chapter have reviewed the RIAA to ensure that the conclusions from the EIA are reflected within Section 11.3.
Section 42 Comments Natural England 28/08/2023	Table 12.4 and 12.5 For clarity and visualisation, the EDRs for relevant projects overlapping the winter area of the SAC should be presented as figures. Consider producing figures to illustrate spatial in-combination effects of disturbance in the submitted RIAA.	The 26 km EDRs for the projects considered are presented within Figure 11.3.
Section 42 Comments Natural England 28/08/2023	12.3.35 The statement: "…it is clear that VE alone would not trigger the 20% threshold under any circumstance." Is not correct as it has been demonstrated that the concurrent piling at VE would	Noted, this text has been amended. See Section 11.3.

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	exceed the daily threshold. Amend this statement accordingly in the submitted RIAA.	
Section 42 Comments Natural England 28/08/2023	Table 12.6 Natural England advise that the maximum area overlap should also be presented in the Table. The submitted RIAA should include maximum area overlap in the Table and later discussion.	Table 12.6 presents the maximum area of overlap.
Section 42 Comments Natural England 28/08/2023	Table 12.6 the Applicant should not rely on the concurrent piling as a way of reducing the exceedance of the seasonal threshold considering that it has been demonstrated that concurrent piling would exceed 20% seasonal threshold in certain circumstances. Amend the assessment in the submitted RIAA accordingly.	Table 12.6 presents the maximum overlap for single piling events not concurrent piling, as this has the maximum effect on the seasonal threshold. The assessment does not rely on the use of concurrent piling as it is all addressed within the SIP. The table has been amended to ensure clarification and reference to concurrent piling reducing the impact has been removed for clarity.
Section 42 Comments Natural England 28/08/2023	12.3.43 At this point, Natural England cannot agree that AEoI will not occur as a result of disturbance to harbour porpoise (as defined by the daily 20% and seasonal 10% thresholds) for VE alone and/or in-combination during construction and decommissioning due to piling, considering that the exceedance of the daily threshold for concurrent piling at VE alone, and calculations for seasonal habitat loss using the average not maximum area overlap thus not taking into account the worst-case scenarios. Additionally, the conclusion of no AEoI relays on the MMMPs which have not yet been	The assessments have been updated to reflect the maximum areas of overlap. Additionally, the mitigation used within the RIAA is the UXO and Piling MMMP (Volume 9, Report 14.1 and 14.2) and SIP (Volume 9, Report 15) which is referenced within Section 11.3 and 12.3 and has been submitted alongside the ES. All relevant mitigation to ensure no AEoI has been detailed within the SIP. Text has been added to clarify.

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	agreed or seen as in the case of UXO MMMP. Ensure RIAA and documents submitted in support of the ES address Natural England's concerns, including bringing forward avoidance and/or mitigation measures to reduce impacts to acceptable levels. Present draft MMMPs for review and discussion as part of the Evidence Plan Process.	
Section 42 Comments Natural England 28/08/2023	Table 12.7 Natural England is unsure as to how the summary table of the in-combination risks includes UXO clearance, when such in-combination assessment has not been presented in the main body text. As far as they can see, the in-combination assessment has only been provided for piling. The submitted RIAA should provide sections on the in-combination assessment for UXO clearance.	Table 12.3 and Table 12.4 present single and double events respectively, including both piling and UXOs. The table captions have been amended to reflect this. Therefore, as UXO assessments are presented, the statements within Table 12.6 are still considered valid. It should be noted that any UXO clearance will be subject to a separate Marine Licence.
Section 42 Comments Natural England 28/08/2023	12.3.46 Given the level of uncertainty in the assessment at this point, it is not possible to conclude that there will not be AEoI resulting from disturbance of harbour porpoise within the SNS SAC from VE in-combination. The wording needs to be carefully chosen to reflect the currently available information (and lack thereof), threshold exceedance and incomplete assessment. Reword the paragraph to reflect the level of uncertainty in the outcome of the assessment.	Paragraph 12.2.49 updated accordingly.

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Section 42 Comments Natural England 28/08/2023	12.3.52 - 53 A summary table clearly indicating values used to calculate the number of seals impacted by in-combination disturbance is highly recommended as it is hard to follow how the calculation was done. Consider producing a summary table to present the number of seals distributed by in-combination effects of underwater noise in the submitted RIAA.	This is noted by the Applicant. Additional values have been added to enable further clarity on the assessments.
Section 42 Comments Natural England 28/08/2023	12.3.59 Vessel disturbance is usually addressed by a Vessel Management Plan. The Site Integrity Plan (SIP) is intended to ensure that the thresholds for significant disturbance are not exceeded. Thus, the project is inappropriately referring to the SIP in this context. Additionally, Natural England do not agree that the vessel related disturbance will be restricted to the same area as the disturbance from piling, considering that there will be many other vessels on the site throughout the project not related to piling activity. The submitted RIAA should refer to the correct best practice for vessel management.	The text has been amended to include the Working in Proximity to Wildlife in the Marine Environment (Volume 9, Report 18.1) however it is considered through the text that the SIP is still relevant mitigation and therefore is still included. Please see Section 12.3.
Section 42 Comments Natural England 28/08/2023	Natural England question the validity of the methodology applied to apportion lesser black-backed gull (LBBG) to Special Protection Area (SPA) colonies during the breeding season for this case. Please note that we do not advise the use of the NatureScot (2018) apportioning methodology in all instances. This is due to concerns around the	Noted, apportioning has been amended and agreed following discussions with Natural England. See Volume 6, Part 5, Annex 4.15: Apportioning Note.

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	calculation of density decay, which we consider arbitrary and unlikely to be representative in many cases. Specifically, they highlight that apportioning to the Alde-Ore Estuary SPA may result in potential underestimation of impacts. Colonies that we consider extremely unlikely to have connectivity (e.g. in Holland) with the site in the breeding season have been included in apportionment calculations. They note that elsewhere in the supplied documentation, these colonies are scoped out using tracking data to evidence a lack of connectivity. Consequently, we consider that the impacts have been underestimated for that site-species combination. Natural England advise that a more precautionary and case-specific approach to apportioning is required for VE and welcome further discussions through ETG to agree methodology. The methodology should draw upon multiple sources of information e.g. tracking data rather than the NatureScot apportioning tool in isolation. Where there is evidence to inform likely connectivity, or a lack thereof, they consider this should be considered in relation to the apportionment of impacts to SPA colonies. To better reflect the uncertainty in the evidence available, Natural England consider it appropriate to present a range of apportionment	

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	rates for the breeding season to be considered in the assessment.	
Section 42 Comments Natural England 28/08/2023	Apportioning of age-classes has been calculated based on stable age structures rather than site specific survey data. Natural England do not agree with the use of the stable age structures for apportioning age classes as they consider a regional scale and may not be applicable at a much smaller specific offshore site. Natural England advise that best practice is to use site specific data for apportioning age classes. Recognising that it can be difficult to age some species from Digital Aerial Survey (DAS) imagery, they currently recommend that all adult type birds are assumed to be adults.	Noted, site specific data for aging has been assessed. See Volume 6, Part 5, Annex 4.15: Apportioning Note.
Section 42 Comments Natural England 28/08/2023	The assessment of impacts on RTD within the OTE SPA due to cable installation and construction and O&M vessels only considers impacts in terms of diver mortality, rather than disturbance levels in the SPA or reduced availability of habitat during the winter period. No mitigation measures are brought forward to address potential impacts. The submitted RIAA should include an assessment of the duration and scale of reduced habitat availability over the non-breeding season and bring forward mitigation measures to address impacts. As a minimum, Natural England's best practice protocol for vessel movements within diver SPAs should be adopted,	Noted, the reduced habitat availability has been assessed and the Natural England best practice protocol for minimising vessel disturbance has been adopted. See Volume 9, Report 9.18.1: Working in Proximity to Wildlife in the Marine Environment.

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	but this may not obviate the need for additional mitigation measures.	
Section 42 Comments Natural England 28/08/2023	Natural England highlight the undeveloped and high-level nature of documents relating to compensatory measures. They highlight the significant difficulties experienced by other projects where compensatory measures have been required. Designing and siting measures, securing tenure, regulatory or other third-party agreements as well as evidencing likely effectiveness all present significant challenges. VE should work collaboratively using the ETG process to accelerate compensatory measure development prior to submission. If compensatory measures are likely to be required, or there is a level of uncertainty pre-examination, then compensatory measures should be fully considered on a without prejudice basis. Natural England's experience is that the Examination period has generally proved insufficient for measures to be adequately developed and secured. Therefore, we would emphasise the need to make significant progress with the draft compensatory measures in the pre-application period. Leaving key details regarding the nature, location and implementation of the measures until the Examination could carry a significant consenting risk.	Noted, the compensatory measures are progressing and details have been submitted alongside the DCO application. See Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan & See Volume 5, Report 5, Annex 5.7: Kittiwake – Implementation and Monitoring Plan & Guillemot and Razorbill Compensation – Evidence, Site Selection and Roadmap document.

Date and consultation phase/type	Consultation and key issues raised	Comment
Section 42 Comments Natural England 28/08/2023	Natural England does not consider the apportionment of 36.8% LBBG to the Alde-Ore SPA to be defensible. Whilst Natural England consider that the NatureScot apportioning method can provide a useful standardised method to apportion birds across multiple colonies, they do not support its use in all circumstances. In this instance Natural England consider the method has not delivered realistic apportioning rates. They believe that a more evidence based approach to apportioning would result in a higher proportion of LBBG should be allocated to the Alde-Ore Estuary SPA. A more appropriate approach to apportioning should be identified and agreed through the ETG, and the project impacts reassessed accordingly in the submitted RIAA. This should draw upon tracking studies for all relevant colonies. Natural England recommend that when devising an alternative approach, the project draws on the Examinations of previous projects predicted to impact Alde-Ore Estuary SPA LBBG. A more appropriate proportion of LBBG from the SPA could be calculated using the apportioning methods recommended by Natural England to Galloper OWF (see Written Summary of Oral case put by Natural England at the issue specific hearing relating to biodiversity, biological environment and ecology – Galloper Wind Farm	Noted, LBBG apportionment for AOE SPA amended to 40% in agreement with Natural England. See Volume 6, Part 5, Annex 4.15: Apportioning Note.

Date and consultation phase/type	Consultation and key issues raised	Comment
	Order application, IPC ref. EN010003, 29/10/2012, paras 62-83). It would also be prudent for a range of apportionment rates for the breeding season could be considered in the assessment. A range based approach can help to acknowledge uncertainty and explore the implications of different apportionment rates for assessments. This approach was advocated by Natural England for the (considerably more distant) Norfolk Vanguard and Boreas projects and was used as the basis of our advice into the Examination. Natural England also suggest the project monitors any outputs of the ORJIP funded 'AppSas' project which Natural England hope will address our concerns around the current iteration of the apportioning method.	
Section 42 Comments Natural England 28/08/2023	11.4.32 - 40 It will be necessary for the RIAA to consider whether the impacts of Highly Pathogenic Avian Influenza (HPAI) have increased the sensitivity of particular SPA/species combinations to additional impacts from e.g. OWF. This was raised during the Examination of the Sheringham and Dudgeon Extensions OWF, where the Applicant produced a note assessing this based on the information on HPAI available at that time. The assessment of impacts on Outer Thames Estuary SPA RTD from construction and operational effects is focussed on potential mortality. Natural England considers the potential for construction phase disturbance during cable installation and	A more comprehensive assessment of red-throated diver impacts within the OTE SPA has been undertaken, considering the Supporting Advice on Conservation Objectives. The Project would also be committing Natural England's advised best practice protocol for vessel movements within diver SPAs, after which the residual effects will be minimal, see Section 11.4.71 and Volume 9, Report 18.1: Working in Proximity to Wildlife in the Marine Environment.

Date and consultation phase/type	Consultation and key issues raised	Comment
	construction/O&M vessel movements warrants consideration in terms of disturbance levels in the SPA and the loss of supporting habitat within the site within a given winter period. Several OWF have adopted Natural England's advised best practice protocol for vessel movements within diver SPAs and Natural England consider this a minimum requirement. Depending on the analysis of the duration and extent of supporting habitat loss, Natural England may seek a seasonal restriction (or other mitigation measures) to cable-installation activities within the SPA. Review the Sheringham and Dudgeon Extensions submissions regarding HPAI and consider taking a similar approach and drawing on any additional information on HPAI that emerges. Update the RIAA assessment to include consideration of the OTE SPA SACO attributes relating to disturbance and availability of supporting habitat, adopt the Natural England best practice protocol and consider the need for mitigation measures for cable installation within the SPA.	
Section 42 Comments Natural England 28/08/2023	11.4.35 It is stated that RTD displacement mortality of >1% is unrealistic, citing the MacArthur Green (2019) review. However, empirical evidence regarding the energetic consequences of displacement for seabirds and wintering waterbirds using the marine environment are very limited.	Noted, a range of mortality estimates, following Natural England guidance (Parker ., 2022c) have been presented. See Section 11.4.

Date and consultation phase/type	Consultation and key issues raised	Comment
	Furthermore, the role of overwinter survival on seabird population dynamics is poorly understood. Considering the paucity of evidence Natural England consider it appropriate, as a matter of best practice, to assess a range of mortality impact scenarios. Mortality rates of 1-10% should be considered to identify if further investigation is warranted, accepting that 10% represents a highly precautionary scenario. However, Natural England highlight that the mortality rates are essentially a crude method of also capturing a range of potentially deleterious effects and in-direct effects that could conceivably arise from displacement. As definitive mortality rates for seabirds (including RTD and auks) are unknown, Natural England advises consideration of a range between 1% and 10% for project alone and in-combination impacts from array, construction and cable laying vessels for RTD and auks (i.e. species for which the cost of displacement could be significant). If significant impacts are predicted under these scenarios further investigation of those impacts may be required.	
Section 42 Comments Natural England 28/08/2023	11.4.198 During the Operations and Maintenance (O&M) phase, VE speculate that the loss of 8 LBBG per annum from the Alde-Ore SPA would have no impact on site integrity as recent Population Viability Analysis (PVAs) for East Anglia 2 OWF where 40 LBBG per annum may be lost from the Alde-Ore	Noted, estimates recalculated and apportioning of 40% to AOE SPA has been agreed.

Date and consultation phase/type	Consultation and key issues raised	Comment
	SPA found <1% decrease in population growth rate. However, we do not consider the apportioning of impacts to SPAs to be appropriate, and therefore question whether the value of 8 adults per annum is sufficiently evidence-based (see Natural England ref. 1 above). Recalculate estimates of mortality arising from collision for LBBG based on an updated apportioning method. Use PVA to assess the likelihood of Adverse Effect on Integrity (AEOI) both for the project alone and in-combination.	See Volume 6, Part 5, Annex 4.15: Apportioning Note.
Section 42 Comments Natural England 28/08/2023	11.4.6 Apportioning of ages classes has been undertaken using season-specific proportions of adults from the Biologically Defined Minimum Population Scale (BDMPS) population derived from the tables in Appendix A of Furness (2015). Natural England does not consider this method appropriate at small offshore sites, as at the regional scale apportioning is unlikely to be representative. Although it is acknowledged that accurately aging some species using DAS is difficult, Natural England best practice is to use site-specific data for apportioning. Wherever feasible, derive the proportion of adults in SPA populations using site specific data such as counts of all adult type birds seen in surveys, and use this information in an updated impact assessment in the RIAA.	Noted, site specific data has been used where appropriate. Methodologies have been agreed with Natural England. Where there is disagreement both the Applicant and the Natural England approaches have been presented. See Volume 6, Part 5, Annex 4.15: Apportioning Note.

Date and consultation phase/type	Consultation and key issues raised	Comment
Section 42 Comments Natural England 28/08/2023	Where project alone impacts have been estimated to cause a <1% increase in baseline mortality for a given species, Natural England acknowledge the contribution of VE to be small. Nevertheless, where in-combination impacts cause a >1% increase in baseline mortality PVA should be undertaken to investigate the implications of this impact. Where in-combination impacts on SPA populations may cause a >1% increase to the baseline mortality of an SPA population e.g. gannet, kittiwake, guillemot and razorbill from the Flamborough and Filey Coast (FFC) SPA and LBBG from the Alde-Ore SPA during VE O&M, PVA needs to be undertaken to demonstrate the in-combination effect as well as indicating the VE contribution. Natural England's PVA tool has been designed to allow PVAs to be undertaken in an efficient and transparent way.	Noted, PVA has been undertaken for the species outlined. See Volume 6, Chapter 5, Annex 4.16: Population Viability Analysis
Section 42 Comments Natural England 28/08/2023	Section 13 In the transboundary statement Dutch LBBG colonies are disregarded as tracking studies suggest little connectivity to VE, yet the NatureScot apportioning tool attributes 45.1% of birds in the PDA to Dutch colonies (Waddenzee, Veerse Meer, Duinen en Lage Land Texel and Duinen Vlieland, c.f. Appendix 2 Apportioning methodology, Table 4). Note the gannet colonies at the Alderney West Coast and Burhou Ramsar site and Cote de Granit Rose-Sept Iles are also screened out for	Noted, the Dutch colonies have been removed altogether from the LBBG calculations and the French colonies have been removed from the gannet calculations. The Alderney colony has remained in the gannet calculations as tracking data shows connectivity between the colony and VE.

Date and consultation phase/type	Consultation and key issues raised	Comment
	transboundary effects, yet in the HRA 14.5% and 24.8% of gannet in the PDA are apportioned to these sites respectively (c.f. Appendix 2 Apportioning methodology, Table 3). See Natural England ref. note 1 above. The approach to apportioning should be fully informed by tracking studies and other relevant information (e.g. regarding gannet foraging space partitioning).	See Volume 6, Part 5, Annex 4.15: Apportioning Note.
Section 42 Comments Natural England 28/08/2023	In the light of the Hornsea 4 decision and the likely additional impacts arising from not-yet-submitted extensions and Round 4 projects, in the absence of agreed project alone impact totals we consider it appropriate to progress in-principal measures for all four qualifying species at FFC SPA.	Noted, without prejudice compensation measures have been progressed.
Section 42 Comments Natural England 28/08/2023	3.2.11 VE suggest the delivery of alternative food resources (such as whole sandeel via purchased quota fished on behalf of the measure) could be investigated. Natural England considers that, given the impacts of forage fisheries on seabird productivity, it would be fundamentally flawed to perpetuate fisheries targeting sandeel and other forage fish for any purpose, including compensatory measures for the benefit of seabirds. Natural England recommend this approach is not progressed.	Agreed.
Section 42 Comments Natural England	Given the likely modest contributions that VE may make to the in-combination totals on FFC SPA kittiwake, the proposal to consider augmenting	Noted, suitable compensation measure now agreed with Natural England.

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28/08/2023	compensatory proposals being developed for more impactful proposals in the North Sea is appropriate. Another potentially productive approach could be collaborative working with other OWF that may have similar-sized impacts e.g. North Falls, Rampion 2 to deliver a single scheme, as measures that deliver for combined impacts are likely to be more practicable and cost-effective.	See Volume 5, Report 5, Annex 5.4: Kittiwake - Evidence, Site Selection and Roadmap
Section 42 Comments Natural England 28/08/2023	1.1.8 Whilst Natural England agree that habitat restoration/ creation and predator fencing are relevant measures to consider, at this early-stage Natural England consider it is premature to exclude predator eradication/ management (e.g. brown rat) until a detailed exploration of issues potentially affecting candidate sites is carried out. When investigating site-specific opportunities for candidate compensation sites, consider merits of predator management/eradication as well as exclusion.	Noted, predator eradication is being considered where appropriate. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments Natural England 28/08/2023	1.1.9 It is proposed that demographic data for LBBG from Horswill & Robinson (2015) will be used to calculate the number of additional breeding pairs required to produce sufficient breeding adults back into the bio-geographic population to compensate for the predicted impacts. Natural England highlight the complexities of compensating for the loss of individuals at a specific SPA colony, and the stated intention to calculate the numbers of additional breeding pairs a compensatory measure would need	Noted and discussed at the ETG. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document

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	to enable in order for sufficient breeding adults to recruit back into the bio-geographic population. Natural England recommend that detailed discussion through ETGs will be required on an appropriate approach to defining scale and success for compensatory measures. In the meantime, we recommend the project reviews the approved LBBG Implementation and Monitoring Plan for the Norfolk Vanguard and Boreas compensatory measures.	
Section 42 Comments Natural England 28/08/2023	Table 2.1 Blackwater Estuary SPA, Hamford Water SPA, Medway Estuary & Marshes SPA, North Norfolk Coast SPA – Natural England notes these SPAs are classified for breeding species that may be susceptible to gull predation. Consider downgrading potential rating due to this factor.	Agreed, downgraded. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments Natural England 28/08/2023	Table 2.1 Steep Holm – it is unclear why landowner collaboration and conservation work on the neighbouring Flat Holm result in scores of low potential, though we agree that connectivity is low. However, at this stage it may be premature to scope out Steep Holm from further consideration. Review potential rating and if appropriate include as a site for further consideration.	Noted, Steep Holm was considered and site survey completed. See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document
Section 42 Comments Natural England 28/08/2023	Table 2.1 The Wash SPA – we highlight that The Wash SPA is not classified for breeding LBBG nor for a breeding seabird assemblage, though the	Noted, Outer Trial Bank colony has been established as a potential site for compensation measures.

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	LBBGs nesting on the Outer Trial Bank may make a contribute to the non-breeding waterbird assemblage at some times of the year. As well as vegetation management, mammalian predation issues may also be an issue that warrants further investigation as part of next steps. However we do not consider that rafts would be suitable within the Wash SPA/Wash and North Norfolk Coast SAC. Consider including Outer Trial Bank as a site for further consideration.	See Volume 5, Report 5, Annex 5.3: Lesser Black-backed gull Compensation – Evidence, Site Selection and Roadmap document. & Volume 5, Report 5, Annex 5.6: Lesser Black-backed Gull – Implementation and Monitoring Plan.
Section 42 Comments Natural England 07/09/2023	Natural England is concerned that EIA assessment criteria and matrices have been applied to Habitats Regulations within the VE Draft RIAA. We would advise that if there is an impact pathway that leads to a credible risk to an interest feature of a European site, then a Likely Significant Effect (LSE) should be concluded. Similarly, the Appropriate Assessment stage in the RIAA should simply conclude that an Adverse Effect on Integrity (AEoI) on that European site(s) and qualifying features either can or cannot be ruled out. The Project should then apply the mitigation hierarchy to suitably avoid, reduce and mitigate the impacts to remove the AEoI.	This is noted. The suggested approach has been followed throughout and the EIA assessment criteria removed to avoid confusion.
Section 42 Comments Natural England 07/09/2023	In line with our comments above, we advise that EIA assessment criteria and matrices should not be applied to HRA. We advise that, in line with the mitigation hierarchy, every effort should be made to avoid-reduce-mitigate impacts to the site, not only	This is noted. An avoid-reduce-mitigate approach has been used throughout and the reference to EIA criteria has been removed to avoid confusion.

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	for project alone effects, but also the contribution made to existing pressures/cumulative impacts. If this is not possible, for example, due to a requirement for cable protection in the Special Area of Conservation (SAC) and AEoI cannot be excluded, then the proposal will have to proceed with a derogation case.	
Section 42 Comments Natural England 07/09/2023	The VE export cable corridor (ECC) overlaps MLS SAC by 1.26 km2(0.19% of the SAC), sandwave clearance is proposed over 0.7 km2(0.11% of the SAC), cable protection is proposed in 0.16 km2 (0.02% of the SAC), and a further c. 4 km of ECC lies adjacent to the SAC at its northernmost tip. These impacts may be small in the context of the overall size of the SAC, but we advise that they are considerable in absolute terms. We draw the Project's attention to Natural England's advice provided in our Norfolk Boreas (NB) and Norfolk Vanguard (NV) Relevant Representations on small scale losses, and to the NB and NV Outline Site Integrity Plan for Haisborough Hammond and Winterton SAC for consideration of impacts and mitigation. Furthermore, we advise that the Project should consider all construction and Operations & Maintenance (O&M) activities and also the Project's impacts in the context of the considerable level of existing pressures on the site (i.e. Cumulatively and in-combination).	Detail regarding cable protection mitigation has been included within the assessment which reduces the overall amount of impact on the SAC. Please see Section 11.2.

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Section 42 Comments Natural England 07/09/2023	Natural England advises that herring and sandeel are important prey components for designated SAC and Special Protection Area (SPA) species. We have concerns regarding fish prey availability for SPA/SAC species. In particular, we are currently unable to agree with the conclusions drawn regarding herring (in particular the Downs herring population spawning habitat area) and, in turn, the assessment of impacts to them during construction/decommissioning, operation and in-combination with other plans/projects.	As detailed within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, the project will be implementing a seasonal piling restriction to mitigate against impacts from underwater noise from piling operations in the array area on spawning Downs herring.
Section 42 Comments Natural England 07/09/2023	Please note that Natural England defers to Cefas for advice on underwater noise modelling.	Noted.
Section 42 Comments Natural England 07/09/2023	Natural England are content with the sites screened in for potential LSE.	Noted.
Section 42 Comments Natural England 07/09/2023	There are several uncertainties within the assessments. Natural England are, therefore, unable to agree with the conclusions of the RIAA. Natural England advise that their advice on the PEIR is reflected on in an updated RIAA before they provide further comments.	Noted. The Applicant has updated the assessments within the RIAA based on the comments received on the PEIR, and updates between the PEIR and ES.
Section 42 Comments Natural England	12.2.53 Natural England note that it has been concluded “that there is no potential for an AEoI to the conservation objectives of the features and sub-	Text around mitigation measures proposed have been added to paragraph 12.2.51,

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07/09/2023	features of the MLS SAC and Essex Estuaries SAC has been concluded in relation to permanent habitat loss/disturbance from VE in-combination with other plans or projects and therefore...the features will be maintained in the long-term....” Natural England believe that the conservation objectives for the site interest features are already being hindered and that further pressures due to the project alone, and in-combination, are likely to further hinder the achievement of these objectives. Natural England advise that, in line with advice provided by Natural England to the PEIR, the mitigation hierarchy should be followed to suitably avoid, reduce, and mitigate the impacts to a level that removes the risk of AEoI.	following the mitigation hierarchy and enabling a conclusion of no AEoI to be reached.
Section 42 Comments Natural England 07/09/2023	Further consideration should be given to the potential impacts of the proposed development on the sub-1mm fraction. The sub-1mm (0.5-1.0mm) fraction is considered the largest element of the invertebrate biomass (crustacea in particular), which form a large part of the food source for fish and invertebrates. We advise that further consideration should be given to this size fraction for infauna, especially on sandbanks and large sand areas (i.e., MLS SAC).	The assessment demonstrates recoverability of the sandbank features for all size fractions. Benthic and Intertidal Ecology (Volume 9, Part 2, Chapter 5) concludes no significant impact on the benthic environment (including the sub-1mm fraction), further evidencing that there is no AEoI on the sandbanks at the MLS SAC.
Section 42 Comments Natural England 07/09/2023	The VE benthic survey was carried out in November 2021. This is sub-optimal in terms of peak biomass. Natural England are concerned that this could have implications for the sites surveyed, including for	The Applicant notes Natural England’s concern that November may not be the optimal time to undertake a benthic survey, however in terms of subtidal biotopes this is

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	Sabellaria sp. These limitations should be considered and discussed in the updates ES and analysis provided on the potential implications for the conclusions of the impact assessment.	less important as many of the communities discussed do not die back in winter months. *Sabellaria spinulosa* reef is known to be ephemeral in nature, however reef is not understood to undergo significant seasonal variation. Whilst there could be a seasonal variation in biomass as described, this is not expected to be significant sub tidally and therefore not fundamentally change the biotopes assessed or the conclusions of the impact assessment. Limitations have been discussed within the benthic ecology chapter however the timing of the survey does not impact the assessment presented here.
Section 42 Comments Natural England 07/09/2023	Natural England advise that there is a need for additional consideration of impacts to prey availability for SPA/SAC species, particularly during construction and in-combination. Natural England advise that the impact assessment for herring (in particular Downs herring), as an important prey species, should be revisited following additional assessment of their habitat area.	As detailed within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, the project will be implementing a seasonal piling restriction to mitigate against impacts from underwater noise from piling operations in the array area on spawning Downs herring.
Section 42 Comments Natural England 07/09/2023	Natural England agrees with the identification of relevant sites and features.	Noted.
Section 42 Comments Natural England	Natural England largely agrees with the methodology undertaken for migratory fish.	As detailed within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, the project will

Date and consultation phase/type	Consultation and key issues raised	Comment
07/09/2023	However, they have concerns regarding the impact assessment for fish prey species (particularly Downs herring) during construction/decommissioning, operation, and in-combination due to disturbance from underwater noise and the potential for change/removal of fish supporting habitat. Natural England advises that an updated habitat assessment for Downs herring should be carried out and, in turn, the impact assessment for SPA/SAC species should be adjusted accordingly.	be implementing a seasonal piling restriction within the VE array during the peak Downs herring spawning season.
Section 42 Comments Natural England 07/09/2023	Please note that for advice on underwater noise impacts to migratory fish, Natural England defer to Cefas.	Noted.
Section 42 Comments Natural England 07/09/2023	Based on Natural England's current knowledge of relevant developments, Natural England considers that the list of plans and projects identified is adequate.	Noted.
Section 42 Comments Natural England 07/09/2023	Natural England agree with the onshore SAC/SPA/Ramsar sites screened in for appropriate assessment.	Noted.
Section 42 Comments Natural England 07/09/2023	Natural England note the avoidance of direct land take within designated site boundaries, although, we also note that the onshore project area is in proximity to Hamford Water SAC, SPA/Ramsar site (c. 900m at closest point). Natural England advises that there is a need to consider all impact pathways	This is dealt with in the text, there is no land take from Hamford Water SAC, SPA or Ramsar site.

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	and appropriate mitigation strategy for the features of these designated sites.	
Section 42 Comments Natural England 07/09/2023	Natural England note the close proximity of the landfall HDD compound to Holland Haven Marshes SSSI, which supports many of the notified features of the designated sites, including Fisher's Estuarine Moth, wintering and breeding wildfowl and waders. Natural England advises that there is a need to consider all impact pathways and appropriate mitigation strategy for these important site features.	Holland Haven Marshes SSSI and it's use by birds is covered substantially in the report.
Section 42 Comments Natural England 07/09/2023	Natural England agree that the key potential pressures/impact pathways have been identified in line with the relevant conservation advice.	Noted.
Section 42 Comments Natural England 07/09/2023	Natural England agree with the methodology that has been used to assess potential impact pathways to international notified features e.g., wintering and breeding birds, Fishers Estuarine Moth.	Noted.
Section 42 Comments Natural England 07/09/2023	Natural England agree with the key impacts listed in the RIAA. Whilst the mitigation measures proposed are broadly appropriate, Natural England advise that they should be more robust and more specific. Natural England recommend the following mitigation measures should be included in a detailed mitigation plan: • Ecological Clerk of Works (ECoW) during construction to carry out pre-commencement checks for the presence of designated features and to	ECoW, the CoCP (Volume 9, Report 21) and the Outline Landscape and Ecological Management Plan (OLEMP) (Volume 9, Report 22) are included in the mitigation plan in Section 11.6.

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	ensure that mitigation measures are in place and that the impacts are either being avoided or satisfactorily mitigated, Mitigation measures that would fall within the remit of the ECoW would include cessation of works in very cold weather, review of effectiveness of acoustic and/or visual screening. • Consideration of planting unsuitable crops in advance of construction in order to deter dark bellied brent geese for the winters that construction will take place. • Code of Construction Practice (CoCP) and HDD Method Statement and 'Frack out' Contingency Plan • Landscape and Ecological Management Plan for the satisfactory handing, storage and re-instatement of soils and vegetation at FLL sites to benefit feeding and roosting birds and Fisher's Estuarine Moth food plant. • Sensitive lighting scheme limiting the increase in lumens over the designated site. Natural England would also wish to see firmer commitments to mitigation prior to Examination, as part of a detailed mitigation plan, which could be reviewed by the relevant responsible officer in Natural England.	
Section 51 Comments The Planning Inspectorate	The Inspectorate notes that the draft HRA documents refer to further supporting information being provided in the Preliminary Environmental Information Report (PEIR) throughout. As the PEIR	References to PEIR have been amended to ES where appropriate throughout the final RIAA.

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26/01/2024	would not form part of the development consent order (DCO) application, the Inspectorate expects that all such references would be updated in the final HRA reports submitted i.e. to the relevant location within the environmental statement (ES) and its appendices, and any other application documents of relevance.	
Section 51 Comments The Planning Inspectorate 26/01/2024	The Inspectorate has not reviewed the PEIR as part of the draft document package and our comments on the draft HRA reports are provided based on information reviewed in the HRA only.	Noted.
Section 51 Comments The Planning Inspectorate 26/01/2024	Appendix 1 is missing a site plan for Hamford Water SAC. This should be provided in the final version.	Noted. Appendix 1 (now referred to as Volume 5, Report 4, Annex 4.4) has been updated.
Section 51 Comments The Planning Inspectorate 26/01/2024	Appendix 1 sets out the conservation objectives for sites screened into the assessment of adverse effects on integrity. For some sites, the conservation status of the qualifying features is also provided, but not for all. The Inspectorate advises that the conservation status should be provided or an explanation should be given as to why the information is not available and what assumptions have been made in the assessment, including how any information or advice provided by the ANCB has been considered.	Noted. Appendix 1 (now referred to as Volume 5, Report 4, Annex 4.4) has been updated to ensure consistency throughout.

Date and consultation phase/type	Consultation and key issues raised	Comment
Section 51 Comments The Planning Inspectorate 26/01/2024	Table 6.1 summarises consultation relevant to HRA matters but only up to November 2022. As set out in Advice Note 10, the Inspectorate recommends that the RIAA includes evidence to demonstrate that the Applicant has fully consulted and had regards to comments received by Natural England as the relevant ANCB during the pre-application phase up to the point of DCO application submission.	Table 6.1 has been updated to reflect all relevant consultation.
Section 51 Comments The Planning Inspectorate 26/01/2024	"Table 8.1 of the draft RIAA summarises proposed mitigation measures, including a list of management plans and how these would be secured. Drafts of the management plans have not been submitted at draft documents stage, so the Inspectorate is not able to comment on their content. The Inspectorate has the following observations on the mitigation proposals: It is stated that the Landscape and Ecological Management Plan (LEMP) setting out mitigation for onshore ecology would be secured as a condition within the deemed marine licence (DML). This should be clarified, i.e. should it be through the requirement (R) 12 of the dDCO. There is a generic reference to following best practice guidance and standard regulatory requirements. Any measure being relied upon should be described, together with confirmation of timing in relation development progress and mechanisms to secure measures.	The comments on the proposed mitigation are noted. Please see Table 8.1 for more details on the proposed mitigation. The Applicant's response is broken down per point raised in the consultation response: The OLEMP (Volume 9, Report 22) is an onshore plan and reference should be to the DCO requirements. A detailed LEMP in accordance with the outline must be approved before the relevant works commence and this is secured in the DCO requirements. Regarding best practice guidelines, each chapter of the ES (as referenced in Table 8.1) details the best practice guidelines relevant to that receptor. For brevity, these documents are not explicitly listed within the RIAA. The Outline PEMP (Volume 9, Report 18) will be submitted alongside the DCO application.

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	Paragraph 9.2.16 indicates that the project environmental management plan (PEMP) is also of relevance to benthic ecology (and preventing the spread of invasive non-native species (INNS)). It is recommended that measures to be included in a biosecurity plan, or an outline version of this document, should be submitted with the DCO application. Paragraph 1.2.6 of the Benthic Compensation Strategy Roadmap suggests that a cable burial risk assessment (CBRA) has been prepared. The Inspectorate recommends this document is submitted with the DCO application as it is likely to contain information of relevance to the assessment of potential adverse effects arising from cable installation and how these could be mitigated.	An Outline CBRA (Volume 9, Report 9) will be submitted alongside the DCO application.
Section 51 Comments The Planning Inspectorate 26/01/2024	Regarding benthic ecology and potential effects from cable installation/ protection, the Inspectorate advises that it should be clear in the RIAA how the Applicant has worked through the mitigation hierarchy, as advised by Natural England as ANCB. This should include an explanation of the process, and which measures have been taken forward and/ or discounted and why. The Inspectorate notes that the draft RIAA contains limited information about the cable protection options and how they would be selected (if required) but welcomes the confirmation in paragraph 1.2.7 of the Benthic Compensation	Section 11.2 (specifically the O&M assessment for the Margate and Long Sands SAC) details the cable protection commitments the project has made as established within the Margate and Long Sands SAC Benthic Mitigation Plan (Volume 9, Report 13).

Date and consultation phase/type	Consultation and key issues raised	Comment
	Strategy Roadmap that this work is on-going and would be used to inform the RIAA."	
Section 51 Comments The Planning Inspectorate 26/01/2024	Section 9.2 describes the methodology for the in-combination assessment. Paragraph 9.2.11 states that tiers were allocated to the identified plans and projects before 1 February 2023, and that updates after this date have not been captured in the draft RIAA but may be included in future updates. The final version of the RIAA should confirm whether any updates have been made and, where additional detailed information has become available about other plans and projects, this should be reflected where it could have a bearing on the incombination assessment.	Section 9.2 details the approach to the in-combination assessment which details the updated approach with a final date for consideration in-combination being 31 October 2023.
Section 51 Comments The Planning Inspectorate 26/01/2024	Section 11.2 considers suspended sediment/ deposition as a potential impact pathway to benthic qualifying features of the Margate and Long Sands SAC and states that the pressure benchmark would be exceeded if up to 5cm of fine material were added to the habitat in a single event. It is stated that deposition is likely to occur in a small area but this is unlikely to exceed the pressure benchmark in a significant way. The Inspectorate recommends that the RIAA clearly describes or cross-refers to the evidence that supports this assertion, and the conclusion of no adverse effects on integrity (AEoI).	The assessment within Section 11.2 has been updated to reflect the updated assessments within Volume 6, Part 2, Chapter 5 Benthic and Intertidal Ecology, which enable the conclusion of no AEoI.

Date and consultation phase/type	Consultation and key issues raised	Comment
Section 51 Comments The Planning Inspectorate 26/01/2024	Paragraph 11.2.28 states that the overlap between the ECC and Margate and Long Sands SAC is 1.26 km^2, with the total area affected by sandwave clearance during construction at 0.7 m^2, equating to habitat disturbance of 0.11% of the SAC because of the Proposed Development. The Inspectorate advises that it should be clear in the RIAA the basis on which this proportion is calculated and what controls there are in the DCO to prevent it from being exceeded, if that is what the assessment is based on.	Section 11.2 details the assessment on the Margate and Long Sands SAC, with the final area of overlap being 1.26 km^2 of the SAC, and the total area that is expected to be disturbed by sandwave clearance is 0.6 km^2 (based on 50% of the ECC requiring sandwave clearance), which equates to 0.09 % of the total SAC. This is highlighted within the Benthic Mitigation Plan (Volume 9, Report 13).
Section 51 Comments The Planning Inspectorate 26/01/2024	Paragraph 11.2.60 states that the maximum height of any cable protection (if required) would be 1.4m and that, on that basis, habitat loss in the Margate and Long sands SAC during operation might not be permanent as it could undergo periods of being buried and uncovered. The Inspectorate advises that it should be clear in the RIAA what controls there are in the DCO to restrict the height of cable protection, if that is what the assessment is based on.	The updated value for cable protection height is 1.1 m, this has been reflected within the text as appropriate. The maximum height for cable protection height will be secured within the CSIP (Volume 9, Report 12).
Natural England's Relevant Representations 21/06/2024	Natural England had several comments on the approaches and outcomes of the RIAA, including > Requests for clarity around the MDS for cable protection, particularly around the phrasing of "additional" protection	The following amendments have been made to this revision of the RIAA: > The wording in the commitment relating to cable protection has been updated (Table 8.1)

Date and consultation phase/type	Consultation and key issues raised	Comment
	> Comments on the impacts of the cable protection on the MLS SAC and requirement for additional mitigation measures	> The Applicant maintains it's position based on the negligible volume of cable protection and the mitigation measures in place
	> Requests to update the assessments based on updated conservation advice for the MLS SAC which is due between Autumn 2024 and March 2025	> The Applicant notes the upcoming updates to conservation advice and requests to be kept informed by Natural England on timescales for these updates
	> Requests to update the screening outcomes for harbour porpoise to include sites that were previously screened out due to a lack of connectivity	> The Applicant maintains it's position with respect to screening based on industry standard approaches and lack of transboundary consultation feedback
	> Requests for clarity around the inclusion of seismic surveys within the in-combination assessment for marine mammals	> The Applicant notes the inclusion of seismic surveys within the in-combination assessment (Section 12.3)
	> Requests for clarity on the tiers used for seismic surveys for the marine mammal assessment	> The Applicant has updated the tiers used for Seismic surveys to Tier 7 (Section 12.3)
	> PVAs were run without a burn-in period	> All PVAs were re-run with 5-year burn in where possible.
	> Requests to provide the omitted data so an appropriate assessment can be made of the risk posed to protected Razorbill populations at the Farnes SPA.	> The Applicant has not included razorbill impacts on the Farne Islands because the predicted impact from the displacement was 0.00%.
	> Requests to update in-combination totals for guillemot and razorbill using 70% Displacement and 2% mortality	> The Applicant will submit both the Natural England's preferred approach (70% displacement and 2% mortality) and the

Date and consultation phase/type	Consultation and key issues raised	Comment
	> Request to present displacement matrices for all species screened into the HRA.	Applicants preferred approach of 50% displacement and 1% mortality. The Applicant has included all relevant matrices that were omitted

7 PROJECT OVERVIEW

7.1 INTRODUCTION

7.1.1 The RIAA draws on Volume 6, Part 2, Chapter 1: Offshore Project Description and Volume 6, Part 3, Chapter 1: Onshore Project Description, each of which includes an 'envelope' designed to include necessary flexibility to accommodate further project refinement and optimisation during detailed design, post consent. VE consists of northern and southern array areas (collectively known as the array areas), an offshore and an onshore boundary, including the landfall, onshore substation and export cable corridor. VEs collective array area is approximately 128 km^2 and at it is closet point located approximately 37 km from the Suffolk coastline.

7.1.2 Full details on the project description are presented within the ES, specifically in Volume 6, Part 2, Chapter 1: Offshore Project Description. It is noted that for a number of aspects of the project, a range of options are available, particularly during the construction phase. To manage the potential for impact, and in line with both the ES and PINS Advice Note 9: Rochdale Envelope, the project elements that represent the maximum design scenario (MDS) for each topic (the 'Rochdale Envelope') have been identified and taken forward. The key project design parameters considered within this RIAA are described below in Section 7.4.

7.1.3 The Screening report identified a number of receptor groups, with the topic-specific MDS for each group presented within the relevant chapter from the ES. The receptor groups identified are: benthic and intertidal Ecology; marine mammals; offshore and intertidal ornithology; onshore ecology; and migratory fish.

7.2 PROJECT DESCRIPTION

7.2.1 A proposed maximum of 79 Wind Turbine Generators (WTGs) will be installed within the array areas. Electricity generated will be transported to the coastline via a maximum of 200 km of inter-array cables and 196 km of offshore export cables which will be installed within the offshore AoS to a landfall site within the cable corridor, to connect to the National Grid's EACN.

7.2.2 The foundation type used for the structures required (e.g. OSPs and WTGs) depends on the site conditions (e.g. water depth and ground conditions) and supply chain possibilities. Given the uncertainty regarding these conditions and the final project design, no particular foundation type has been selected at this stage. At this stage, six types of foundation are being considered: monopiles, multi-leg pin-piled jackets, mono suction caissons, multi-leg suction caisson jackets, monopile GBS, and multi-leg GBS jackets.

7.2.3 Scour protection will be put in place around the foundations (where necessary), with several methods considered including rock or gravel placement, concrete mattresses, flow energy dissipation devices, protective aprons or coverings (solid structures of varying shapes, typically prefabricated in concrete or high-density plastics), and bagged solutions.

7.2.4 Several cable installation methodologies are being considered for the installation of inter-array and offshore export cables, including jet-trenching, pre-cut and post-lay trenching, mechanical trenching, dredging (Trailing Hopper Suction Dredger and backhoe dredger), mass flow excavation, rock cutting, and burial sledge. Additionally, a ducted cable methodology is being considered for inter-array cables only.

7.2.5 With respect to cable protection, all cables will be buried where possible. Where it is not reasonably possible to bury cables (inter-array and export), it will be necessary to install cable protection to prevent scour and minimise the risk of damage to the cable. An analysis of the requirement for the cables to cross existing infrastructure (such as cables and pipelines) is provided within the ES (Volume 6, Part 2, Chapter 1: Offshore Project Description) along with realistic worst case design parameters to enable a detailed assessment to be undertaken.

7.2.6 The onshore elements of VE will comprise the landfall, a substation and onshore ECC (collectively, the "onshore infrastructure"). The landfall is where the offshore electrical cable will come ashore to meet the onshore electrical cable. These will be joined at a transition joint bay which will be onshore (further details of onshore cable installation can be found in Volume 6, Part 3, Chapter 1: Onshore Project Description). The substation will be used to make the power generated by the wind farm suitable for transfer to the National Grid. The electrical cable will link the landfall to the substation and then the substation to the National Grid. The onshore sections of the export cable will be buried underground. The onshore order limits form an area of approximately 12,000 ha, encompassing land between Holland-on Sea, Frinton-on-Sea, Manningtree and Elmstead Market. It is shown in Figure 7.1. The assessments presented here assume the project is completed as detailed and described in the paragraphs above. If the project design is further refined, the conclusions of assessments made here will be revisited to confirm they remain valid.

7.3 SITE SELECTION

7.3.1 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) in relation to the HRA process, is presented in full in Volume 1, Chapter 4: Site Selection and Alternatives.

7.3.2 In summary, 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.

7.3.3 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 proposed grid connection location;
- Stage 3 - identification of the landfall zones;
- Stage 4 - identification of offshore cable route;
- Stage 5 - identification of the onshore infrastructure area of search;
- Stage 6 - offshore refinement of project from Scoping to ES; (with statutory consultation); and
- Stage 7 - onshore refinement of project from Scoping to ES; (with statutory consultation).

CONSULTATION ON SITE SELECTION

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

7.3.5 Consultation is a key part of this process informing all stages and has helped to refine the project through wider spatial, design and process considerations discussed in broader forums, both formally through the EPP and workshops with key stakeholders, or more informally through the feedback received through public events. This process was iterative, taking account of refinements to the preferred ECC search area and the latest site-specific data to ensure that options were aligned and site appropriate. Consideration was given to several technical, commercial and environmental consenting constraints informed by data analysis and constraints mapping prior to presentation and consultation with key stakeholders.

7.3.6 The aim of consultation is to seek consensus between all parties on the amount, type and range of evidence collected to ensure the DCO Application meets the requirement to provide sufficient information to enable recommendations to be made.

7.3.7 The following meetings have taken place to discuss, among other things, site selection and alternatives with key stakeholders:

- December 2021:

- Post-scoping ETG meetings were held for the offshore topics (see relevant chapters for full details e.g. siting consultation is detailed within Volume 6, Part 2, Chapter 9: Shipping and Navigation);
- May 2022:
  - Updates were provided to the ETGs for onshore topics including a site selection update;
- October 2022:
  - Shipping and Navigation Hazard Workshop, Site selection and alternatives were discussed with key offshore shipping and navigation stakeholders and feedback received;
- November 2022:
  - Pre-PEIR ETG Meetings across all topics to all key stakeholders:
    - Project updates on site selection, approaches and evidence were presented;
- December 2022:
  - Commercial Fisheries Working Group
    - Project updates on site selection, approaches and evidence were presented;
- July 2023 to February 2024:
  - Post-PEIR meetings were held with a number of Shipping and Navigation stakeholders including: UK Chamber of Shipping, Harwich Haven Authority, DFDS Seaways, Marine Coastguard Agency, Trinity House, Port of London Authority and London Gateway.
- September 2023:
  - Post-PEIR ETG Meetings across all Onshore and Offshore topics to all key stakeholders, including updates on site selection.
- October 2023 to February 2024
  - Number of meetings held with Natural England and Defra to provide updates regarding the project and to discuss compensation measures.

7.3.8 The consultees consulted with throughout the site selection process are listed below:

- BT Group
- Chamber of Shipping
- East Suffolk Coast and Heaths AONB
- East Suffolk County Council
- Eastern Inshore Fisheries Conservation Authority
- Environment Agency
- Essex County Council

- Essex Wildlife Trust
- Harwich Harbour Authority
- Historic England
- Kent and Essex Inshore Fisheries and Conservation Authority (IFCA)
- Maritime and Coastguard Agency (MCA) [and Trinity House]
- Ministry of Defence
- MMO
- National Air Traffic Services
- National Trust
- Natural England
- Port of London Authority
- Royal Yachting Association
- RSPB
- Suffolk County Council
- Suffolk Wildlife Trust
- Sunk Vessel Traffic Services
- Tarmac marine
- Tendering District Council
- The Wildlife Trust

7.4 MAXIMUM DESIGN SCENARIO

7.4.1 The MDS is referred to throughout the ES and here in the RIAA. This approach ensures that the scenario that would have the greatest impact (e.g. largest footprint, longest exposure, or tallest dimensions, depending on the topic) is assessed; we can be confident that any other (lesser) scenarios will have an impact that is no greater than that assessed.

7.4.2 The Screening Report identified a number of receptor groups, with the topic specific maximum design scenario for each group presented within the relevant chapter from the ES. Where a receptor group remains screened in for potential LSE, these chapters are drawn on here. The receptor groups are outlined below, together with the relevant ES chapter:

- Volume 6, Part 2, Chapter 4: Offshore Ornithology;
- Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology;
- Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology;
- Volume 6, Part 2, Chapter 7: Marine Mammal Ecology; and
- Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation;

7.4.3 The MDS, as it applies to each receptor group, is defined in the relevant chapter and draws on the information presented in the tables listed above in the individual ES chapters. The MDS for each receptor group is also summarised in a table at the beginning of each assessment section. 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.

7.5 CONSTRUCTION PROGRAMME

7.5.1 The construction programme for VE is dependent on a number of factors which may be subject to change, including:

- The date of a connection to the National Grid;
- The date that the DCO is granted;
- Should it be required, obtaining a Contract for Difference (CfD) from the UK Government within the anticipated programme; and
- The availability and lead-in times associated with procurement and installation of project components.

7.5.2 Main offshore construction works are anticipated to commence in 2029, with some preliminary survey and clearance works potentially taking place in 2026 to 2028. The wind farm is anticipated to be operational by 2030.

7.5.3 Offshore construction works are typically carried out under relatively calm metocean conditions normally experienced during the summer, although some activities may take place throughout the year. Furthermore, 24-hour offshore working will be required, with illumination required on construction vessels during night-time and low light conditions. Figure 7.1 below illustrates the indicative dates and durations for each activity, and the order in which they are expected to occur in the construction campaign.

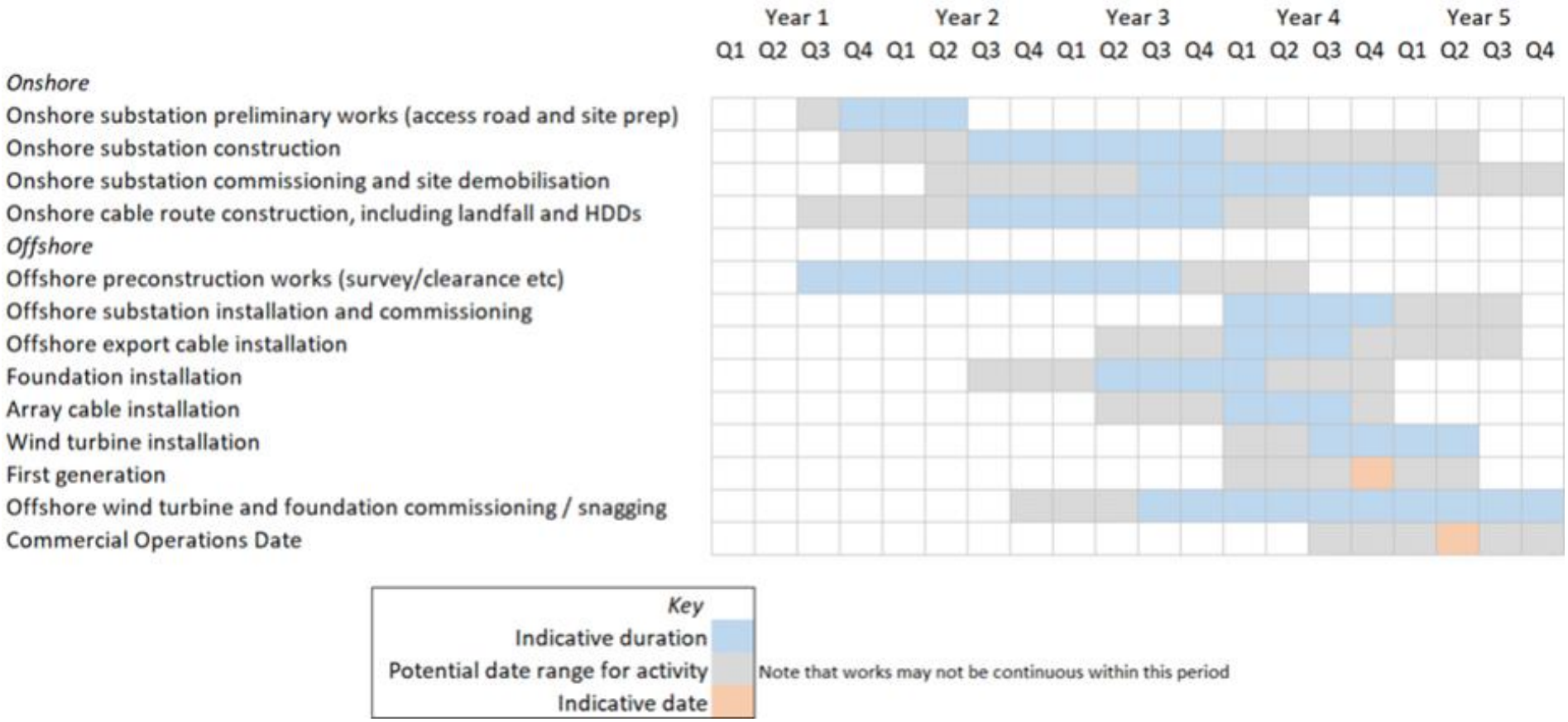

Figure 7.1 Indicative construction programme

7.6 OPERATION, MAINTENANCE AND DECOMMISSIONING PROGRAMME

7.6.1 A full project description is provided in Volume 6, Part 2, Chapter 1: Offshore Project Description and Volume 6, Part 3, Chapter 1: Onshore Project Description, with Operation and Maintenance addressed in Section 1.9 in both chapters. Each chapter presents a summary of the MDS per receptor for all phases of the project.

7.6.2 The overall O&M strategy will be finalised once the O&M base location and technical specification of VE are known, including wind turbine generator type, electrical export option and final project layout. Maintenance activities will be undertaken throughout the operational life of VE (anticipated 24 to 40 years) and will be both preventive (scheduled) and corrective (unexpected repairs). Full detail for the works to be undertaken in this stage are presented within the Outline O&M Plan (Volume 9, Report 17: Outline Offshore Operations and Maintenance Plan).

7.6.3 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. Whereas O&M requirements for the onshore substation and electrical balancing infrastructure will be both preventative and corrective.

7.6.4 For the purposes of the RIAA, at the end of the operational lifetime of VE, it is assumed that all infrastructure above the seabed will be completely removed. The decommissioning sequence will generally be in the reverse of construction (reverse lay) and is expected to involve similar types and numbers of vessels and equipment and take place over a three-year period.

7.6.5 Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components *in situ*, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations) or left *in situ* (e.g. in the case of subsea cables and rock protection). As part of the decommissioning works, cables may be removed or left in-situ. If removed HDD ducts will be left *in situ* and capped appropriately.

7.6.6 The decommissioning plan and programme will be updated during VE'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.

8 MITIGATION

8.1.1 The information on mitigation per receptor draws on individual topic chapters as listed in Section 2.4. All impact avoidance/ mitigation measures relevant to the RIAA are summarised below in Table 8.1 including the route for securing each element of mitigation. Further detail is presented in the ES Volume 9, Report 31: Schedule of Mitigation and Mitigation Route Map. The mitigation measures contained in Table 8.1 are mitigation measures or commitments that have been identified and adopted as part of the evolution of the project design of relevance to the topic, these include project design measures, compliance with elements of good practice and use of standard protocols. Mitigation is only a consideration during the determination of potential for adverse effect within the design scenario assessed. The approach ensures the RIAA is compliant with the People over Wind ruling referenced in Section 4.4.

Table 8.1 Mitigation relevant to HRA receptor groups

Mitigation	Relevant Receptor	Details
Avoidance Through Project Design		
Impact avoidance/ reduction through project design	> Benthic and Intertidal Ecology > Migratory Fish > Offshore and Intertidal Ornithology > Marine Mammals > Onshore Ecology and Biodiversity	Avoidance of designated sites and sensitive habitats through careful ECC route selection Full details of avoidance/ mitigation through design are set out in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 6: Migratory fish, Volume 6, Part 2, Chapter 4: Offshore and Intertidal Ornithology, and Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.
Additional Mitigation		
Marine Mammal Mitigation Protocol (MMMP) implementation	> Marine Mammals > Migratory Fish	Volume 9, Report 14.1: Outline Marine Mammal Mitigation Protocol - Piling will be implemented as a condition in the dML. The MMMP will be secured as a condition within the dML. The purpose of the MMMP will be to reduce the impact of auditory injury (PTS) to negligible levels. A final MMMP will be produced in the post-consent phase (see Volume 7, Report 8: Outline MMMP A decommissioning MMMP will be implemented subject to a separate Marine Licence application prior to decommissioning, should this be required. Further detail of the MMMP are set out in Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, and Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.

Mitigation	Relevant Receptor	Details
Cable Specification and Installation Plan (CSIP) implementation	> Benthic and Intertidal Ecology > Migratory Fish	Development of, and adherence to, a Cable Specification and Installation Plan (CSIP), relating to the offshore ECC, post consent. The CSIP will set out appropriate cable burial depth in accordance with industry good practice, minimising the risk of cable exposure. The CSIP will also ensure that cable crossings are appropriately designed to mitigate environmental effects, these crossings will be agreed with relevant parties in advance of CSIP submission. The CSIP will be conditioned in the deemed Marine Licence. An Outline CSIP has been provided as part of this DCO Application (Volume 9, Report 12).
Southern North Sea (SNS) SAC Site Integrity Plan (SIP)	> Marine Mammals	Development of, an adherence to, the Outline SIP (see Volume 9, Report 15) to reduce the impact of underwater noise disturbance on the harbour porpoise feature of the Southern North Sea SAC as a condition withing the dML.
Margate and Long Sands SAC Benthic Mitigation Plan	> Benthic and Intertidal Ecology	As detailed within the Outline M&LS SAC Benthic Mitigation Plan (Volume 9, Report 13) additional mitigation is applied to cable protection within the M&LS SAC, this aims to reduce pressures on the sandbank features within this site. This mitigation plan has been developed in line with Natural England's mitigation hierarchy for designated sites. The mitigation that has been applied includes the following commitments: > The area of cable protection in the SAC will not exceed 5,400 m^2; > Final cable routing will seek to take the shortest route through the M&LS SAC where possible, and considering the required separation to North Falls cables and from the pilot boarding area – this routing work will also consider the potential for successful cable burial with the objective of avoiding the need for cable

Mitigation	Relevant Receptor	Details
		protection using the cable burial hierarchy set out in Section 5 of Volume 9, Report 13; > Should burial not be achieved at the first attempt the burial hierarchy will followed in line with Section 5 of Volume 9, Report 13; > Rock dumping using loose rock will not be considered a feasible protection in the M&LS SAC; and > Should protection be required then mattresses or another form of protection that is equivalent or less in terms of footprint or impact will be used. Cable protection selection will also take into account the ability to remove the protection at the end of the life of the cables. Additional protection after construction would require a subsequent Marine Licence.
Seasonal Piling Restriction	> Fish and Shellfish Ecology	No piling within the array area will be undertaken during the peak Downs herring spawning period. Specific details can be found in Volume 6, Part 5, Annex 6.4: Herring Seasonal Restriction Note.
Project Environmental Management Plan (PEMP) implementation	> Offshore and Intertidal Ornithology > Marine Mammals	A Project Environmental Management Plan (PEMP) (Volume 9, Report 18) has been proposed to be produced to ensure that the potential for contaminant release is strictly controlled. The PEMP will include a Marine Pollution Contingency Plan (MPCP) and will also incorporate plans to cover accidental spills, potential contaminant release and include key emergency contact details (e.g. NE, Maritime Coastguard Agency and the project site co-ordinator). The PEMP will be secured as a condition in the deemed Marine Licence (dML).
Working in Proximity to Wildlife	> Offshore and Intertidal Ecology > Marine Mammals	Volume 9, Report 18.1: Working in Proximity to Wildlife will reduce the risk of vessel disturbance and collision risk which will consider the mitigation listed in the Working in Proximity to Wildlife in the

Mitigation	Relevant Receptor	Details
		Marine Environment Code of Conduct document. The Working in Proximity to Wildlife will be secured as a condition within the dML.
GCN, Bats and Dormouse European Protected Species Licences (EPSL)	> Onshore Ecology	An EPSL from NE will be required for temporary works affecting terrestrial habitat used by GCN along the route. The project proposes to enter the District Level Licensing (DLL) scheme, based on current survey data and available scheme details. The DLL differs from the traditional EPSL route in that any impacts to GCN are offset at a district or county-level rather than site-level and uses a conservation fee from developers that is used to create and maintain new ponds and habitat in locations that will benefit the species for the foreseeable future. This approach has been discussed and agreed with NE as part of the evidence plan process; it is anticipated that NE will issue an Impact Assessment and Conservation Payment Certificate (IACPC) for countersigning based upon the MDS used to inform this assessment, which will be included at Volume 6, Part 6 Annex 4.20: Five Estuaries Offshore Wind Farm: GCN District Level Licencing Impact Assessment and Conservation Payment Certificate (unsigned) and associated documents. The IACPC is considered equivalent to a “Letter of No Impediment” LONI, i.e., confirmation that NE agrees to the DLL approach described, subject to the payment stated and conditions of the licence. The final approach to GCN EPSL would be revisited post-consent, and would be informed by pre-commencement survey data and final scheme design.
Code of Construction Practice (CoCP) Implementation	> Onshore Ecology	All construction work will be undertaken in accordance with a Code of Construction Practice (CoCP, see Volume 9, Report 21) which includes the assessment of vegetation clearance and other construction works, disturbance reduction to breeding and non-

Mitigation	Relevant Receptor	Details
		breeding birds at landfall, Invasive Not Native Species (INNS) control measures, and all best practice guidelines.
Measures to reduce disturbance to non-breeding birds along the Onshore ECC and at the Onshore Substation (OnSS)	> Onshore Ecology	The draft CoCP (ES Volume 9, 9.21: Draft Code of Construction Practice) includes measures to reduce disturbance to important populations of non-breeding birds along the onshore ECC and at the OnSS, including: Where practical, in areas where disturbance to significant numbers of non-breeding waterbirds is likely, measures such as fencing/ hoarding would be used during the winter months to provide visual and acoustic screening of active working areas. The requirement for such measures would be determined by the ECOW, considering the nature and timing of the works and relevant bird data, including previous survey data and observations made during the construction period.
Landscape and Ecological Management Plan (LEMP)	> Onshore Ecology	The Outline LEMP (OLEMP) (Volume 9, Annex 9.22, Outline Landscape and Ecological Management Plan) includes measures to reduce disturbance to important populations of non-breeding birds along the onshore ECC and at the OnSS, including: Where practical, in areas where disturbance to significant numbers of non-breeding waterbirds is likely, measures such as fencing/ hoarding would be used during the winter months to provide visual and acoustic screening of active working areas. The requirement for such measures would be determined by the ECOW, considering the nature and timing of the works and relevant bird data, including previous survey data and observations made during the construction period.
Decommissioning Plan implementation	> Marine Mammals > Benthic and Intertidal Ecology	A Decommissioning Programme will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project

Mitigation	Relevant Receptor	Details
	> Migratory Fish > Offshore and Intertidal Ornithology	vessels on-site, partially deconstructed structures) the mitigation measure will be similar to those for the construction phase. The Decommissioning Programme will be secured as a condition in the deemed Marine Licence.
Following best practice guidance and standard regulatory requirements	> Offshore and Intertidal Ornithology > Migratory Fish > Benthic and Intertidal Ecology > Marine Mammals > Onshore Ecology	Adherence to best practice guidelines for all stages of the project to reduce and minimise risk of injury or disturbance to wildlife and sensitive habitats. The Applicant commits to the disposal of sewage and other waste in a manner which complies with all regulatory requirements, including but not limited to the IMO MARPOL requirements. Full details of best practice are set out in Volume 6, Part 2, Chapter 4: Offshore and Intertidal Ornithology, Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, and Volume 3, Chapter 4: Onshore Biodiversity and Nature Conservation.

9 HRA SCREENING

9.1 SCREENING UPDATES FOR VE ALONE

9.1.1 The updated Screening report includes details on the changes made that are associated with relevant consultation (Section 5.1 of the Screening Report), incorporating VE's comments on NE's consultation response.

9.1.2 A key change included in the update to the Screening Report is a marked reduction in the north eastern section of the northern array boundary and slight increases in the offshore ECC (see Figure 1.1 in the Screening Report). For offshore ornithology, onshore ecology, marine mammals, and migratory fish the screening approach (as presented in the Screening Report) is primarily driven by the potential for connectivity between designated sites and VE based on distance alone (where distances to relevant sites have been confirmed through the use of Geographical Information Systems (GIS). The change in such distances as a result of the changes in the northern array area and the ECC boundaries is minimal and has not resulted in in any change to the list of sites or features previously screened in for potential LSE.

9.1.3 For the onshore EEC, the refinement of the scheme to one option and the reduction in the cable route area are key changes between this document and the Screening report. The retained option is the Project and is what is assessed in the RIAA. The designated sites identified for assessment at screening for onshore receptors remain the same.

9.1.4 However, changes have taken place to the conclusions of potential for LSE for four offshore ornithological features that were initially presented in Table 7.3 of the Screening Report. Detailed explanations as to why these species have subsequently been screened out can be found in the Volume 5, Report 4, Annex 4.4: Summary of Designated Sites. These are as below:

9.1.5 Red-throated diver (Outer Thames Estuary SPA) – now only screened in for disturbance and displacement within the ECC during construction and decommissioning (previously also screened in during operation and maintenance, which has now been screened out). The VE array area is beyond the maximum expected extent of displacement/disturbance for red-throated divers (see SNCBs, 2022 for recent evidence and SNCB advice on red-throated diver displacement). Therefore, red-throated diver was screened in for disturbance and displacement due to work activity and vessel movements within the preferred ECC only.

9.1.6 Little tern (Outer Thames Estuary SPA, Alde Ore Estuary SPA, Thanet Coast and Sandwich Bay SPA, Hamford Water SPA, Minsmere-Walberswick SPA) – now screened out (previously screened in for collision on migration during operation and maintenance, and for Outer Thames Estuary SPA also for disturbance and displacement within the ECC during construction). Little tern in Outer Thames Estuary SPA breed on Scroby Sands intertidal sand bank, located 79 km from the ECC. This is well outside of the reported foraging ranges for the species (Thaxter ., 2012, 6.3+-2.4 km (MMF+-SD); Woodward ., 2019, 5 km (MMF)). In addition, little tern were not detected during the bird surveys of the VE site (March 2019 – February 2021). The species can thus be considered highly unlikely to have connectivity with the VE ECC, and as such, LSE can be discounted in relation to both alone and in-combination effects.

9.1.7 In addition, little tern has been screened out for risk of collision on migration. Evidence shows that little tern are a strictly coastal, rather than marine species; they are the most inshore of all tern species, found in shallow waters on passage (BirdLife International, 2022). WWT & MacArthur Green (2014) found that little tern migrate within 10 km of the shoreline. In addition, little tern were not detected during the bird surveys of the VE site (March 2019 – February 2021). Based on the information outlined above, the species can thus be considered highly unlikely to have connectivity with the VE array area, and as such, LSE can be discounted in relation to both alone and in-combination effects.

9.1.8 Little gull (Greater Wash SPA) - now screened out (previously screened in for collision on migration during operation and maintenance and disturbance and displacement). This species has been screened out based on the fact that Greater Wash SPA is located >62 km north of both the VE array and ECC. As the species breeds north of the SPA, there is no interaction with the VE array and ECC.

9.1.9 Sandwich tern (Alde Ore Estuary SPA) - now screened out (previously screened in during operation and maintenance for collision, disturbance and displacement and barrier effects). This species has been screened out owing to low numbers recorded within the array; only two individuals were recorded throughout the entire two survey years (both birds recorded in year one, in April and October respectively, no birds recorded in year two). Furthermore, Alde Ore Estuary SPA is beyond mean max foraging range (but within mean max foraging range +-1SD) of the VE array.

9.1.10 Common tern (Outer Thames Estuary SPA) now screened out (previously screened in for collision during O&M). This species has been screened out owing to low numbers recorded within the array (abundance estimate of 3.52 recorded in one month only across the two survey years). Additionally, the ECC overlaps <1% (0.892%) of the Outer Thames Estuary SPA and therefore any displacement from this area during construction will have a negligible effect on habitat availability and prey resource.

9.1.11 Marsh Harrier (Alde Ore Estuary SPA) – now screened out (previously screened in for collision on migration during operation and maintenance). Alde-Ore Estuary SPA lies directly to the west of the VE array. With migratory marsh harrier migrating to Southern Europe and sub-Saharan Africa (i.e. in a southerly direction) (Wright ., 2012), it can be considered highly unlikely that migrating marsh harrier from this SPA have connectivity with the VE array located to the east, and as such, LSE can be discounted in relation to both alone and in-combination effect.

9.1.12 Nightjar (Minsmere-Walberswick SPA) – now screened out (previously screened in for collision on migration during operation and maintenance) using the same justification as for Marsh Harrier from Alde Ore Estuary SPA.

9.1.13 The updated screening conclusions for these features are presented in Table 9.1.

9.1.14 Additionally, for benthic and intertidal ecology, the screening approach has been updated using the overlap identified between the zone of influence (i.e., the benthic ecology study area) and designated sites for benthic and intertidal ecology features (as presented in both Figure 5.1 in the Screening Report and Figure 5.1 in ES Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology). The updated ranges for all designated sites are included in Table 9.1.

9.1.15 With respect to marine mammals, additional information has been considered for the screening out of transboundary sites for harbour porpoise. All transboundary sites remain screened out based on the following considerations with respect to each effect:

- Underwater noise (disturbance/TTS, PTS, and barrier effects);
  - Based on the distance to site and the consideration of effective deterrent ranges (EDRs), the range considered for underwater noise effects is 26 km. All of the transboundary sites for harbour porpoise are beyond 26km and therefore there is no potential for LSE.
- Vessel collision risk (injury and disturbance);
  - Compared to the background vessel traffic, the number of vessels added by VE will result in a comparatively small increase in vessel traffic during construction. Furthermore, as the closest site is 65 km away from VE at it's closest point, it is considered that the potential impacts of increased vessel activity with respect to both injury and disturbance is not a significant risk to the population as a whole and therefore there is no potential for LSE at any transboundary site.
- Habitat loss;
  - Harbour porpoise are known to be wide-ranging animals with a large range of supporting habitats. When considering the distance to VE from any transboundary site (65 km away from VE at it's closest point), the short-term and intermittent impacts from the development of VE, it is considered that there are no impacts on harbour porpoise from habitat loss or disturbance and therefore no LSE on any transboundary sites.
- Accidental pollution and changes in water quality;
  - Based on the distance to the transboundary sites (65 km to the closest site), it is considered that there is no potential pathway for effect from this impact given the extent of the impact and influence of tidal factors.
- Changes to prey.
  - Harbour porpoise are known to be wide-ranging animals with large foraging ranges and a wide variation in diet. When considering the distance to VE from any transboundary site (65 km away from VE at it's closest point), the short-term and intermittent impacts from the development of VE, and the conclusions drawn on both benthic ecology and fish and shellfish within the RIAA and ES, it is considered that there are no direct impacts on harbour porpoise prey species and therefore no indirect impacts on marine mammals through impacts to prey.

9.1.16 Other than the information above, the full screening exercise is not repeated or expanded on here further, with the screening conclusions for the project alone summarised in Table 9.1. This summarises, on a site-by-site basis, the features screened in for potential LSE from the project alone. Information on sites/features/effects screened out from potential LSE is contained within the Screening Report but is not reproduced in full here in the interests of brevity.

Table 9.1 The results of the HRA screening assessment for VE alone

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
Benthic and Intertidal Ecology Screening							
Margate and Long Sands SAC	23.61	0.00	21.01	> Sandbanks which are slightly covered by sea water all the time	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > Accidental pollution	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > EMF > Changes to physical processes > Accidental pollution	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > Accidental pollution
Essex Estuaries SAC	64.38	9.02	7.37	> Estuaries > Mudflats and sandflats not covered by seawater at low tide > Salicornia and other annuals colonizing mud and sand > Spartina swards (*Spartinion maritimae*) > Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) > Mediterranean and hermos-Atlantic halophilous scrubs (*Sarcocornetea fruitocosi*) > Sandbanks which are slightly covered by sea water all the time	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > Accidental pollution	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > EMF > Changes to physical processes > Accidental pollution	> Physical habitat loss/ disturbance > Suspended sediment/ deposition > INNS > Accidental pollution
Marine Mammal Screening							
Berwickshire and North Northumberland Coast SAC	445.90	434.21	418.96	> Grey seal	> Underwater noise (disturbance/TTS, PTS, and barrier effect) > Collision risk (injury and disturbance)	> Collision risk > Changes to prey > Disturbance at haul out	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Changes to prey > Habitat loss

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
					> Changes to prey > Habitat loss > Disturbance at haul out		> Disturbance at haul out
Humber Estuary SAC	203.32	188.56	174.21	> Grey seal	> Underwater noise (disturbance/TTS, PTS, and barrier effect) > Collision risk (injury and disturbance) > Changes to prey > Habitat loss > Disturbance at haul out	> Collision risk > Changes to prey > Disturbance at haul out	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out
Humber Estuary Ramsar	197.29	182.18	167.67	> Grey seal	> Underwater noise (disturbance/TTS, PTS, and barrier effect) > Collision risk (injury and disturbance) > Changes to prey > Habitat loss > Disturbance at haul out	> Collision risk > Changes to prey > Disturbance at haul out	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out
Southern North Sea SAC	0.00	0.00	27.52	> Harbour Porpoise	> Underwater noise (disturbance/TTS, PTS, and barrier effect) > Collision risk > Accidental pollution and changes in water quality > Changes to prey	> Underwater noise (disturbance/TTS) > Collision risk > Changes to prey	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Accidental pollution and changes in water quality > Changes to prey
The Wash and North Norfolk Coast SAC	126.45	119.42	105.40	> Harbour Seal	> Underwater noise (disturbance/TTS, PTS, and barrier effect) > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out	> Collision risk > Changes to prey > Disturbance at haul out	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
Transboundary sites for seals; > Bancs des Flandres SCA; > Doggersbank (Netherlands) SAC > Klaverbank 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..	Various	Various	Various	> Harbour seal; and > Grey seal	> Underwater (disturbance/TTS, PTS, and barrier effect) noise > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out	> Collision risk > Changes to prey > Disturbance at haul out	> Underwater noise (disturbance/TTS, PTS) > Collision risk > Changes to prey > Habitat loss > Disturbance at haul out
Offshore and Intertidal Ornithology Screening							
Outer Thames Estuary SPA	17.24	0.00	1.85	> Red-throated diver	> Disturbance and displacement due to work activity and vessel movements within the ECC only	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> Disturbance and displacement due to work activity and vessel movements within the ECC only
				> Common tern	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)
				> Little tern	> No LSE (see Volume 5, Report 4, Annex 4.4:	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
					Summary of Designated Sites)		
Alde-Ore Estuary SPA	37.44	12.27	26.65	> Lesser black-backed gull	> No LSE	> Risk of collision	> No LSE
				> Sandwich tern	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Little tern	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Marsh harrier	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Avocet > Redshank > Ruff	> No LSE	> Risk of collision on migration	> No LSE
Alde-Ore Estuary Ramsar	37.44	12.27	23.65	> Lesser black-backed gull	> No LSE	> Risk of collision	> No LSE
				> Avocet > Redshank	> No LSE	> Risk of collision on migration	> No LSE
Minsmere-Walberswick SPA	41.88	36.99	49.86	> Little tern	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Marsh harrier	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Nightjar	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
				> Avocet > Bittern > Gadwall > White-fronted goose > Hen harrier > Shoveler	> No LSE	> Risk of collision on migration	> No LSE

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
				> Teal			
Minsmere-Walberswick Ramsar	41.88	37.00	49.86	> Bittern > Gadwall > Teal > Shoveler > Marsh harrier > Avocet > Bearded tit	> No LSE	> Risk of collision on migration	> No LSE
Deben Estuary SPA	48.45	11.39	19.65	> Avocet > Dark-bellied brent goose	> No LSE	> Risk of collision on migration	> No LSE
Deben Estuary Ramsar	48.45	11.39	19.65	> Dark-bellied brent goose	> No LSE	> Risk of collision on migration	> No LSE
Hamford Water SPA	51.17	3.16	0.80	> Little tern	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)
				> Avocet > Black-tailed godwit > Dark-bellied brent goose > Grey plover > Redshank > Ringed plover > Shelduck > Teal	> No LSE	> Risk of collision on migration	> No LSE
Hamford Water Ramsar	52.89	3.70	0.81	> Black-tailed godwit > Dark-bellied brent goose > Redshank > Ringed plover	> No LSE	> Risk of collision on migration	> No LSE
Stour and Orwell Estuaries SPA	54.81	12.75	3.15	> Black-tailed godwit	> No LSE	> Risk of collision on migration	> No LSE

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
				> Dark-bellied brent goose > Dunlin > Grey plover > Knot > Pintail > Redshank			
Stour and Orwell Estuaries Ramsar	54.80	12.75	3.15	> Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot > Pintail > Redshank	> No LSE	> Risk of collision on migration	> No LSE
Thanet Coast and Sandwich Bay SPA	57.69	45.81	47.19	> Little tern	> No LSE	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE
Colne Estuary (Mid-Essex Coast Phase 2) SPA	66.63	10.89	7.30	> Dark-bellied brent goose > Pochard > Redshank > Ringed plover	> No LSE	> Risk of collision on migration	> No LSE
Colne Estuary (Mid-Essex Coast Phase 2) Ramsar	66.62	10.89	7.30	> Dark-bellied brent goose > Redshank	> No LSE	> Risk of collision on migration	> No LSE
Dengie (Mid-Essex Coast Phase 1) SPA	73.74	19.59	17.91	> Dark-bellied brent goose > Grey plover > Knot	> No LSE	> Risk of collision on migration	> No LSE

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
Dengie (Mid-Essex Coast Phase 1) Ramsar	73.74	19.59	17.91	> Dark-bellied brent goose > Grey plover > Knot	> No LSE	> Risk of collision on migration	> No LSE
Blackwater Estuary (Mid-Essex Coast Phase 4) SPA	77.81	21.08	14.36	> Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover	> No LSE	> Risk of collision on migration	> No LSE
Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar	77.81	21.08	14.36	> Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover	> No LSE	> Risk of collision on migration	> No LSE
Flamborough and Filey Coast SPA	275.50	264.61	251.31	> Kittiwake	> No LSE	> Risk of collision (non-breeding)	> No LSE
				> Gannet	> Direct disturbance and displacement	> Risk of collision > Direct disturbance and displacement	> Direct disturbance and displacement
				> Guillemot	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea
				> Razorbill	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea
Farne Islands SPA	472.54	461.41	446.28	> Guillemot	> Direct disturbance and displacement due to the potential for this species to	> Direct disturbance and displacement due to the	> Direct disturbance and displacement due to the potential for this species to migrate

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
					winter in southern North Sea	potential for this species to winter in southern North Sea	through VE and winter in southern North Sea
				> Razorbill	> Direct disturbance and displacement due to the potential for this species to winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to winter in southern North Sea	> Direct disturbance and displacement due to the potential for this species to migrate through VE and winter in southern North Sea.
Greater Wash SPA	62.70	69.41	89.71	> Little gull	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)	> No LSE (see Volume 5, Report 4, Annex 4.4: Summary of Designated Sites)
Migratory Fish Screening							
Vlaamse Banken	34.75	40.44	83.67	> Twaite Shad	> Underwater Noise	> No LSE	> Underwater Noise
Onshore Ecology Screening							
Hamford Water SAC	54.73	4.04	0. 82	> Fisher's estuarine moth *Gortyna borelii lunata*	> Impacts on supporting populations, food plant and potential habitat outside SAC. > Water quality: pollution from site run-off affecting habitat quality > Decreases in water quantity. > Decrease in air quality	> No LSE	> Impacts on supporting populations, food plant and potential habitat outside SAC. > Water quality: pollution from site run-off affecting habitat quality > Decreases in water quantity. > Decrease in air quality.
Hamford Water SPA	51.17	3.16	0.80	> Over winter: > Avocet > Black-tailed godwit > Dark-bellied brent goose > Grey plover > Redshank > Ringed plover > Shelduck > Teal During the breeding season:	> Loss of foraging and roosting habitat outside the SPA. > Disturbance of birds outside the SPA. > Water quality: pollution from site run-off affecting prey availability. > Decreases in water quantity. > Decrease in air quality.	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work.	> Disturbance of birds outside SPA. > Water quality: pollution from site run-off affecting prey availability. > Decrease in air quality

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
				> Little Tern			
Hamford Water Ramsar	52.89	3.70	0.81	> Important wintering populations of: > Black-tailed godwit > Dark-bellied brent goose > Redshank > Ringed plover	> Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting prey availability. > Decreases in water quantity. > Decrease in air quality.	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work.	> Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting prey availability. > Decrease in air quality.
Stour and Orwell Estuaries SPA	54.81	12.75	3.15	> Over winter: > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot > Pintail > Redshank > Waterbird assemblage > On passage: > Redshank > During the breeding season: > Avocet	> Loss of foraging and roosting habitat outside the SPA > Disturbance/ displacement of birds outside SPA, > Pollution from site run-off affecting prey availability. > Decreases in water quantity. > Decrease in air quality	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work	> Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting prey availability. > Decrease in air quality.
Stour and Orwell Estuaries Ramsar	54.80	12.75	3.15	> Important wintering populations of: > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot	> As for the SPA	> As for the SPA plus, impacts on supporting populations of plants and invertebrates outside the Ramsar.	> Disturbance/ displacement of birds outside SPA > Pollution from site run-off affecting prey availability > Impacts on supporting populations of plants and invertebrates outside the Ramsar

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
				> Pintail > Redshank > Important passage populations of redshank. > Also qualifies for: > Wintering waterbird assemblage			
Colne Estuary (Mid-Essex Coast Phase 2) SPA	66.63	10.89	7.39	> Over winter: > Dark-bellied brent goose > Hen harrier > Pochard > Redshank > Ringed plover > Waterbird assemblage > During the breeding season: > Little tern	> As for Stour and Orwell Estuaries SPA	> As for Stour and Orwell Estuaries SPA	> As for Stour and Orwell Estuaries SPA
Colne Estuary (Mid-Essex Coast Phase 2) Ramsar	66.62	10.89	7.30	> Over winter: > Dark-bellied brent goose > Redshank > Waterbird assemblage > Wetland invertebrate assemblage > Wetland plant assemblage > Saltmarsh	> As for Stour and Orwell Estuaries SPA	> As for Stour and Orwell Estuaries SPA	> As for Stour and Orwell Estuaries SPA
Abberton Reservoir SPA	79.78	22.72	12.07	> Breeding: > Cormorant > Non-breeding:	> Loss of foraging and roosting habitat outside the SPA.	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work	> Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting habitat quality.

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
				> Coot > Gadwall > Goldeneye > Great crested grebe > Mute swan > Pochard > Shoveler > Teal > Tufted duck > Wigeon > Waterbird assemblage	> Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting habitat quality. > Decrease in air quality		> Decrease in air quality
Abberton Reservoir Ramsar	79.78	22.71	12.07	> Wintering: > Gadwall > Shoveler > Wigeon > Waterbird assemblage	> As for the SPA	> As for the SPA	> As for the SPA
Blackwater Estuary (Mid-Essex Coast Phase 4) SPA	77.81	21.08	14.36	> Non-breeding: > Black-tailed godwit > Dark-bellied Brent goose > Dunlin > Grey plover > Hen harrier > Waterbird assemblage > Breeding: > Little tern > Pochard > Ringed plover	> Loss of foraging and roosting habitat outside the SPA. > Disturbance/ displacement of birds outside SPA. > Water quality: pollution from site run-off affecting habitat quality. > Decreases in water quantity. > Decreases in air quality	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work	> Disturbance/ displacement of birds outside SPA > Water quality: pollution from site run-off affecting habitat quality. > Decreases in water quantity. > Decreases in air quality.

Designated Site	Distance to VE Order Limits (km)			Features screened in*	Potential for LSE Identified		
	Array Area	Offshore ECC	Onshore ECC		Construction	Operation and Maintenance	Decommissioning
Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar	77.81	21.08	14.36	> Wintering: > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Waterbird assemblage > Saltmarsh > Wetland invertebrate assemblage > Wetland plant assemblage	> As for the SPA plus impacts on supporting populations of plants and invertebrates outside the Ramsar.	> As for the SPA	> As for the SPA, plus impacts on supporting populations of plants and invertebrates outside the Ramsar.

9.2 SCREENING UNDERTAKEN FROM VE IN-COMBINATION

9.2.1 The Habitats Regulations include a requirement for the Competent Authority to carry out a HRA 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 is summarised above in Section 9.1, with screening for the project in-combination undertaken within the Screening Report and the conclusions confirmed here.

9.2.2 The following list has been applied to VE when identifying plans and projects for consideration in-combination (taking account of relevant advice, such as the PINS Advice Note 10, which addresses which plans and projects to include):

- 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's programme or 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.

9.2.3 A full review of such plans and projects has been conducted for VE, with each individual topic chapter for the ES having undertaken screening of the full list of projects, plans and activities, to identify those relevant to individual receptor groups. The relevant plan/ project screening tables for the receptor groups within the RIAA are presented within the ES chapters as follows:

- Volume 6, Part 2, Chapter 4: Offshore Ornithology;
- Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology;
- Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology;
- Volume 6, Part 2, Chapter 7: Marine Mammal Ecology;
- Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation;

9.2.4 With respect to in-combination effects within the HRA process, the Screening Report identified the broad categories of plans and projects to be considered within this RIAA. The specific plans and projects relevant to individual receptors draw on those identified within the individual ES chapters, as highlighted above, 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.

9.2.5 Further, it is acknowledged that the potential contribution to an in-combination AEoI by VE could stem not only from those effects where potential LSE exists in relation to the project alone (as highlighted in Section 9.1 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. Where a theoretical pathway exists but there is no conceivable way that this could result in any tangible effect on a qualifying feature of a European site the assessment has concluded that there is no pathway for effect. This includes effects which are trivial in terms of scale, extent, duration and magnitude. An effect pathway that is considered to be inconsequential should be considered immaterial due to its inconsequential or 'trivial' scale and would not result in a conceivable effect (paragraph 3.16 (1) of Advice Note 10 version 9 (Planning Inspectorate, 2022)) or real risk to the European site's conservation objectives.

9.2.6 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.

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

9.2.8 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' reflects 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 VE.

9.2.9 The tiering structure applied here is in common with that applied within the relevant ES chapters (listed above) and is provided below in Table 9.2.

9.2.10 It is noted that there is significant variability in project certainty between a project in planning but not yet submitted to PINS, 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' 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 much greater in terms of impact/timeframe than a project at the point of construction e.g., fewer turbines, more clearly defined (and often shorter) construction window etc.

Table 9.2 Description of Tiers of other developments considered for in-combination assessment[4]

Tier 1	Tier 2	Tier 3
Projects in operation (that do not form part of the baseline)	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted
Projects that are under construction		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
Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented		
Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined	Projects under the Planning Act 2008 where a PEIR has been submitted for consultation	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

[4]Adopted from PINS Advice Note 10, with the addition of projects in operation.

Table 9.3 Description of Tiers of other developments considered for in-combination assessment for offshore ornithology

Tier 1	Tier 2	Tier 3
Projects in operation	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted
Projects under construction		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
Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented	Projects under the Planning Act 2008 where a PEIR has been submitted for consultation	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
Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined		

Table 9.4 Description of Tiers of other developments considered for in-combination assessment for marine mammals

Tier 1	Tier 2	Tier 3	Tier 4	Tier 5	Tier 6	Tier 7
Built and operational projects should be included within the in-combination 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 e.g. "background" distribution or mortality rate for birds	Tier 1 + projects under construction.	Tier 2+ projects that have been consented (but construction has not yet commenced).	Tier 3 + projects that have an application submitted to the appropriate regulatory body that have not yet been determined.	Tier 4 + Projects that have an application submitted to the appropriate regulatory body that have not yet been determined	Tier 5 + projects that the regulatory body are expecting an application to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects)	Tier 6 + projects that have been identified in relevant strategic plans or programmes.

9.2.11 The Screening Report identified the designated sites and relevant plans and projects to include for in-combination assessment (plans or projects which are located within 22.5 km of the designated site). For benthic and intertidal ecology, the sites screened in for in-combination assessment are:

- Margate and Long Sands SAC; and
- Essex Estuaries SAC.

9.2.12 In terms of plans and projects to be considered, the conclusions of the screening for other plans and projects considered relevant for benthic and intertidal ecology are provided in Table 9.5.

Table 9.5 Summary plans and projects to be considered in-combination for benthic and intertidal ecology.

Project/Plan				Range to SACs Considered (km)	
Development type	**Project**	**Status**	**Tier**	**Margate and Long Sands SAC**	**Essex Estuaries SAC**
OWF	East Anglia TWO	Consented	1	39	51.6
	North Falls	In-planning	2	8.4	49.1
Aggregate production Area	Tarmac Marine Ltd (509/1)	Operation	1	3	30.3
	Tarmac Marine Ltd (509/2)	Operation	1	3	26
	Tarmac Marine Ltd (509/3)	Operation	1	0	30.3
	CEMEX UK Marine Ltd (510/2)	Operation	1	0.12	37.9
	CEMEX UK Marine Ltd (507/1)	Operation	1	10.8	42.7
	CEMEX UK Marine Ltd (507/2)	Operation	1	42.7	10.88
	CEMEX UK Marine Ltd (507/3)	Operation	1	47.8	14.0

Project/Plan				Range to SACs Considered (km)	
	CEMEX UK Marine Ltd (507/4)	Operation	1	48.3	14.2
	CEMEX UK Marine Ltd (507/6)	Operation	1	55.8	18.8
	Hanson Aggregates Marine Ltd (Area Number 528/2)	Operation	1	35.3	7.9
	Britannia Aggregates Ltd (508)	Operation	1	0	30.3
Disposal Sites	TH056 Inner Gabbard East	Operation	1	9.9	50.0
	TH052 Inner Gabbard	Operation	1	5.9	45.5
	EC-5TH073 Whitstable C	Operation	1	6.3	17.4
	TH213 Wrabness Beach	Operation	1	33.8	14.7
	TH216 Copperas	Operation	1	29.7	16.2
	TH217 Erwarton Track	Operation	1	28.9	18.4
	TH027 Harwich Haven	Operation	1	5.2	37.5
	TH064 Maldon Saltings 3	Operation	1	34.9	0
	TH221 EA One Route EC-2	Operation	1	19.1	34.4
	TH153 TEOW Disposal site 1	Operation	1	6.4	36.9
	TH154 TEOW Disposal site 2	Operation	1	5.0	36.5

Project/Plan				Range to SACs Considered (km)	
	TH155 TEOW Disposal site 3	Operation	1	8.6	36.2
	TH058 Northey Island	Operation	1	33.4	0
	TH229 Wrabness Beach East	Operation	1	33.5	0
	TH230 Horsey.	Operation	1	24.0	14.5
Electricity cable	Neuconnect	Consented	1	0	1.5
Electricity cable	Sealink Interconnector	Proposed	2	0	47.1
	Gridlink Interconnector	Proposed	2	0	21.3
Interconnector	Nautilus Multi-Purpose Interconnector (MPI)	Proposed	3	31.8	57.1
	LionLink	Proposed	3	34.2	57.1

9.2.13 For the plans and projects highlighted in Table 9.5 it is considered that there is potential for LSE in-combination with VE with respect to the relevant site/feature(s). The potential for such an effect will vary, depending on parameters such as the timing of works and the nature of those works, with these to be considered in full in the determination of AEoI.

9.2.14 The sites and effects considered in-combination for benthic and intertidal ecology are the same as those screened in for potential LSE for the project alone. Due to the distance from the sites, no potential for any meaningful contribution to an in-combination effect resulting from VE has been identified in relation to those sites and effects screened out from potential LSE alone. Those sites and effects include physical habitat loss/ disturbance, suspended sediment/ deposition, accidental pollution, INNS and changes to physical processes at:

- Vlaamse Banken SAC;
- Thanet Coast SAC;
- Bancs des Flandres SAC;
- Alde Ore and Butley Estuaries SAC;
- Orfordness – Shingle Street SAC;
- Deben Estuary Ramsar;

- Stour and Orwell Estuaries Ramsar;
- Colne Estuary (Mid-Essex Coast Phase 2) Ramsar;
- Alde Ore Estuary Ramsar; and
- Foulness (Mid-Essex Coast Phase 5) Ramsar.

9.2.15 With regards to Subtidal and Intertidal Ecology there have been changes to the potential effects which were originally screened into the in-combination assessment. These are listed below:

- Construction and decommissioning phase:
  - Increased risk of introduction or spread of marine INNS – now screened out for the in-combination assessment. This impact has been screened out as the potential impact from VE alone has been assessed as negligible due to the mitigation measures which will be put in place, which includes following best practice guidelines and standard operating practices (as managed through the PEMP and biosecurity plan). These measures are considered in addition to the measures that will be in place on other projects to reduce the risk of the spread of marine INNS cumulatively.
- O&M Phase
  - Electromagnetic Frequency (EMF) effects – now screened out for the in-combination assessment. This impact has been screened out as the potential impact from VE alone has been assessed as negligible and there is overall no significance.
  - Increased risk of introduction or spread of marine INNS – now screened out for the in-combination assessment. As above with regards to the construction and decommissioning phase this impact has been screened out as the potential impact from VE alone has been assessed as negligible due to the mitigation measures which will be put in place, which includes following best practice guidelines and standard operating practices (as managed through the PEMP and biosecurity plan). These measures are considered in addition to the measures that will be in place on other projects to reduce the risk of the spread of marine INNS cumulatively.
  - Changes to physical processes – now screened out for the in-combination assessment. This impact has been screened out as the potential impact from VE alone has been assessed as negligible and there is overall no significance.
  - Suspended sediment/ deposition – now screened out for the in-combination assessment. During the O&M phase any potential impacts will be highly localised and are unlikely to combine in any significant manner with any other potential projects.

9.2.16 These changes are in line with the impacts screened into the in-combination assessment within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology.

MARINE MAMMALS

9.2.17 For marine mammals, screening for in-combination effects has considered those same European sites which were screened for project alone effects. The approach followed is also the same, whereby a plan or project is screened in where there is potential for that project (through consideration of construction and O&M impacts) to have a temporal and/ or spatial overlap with that of VE and the plan/ or project is within the relevant range to the designated site (North Sea Management Unit (MU) for harbour porpoise, Southeast MU for harbour seals, combined Southeast and Northeast MUs for grey seals).

9.2.18 The in-combination section of the RIAA therefore considers the following sites:

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland SAC (grey seal);
- Transboundary sites for harbour seal (Doggersbank (Netherlands) SAC, Klaverbank SCI, and Vlaamse Banken SAC); and
- Transboundary sites for grey seal (Doggersbank (Netherlands) SAC, and Klaverbank SCI, Bancs des Flandres SCI, Vlaamse Banken SCI, SBZ 1 SCI, SBZ 2 SCI, SBZ 3 SCI, Vlakte van de Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, Waddenzee SCI).

9.2.19 Not all the effects considered for potential LSE alone for marine mammals are considered in-combination, with the RIAA in-combination excluding several impacts assessed in the RIAA alone. This is due to the highly localised nature of several impacts, the management and mitigation measures proposed by The Applicant to address the impact of the project alone (resulting in no residual effect as considered in Section), and the management and mitigation measures proposed on other projects that will reduce the in-combination effects. Additionally, impacts have been screened out in-combination where the potential significance of the impact from VE alone has been assessed as negligible in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Therefore, only disturbance/TTS from underwater noise during construction and decommissioning, and vessel disturbance (at sea and at seal haul out sites) during all phases of the project are considered for the RIAA in-combination.

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

9.2.21 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 when the assessment is made for the construction and decommissioning period. For example, relevant projects / plans with consent and (if required) a CfD (or similar) are more likely to contribute to in-combination impacts with VE (providing an effect or temporal pathway exists), whereas projects/ plans not yet approved or not yet submitted to planning are less certain to contribute to such an impact, as some may not achieve approval within the relevant timescales or may not ultimately be built due to other factors.

9.2.22 That uncertainty in the context of the VE tiering structure is noted throughout Section 9.2. A key part of the response to that uncertainty is the provision of an Outline Site Integrity Plan (SIP), which is presented alongside the ES (Volume 9, Report 15: Outline SNS SAC SIP). The requirement for a SIP, secured within the draft DCO, is to provide the required level of certainty that such risk will be managed and addressed as the project progresses, thus ensuring that the conclusions of the RIAA remain valid. Such a SIP has been used on a number of other offshore wind projects to date and is designed to provide the required level of certainty. Although the SIP is specific to the SNS SAC, management and/or mitigation of underwater noise for one species (harbour porpoise) has wider benefits for other noise sensitive species.

9.2.23 The Outline SNS SAC SIP has been submitted alongside the ES and will provide details of project commitments, including a list of in-principle mitigation measures, and implementation mechanisms as required in order to maintain the conclusions detailed within this RIAA. A number of mitigation measures are available (see Section 8) to be secured through the SIP, however which of these mitigation measure(s) is ultimately chosen (if indeed any are required) to ensure the conclusions are maintained, will be determined through the drafting of the final SNS SAC SIP prior to the construction of VE and will be a function of the final construction methodology and schedule of individual plans and projects. The Outline SNS SAC SIP addresses the following key points:

- Introduction - provides an overview of the project, the purpose of and requirement for the Outline SNS SAC SIP;
- Description of the project - summarises the MDS considered for VE;
- Summary of Potential Impacts - summarises the potential effects to marine mammals from VE with respect to the MDS and the ES assessments;
- Mitigation Methodology - notes the measures included within the RIAA and that should the need for further measures be identified through the SIP process, these would be to address risk of disturbance only. Includes note on potential mitigation measures available and the relative efficacy (where known, while leaving the option for novel technologies to be developed in the interim and applied); and
- References.

9.2.24 Drawing on the long list of projects identified during screening, the potential for in-combination LSE as a result of disturbance from underwater noise during the construction and decommissioning phase has been determined based on the following:

- A plan or project where there is potential for the construction period to have temporal overlap with the construction window of VE and the plan/ or project has

spatial overlap with only the winter area of the SNS SAC (as the VE array areas and most of the ECC is located within the winter area of the SNS SAC) OR is within the relevant species-specific MU of the designated sites for seals.

9.2.25 For vessel disturbance effects, consideration has been given to plans and projects in construction, operation and decommissioning, as identified by their location within the species-specific MU.

9.2.26 The differentiation between the construction period and the O&M period impacts is made here for marine mammals, in light of the typical scale of effects that may occur during construction compared to those during O&M (as evidenced by ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

9.2.27 It is acknowledged that other activities have the potential to contribute to an in-combination effect, specifically with regard to underwater noise. Previous assessments within the SNS SAC (e.g. the recently consented Norfolk Boreas, Norfolk Vanguard, East Anglia ONE North and East Anglia TWO OWFs) have included consideration of seismic surveys associated with oil and gas activity, together with UXO detonations. Where planned seismic surveys are known in association with the plans and projects identified in Table 12.2, these are screened in for assessment. Given the timeframes involved (with offshore construction works (including piling) at VE likely to commence in 2029, potentially preceded by geophysical survey and/or UXO clearance in 2028), it has been assumed that planned seismic surveys associated with the oil and gas industry will be ongoing throughout the construction period of VE. However, as the potential number of seismic surveys that could be undertaken is unknown it has been assumed that four will be conducted at any one time within the North Sea (to account for concurrent surveys in the northern and southern North Sea in both UK waters and those of neighbouring North Sea nations), when assessing harbour porpoise. Given that the MUs for seals are smaller than that for harbour porpoise, it is assumed that the in-combination assessment for both harbour and grey seals would incorporate two seismic survey operations within their respective MUs at any one time.

9.2.28 Similarly, as regards UXO clearance, where any planned works associated with projects screened in are known, these are included within the assessment.

9.2.29 The RIAA only takes account (and should only take account) of planned/consented works within the licensing process. It is not considered appropriate to undertake a speculative in-combination assessment in HRA terms based on historic activity for either oil and gas works or UXO clearance. It is therefore considered appropriate within the RIAA for VE to limit the in-combination assessment to works known to be occurring and not based on an assumption of past activity continuing. In any case, any activity that would be included within an in-combination assessment (but for which no information is as yet in the public domain) would be expected to undertake the HRA process in its own right and would therefore be the subject of assessment at that point, including consideration in combination with VE.

9.2.30 Furthermore, the expected delivery of the SIP with respect to the SNS SAC provides certainty that the in-combination assessment will be revisited on a defined timeframe, with additional plans/projects (or if necessary, the relevant project parameters) to be amended/included at that point as relevant. The process provides certainty in the in-combination screening process for harbour porpoise, and additional coverage for harbour and grey seals, given that the potential for effect of underwater noise on harbour seal and grey seal is smaller than for harbour porpoise.

9.2.31 Table 9.6 below uses the outputs of the Screening Report and identifies which plans and projects have been considered in the in-combination assessment. Several projects were removed from the initial long-list including projects that have:

- No data available;
- No timeline available;
- No conceptual effect-receptor pathway;
- No physical effect-receptor overlap; and
- No temporal overlap.

9.2.32 Additionally, several offshore project types were screened out as follows:

- Commercial fisheries (all operational: ongoing impact and part of the baseline);
- Shipping (all active: ongoing impact and part of the baseline);
- Aggregates (all operational: ongoing impact and part of the baseline); and
- Military, Aviation & Radar (all active: ongoing impact and part of the baseline)

Table 9.6: Summary plans and projects to be considered in-combination in relation to marine mammals

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
OWFs	Arven Floating	C&D, O&M	6	523.9	783.6	713.1	476.5
	Aspen Floating	Unknown	6	248.0	503.6	432.8	218.5
	Avalon Floating	O&M	4	255.4	508.2	435.9	212.7
	Ayre Floating	C&D, O&M	6	402.1	644.9	564.3	312.2
	Beech	Unknown	6	257.2	523.8	464.4	301.5
	Bellrock	C&D, O&M	6	151.9	407.3	337.8	147.6
	Berwick Bank Firth of Forth	C&D, O&M	4	144.0	345.9	261.5	30.1
	Blyth Demonstration Phases 2&3	O&M	6	124.4	248.1	158.5	17.4
	Borkum Riffgrund 3	O&M	2	220.2	347.9	393.5	508.4

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Bowdun	C&D, O&M	6	203.3	434.0	353.9	116.2
	Broadshore	O&M	6	331.3	572.4	491.5	241.4
	Buchan	C&D, O&M	6	330.6	578.7	502.5	261.3
	Caledonia	C&D, O&M	6	340.8	570.3	484.9	227.7
	CampionWind	C&D, O&M	6	181.9	442.3	374.9	184.8
	Cedar	C&D, O&M	6	145.7	409.1	345.9	187.5
	Cenos	C&D, O&M	6	173.3	439.6	379.5	228.4
	Centre-Manche 1	C&D, O&M	5	207.0	322.9	389.6	606.7
	Centre-Manche 2	Unknown	7	200.2	319.7	386.8	605.6
	Culzean	O&M	6	196.6	462.9	406.5	265.7
	Dieppe - Le Treport	O&M	6	102.3	291.4	362.0	602.3

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Dogger Bank A	O&M	3	0.0	188.3	158.7	207.2
	Dogger Bank B	O&M	3	0.0	204.6	164.2	192.3
	Dogger Bank C	C&D, O&M	3	24.1	233.6	218.1	258.8
	Dogger Bank D	C&D, O&M	6	24.1	233.6	218.1	258.8
	Dogger Bank South (East)	C&D, O&M	5	0.0	155.1	141.8	221.5
	Dogger Bank South (West)	C&D, O&M	5	0.0	167.8	129.3	191.4
	Dudgeon Extension	C&D, O&M	4	14.1	24.3	63.2	284.2
	Dunkerque	C&D, O&M	5	23.5	212.6	286.5	531.4
	East Anglia ONE NORTH	C&D, O&M	3	0.0	98.8	177.5	412.4

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	East Anglia THREE	O&M	3	0.0	112.9	185.3	403.3
	East Anglia TWO	O&M	3	0.0	99.0	177.8	416.2
	EnBW He dreiht	O&M	2	227.8	361.0	401.3	499.2
	Fecamp	O&M	2	156.3	313.3	383.3	614.6
	Firth of Forth - Alpha and Bravo	O&M	2	181.2	397.4	314.1	64.5
	Flora Floating	Unknown	6	252.0	494.0	416.6	179.5
	ForthWind Offshore Wind Demonstration Project - phase 1	C&D, O&M	2	242.9	401.2	302.5	53.5
	Green Volt	C&D, O&M	4	274.7	526.4	453.6	224.7

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Harbour Energy North	Unknown	6	265.5	531.0	468.7	294.9
	Harbour Energy South	Unknown	6	141.9	407.3	360.7	254.5
	HKZ Kavel III	O&M	2	63.6	207.5	283.0	499.8
	Hollandse Kust (West)	O&M	2	35.5	179.7	255.4	473.5
	Hornsea Project Four (HOW04)	C&D, O&M	3	0.0	105.5	79.8	204.7
	Hornsea Project Three (HOW03)	C&D, O&M	3	1.4	119.8	141.5	283.1
	IJmuiden Ver	C&D, O&M	6	0.5	144.4	217.4	414.3
	IJmuiden Ver 2021 - Y-VER	C&D, O&M	6	7.8	149.6	219.2	417.5
	Inch Cape	O&M	2	203.0	400.2	310.0	52.0

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Marram	C&D, O&M	6	291.2	546.5	475.1	244.9
	Moray West	O&M	2	364.0	587.2	497.6	235.8
	Morven	O&M	6	135.1	375.4	301.0	97.3
	Muir Mhòr	C&D, O&M	6	220.4	473.3	401.7	183.1
	N-10.1	C&D, O&M	7	221.3	367.2	400.6	487.6
	N-10.2	C&D, O&M	7	211.5	362.9	392.9	474.1
	N-3.7	O&M	7	277.2	406.8	454.4	567.7
	N-6.6	C&D, O&M	7	209.0	340.1	380.8	485.8
	N-6.7	C&D, O&M	7	201.3	335.3	374.4	477.1
	N-9.1	C&D, O&M	7	195.0	331.6	369.2	470.0
	N-9.2	C&D, O&M	7	205.8	349.4	383.7	475.5
	N-9.3	C&D, O&M	7	188.5	327.8	363.9	462.6
	N-9.4	Unknown	7	196.8	341.4	375.0	466.7

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Neart na Gaoithe	O&M	2	196.0	379.8	288.0	28.6
	Nordlicht I	O&M	4	227.7	357.8	399.7	502.2
	Nordsee Cluster A - N-3.8	C&D, O&M	7	267.0	395.7	442.3	553.4
	Nordsee Cluster B - N-3.5	C&D, O&M	7	263.1	392.7	440.5	553.4
	Nordsee Cluster B - N-3.6	C&D, O&M	7	259.0	388.5	436.3	548.9
	Nordsren I	O&M	6	307.5	480.7	494.3	519.3
	Nordsren II	O&M	6	285.1	461.6	472.8	489.0
	Nordsren II vest	O&M	6	251.1	426.0	438.1	469.3
	Nordsren III	O&M	6	294.9	481.2	486.5	490.6

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Nordsren III vest	O&M	6	231.0	408.7	418.5	437.2
	Norfolk Boreas	C&D, O&M	3	0.0	109.7	173.8	374.6
	Norfolk Vanguard	O&M	3	0.0	80.1	149.3	368.0
	North Falls	C&D, O&M	5	0.0	117.5	193.0	436.8
	Ossian	C&D, O&M	6	129.9	378.4	306.4	114.0
	Outer Dowsing	C&D, O&M	5	0.0	47.9	53.1	258.8
	Parc eolien pose au large de la Normadie (AO4)	C&D, O&M	6	200.2	319.7	386.8	605.6
	Pentland Floating	O&M	3	448.0	667.4	576.4	314.2

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Offshore Wind Demonstrator						
	Perpetuus Tidal Energy Centre (PTEC)	O&M	3	212.4	265.1	332.8	537.4
	Rampion 2 (Rampion Extension)	C&D, O&M	4	149.2	239.2	306.4	528.5
	Salamander	C&D, O&M	6	262.4	505.7	428.6	191.0
	SENSEWind Pelastar	Unknown	6	230.5	450.8	366.0	115.7
	Sheringham Shoal Extension	C&D, O&M	4	25.6	8.4	59.7	290.9
	Sofia	O&M	3	0.0	213.2	194.0	221.9
	Stoura Floating	Unknown	6	552.2	813.1	743.7	512.0

Project/Plan				Range to SACs (km)			
Development type	**Project**	**Phase of project which overlaps with VE**	**Tier**	**SNS SAC**	**WNNC SAC**	**Humber Estuary SAC/ Ramsar**	**BNN SAC**
	Stromar	C&D, O&M	6	365.8	605.7	524.3	272.0
	Thor	O&M	3	358.7	537.7	547.8	555.3
	Vesterhav Nord	O&M	2	408.8	590.2	599.5	597.9
	Vesterhav Syd	O&M	2	383.0	553.1	569.5	590.2
	West of Orkney	C&D, O&M	4	471.4	690.8	598.7	336.4
Seismic survey	Seismic survey 1	C&D, O&M	7	N/a	N/a	N/a	N/a
	Seismic survey 2	C&D, O&M	7	N/a	N/a	N/a	N/a
	Seismic survey 3	C&D, O&M	7	N/a	N/a	N/a	N/a
	Seismic survey 4	C&D, O&M	7	N/a	N/a	N/a	N/a

9.2.33 The plans and projects identified as relevant to the in-combination assessment for offshore ornithology receptors are based on an initial screening exercise undertaken on a long list of plans and projects and published in the ES (see Volume 6, Part 1, Annex 3.1: Cumulative Effects Assessment Methodology). A consideration of effect-receptor pathways, data confidence and temporal and spatial scales has been made in order to select the projects that have been included in the in-combination assessment.

9.2.34 Several planned and operational projects were screened out of further consideration for potential in-combination effects. This is because the potential for impact-pathway-receptor effects that occurred during construction, O&M or decommissioning had been excluded, for one or more of the following reasons:

- There was no potential impact-receptor-pathway due to the project being outside of the UK North Sea and English Channel;
- There was no temporal overlap between projects / activities;
- The project / activity is ongoing and was considered to be part of the current baseline; and
- There was no data available or there was a low level of confidence in the available data (see below).

9.2.35 The projects screened out included UK offshore wind farms evaluated as having low data confidence on the basis that no construction or operational period is known and / or because they were a UK offshore wind farm located outside of the North Sea. Other projects from non-offshore energy projects screened out included commercial fisheries as well as shipping and navigation, which were evaluated as being part of the offshore baseline.

The specific projects screened into the in-combination assessment for offshore ornithology receptors, which included only offshore wind farm projects, as well as the tiers (and sub-tiers) into which they have been allocated are presented in Table 9.7below.

Table 9.7 Projects screened into the offshore ornithology in-combination assessment.

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Beatrice	Operational	Potential temporal overlap of operation with VE
1	Beatrice Demonstration Site	Operational	Potential temporal overlap of operation with VE
1	Blyth Demonstration Site	Operational	Potential temporal overlap of operation with VE
1	Dudgeon	Operational	Potential temporal overlap of operation with VE
1	East Anglia One	Operational	Potential temporal overlap of operation with VE
1	European Offshore Wind Deployment Centre (EOWDC)	Operational	Potential temporal overlap of operation with VE
1	Galloper	Operational	Potential temporal overlap of operation with VE
1	Greater Gabbard	Operational	Potential temporal overlap of operation with VE
1	Gunfleet Sands	Operational	Potential temporal overlap of operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Humber Gateway	Operational	Potential temporal overlap of operation with VE
1	Hywind	Operational	Potential temporal overlap of operation with VE
1	Lincs, Lynn & Inner Dowsing	Operational	Potential temporal overlap of operation with VE
1	Kentish Flats I	Operational	Potential temporal overlap of operation with VE
1	Kentish Flats II	Operational	Potential temporal overlap of operation with VE
1	Kincardine	Operational	Potential temporal overlap of operation with VE
1	London Array	Operational	Potential temporal overlap of operation with VE
1	Methil	Operational	Potential temporal overlap of operation with VE
1	Race Bank	Operational	Potential temporal overlap of operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Rampion	Operational	Potential temporal overlap of operation with VE
1	Sheringham Shoal	Operational	Potential temporal overlap of operation with VE
1	Scroby Sands	Operational	Potential temporal overlap of operation with VE
1	Teesside	Operational	Potential temporal overlap of operation with VE
1	Thanet	Operational	Potential temporal overlap of operation with VE
1	Westermost Rough	Operational	Potential temporal overlap of operation with VE
1	Hornsea Project One	Operational	Potential temporal overlap of operation with VE
1	Hornsea Project Two	Under Construction	Potential temporal overlap of construction and operation with VE
1	Firth of Forth Alpha and Bravo	Under construction	Potential temporal overlap of construction and operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Moray East	Under Construction	Potential temporal overlap of operation with VE
1	Triton Knoll	Operational	Potential temporal overlap of operation with VE
1	Neart na Gaoithe	Under Construction	Potential temporal overlap of operation with VE
1	Seagreen Alpha	Under Construction	Potential temporal overlap of operation with VE
1	Seagreen Bravo	Under Construction	Potential temporal overlap of operation with VE
1	Dogger Bank A	Consented– construction expected 2021-2024	Potential temporal overlap of operation with VE
1	Dogger Bank B	Consented– construction expected 2021-2024	Potential temporal overlap of operation with VE
1	Dogger Bank C	Consented - construction expected 2023-2026	Potential temporal overlap of construction and operation with VE
1	East Anglia Three	Consented - construction expected 2021-2024	Potential temporal overlap of operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Hornsea Three	Consented – construction expected 2024-2030	Potential temporal overlap of construction and operation with VE
1	Inch Cape	Consented	Potential temporal overlap of operation with VE
1	Moray West	Consented	Potential temporal overlap of operation with VE
1	Moray Firth (EDA)	Operational	Potential temporal overlap of operation with VE
1	Sofia	Consented - construction expected 2023-2026	Potential temporal overlap of construction and operation with VE
1	East Anglia One North	Consented	Potential temporal overlap of construction and operation with VE
1	East Anglia TWO	Consented	Potential temporal overlap of construction and operation with VE
1	Norfolk Boreas	Consented	Potential temporal overlap of construction and operation with VE
1	Norfolk Vanguard	Consented	Potential temporal overlap of construction and operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
1	Hornsea Four	Awaiting determination construction expected 2025-2028	Potential temporal overlap of construction and operation with VE
2	Rampion 2	In planning	Potential temporal overlap of construction and operation with VE
2	Outer Dowsing	In planning	Potential temporal overlap of construction and operation with VE
2	North Falls Offshore Wind Farm	In planning	Potential temporal overlap of construction and operation with VE
2	Dogger Bank South (East)	In planning	Potential temporal overlap of construction and operation with VE
2	Dogger Bank South (West)	In planning	Potential temporal overlap of construction and operation with VE
2	Dogger Bank D	In planning	Potential temporal overlap of construction and operation with VE
2	Dudgeon Offshore Wind Farm Extensions	In planning	Potential temporal overlap of construction and operation with VE
2	Sheringham Shoal Offshore Wind Farm Extension	In planning	Potential temporal overlap of construction and operation with VE

Tier	Long List Offshore Project Name (all OWFs)	Offshore Project Details	Reason for Project Inclusion in VE In-combination Assessment
2	Greenvolt	In planning	Potential temporal overlap of construction and operation with VE
2	Pentland	In planning	Potential temporal overlap of construction and operation with VE
2	West of Orkney	In planning	Potential temporal overlap of construction and operation with VE
2	Berwick Bank	In planning	Potential temporal overlap of construction and operation with VE
3	Endurance CCS	Pre-planning	Potential temporal overlap of construction and operation with VE

9.2.36 The key risks in terms of potential in-combination effects on offshore ornithology receptors relate to the combined impacts on breeding and non-breeding seabirds (on passage or over-wintering), of displacement during the construction, operational & maintenance and decommissioning phases and mortality resultant from collision in the operational phase. In relation to those breeding and non-breeding seabirds, for there to be an in-combination effect to be assessed, it is considered that an effect arising from VE assessed alone has to be of sufficient magnitude to make a material contribution to an in-combination assessment at the wider, usually North Sea, scale. Therefore, where an effect from VE alone was determined to be trivial and inconsequential that would be well within the error margins of the assessment, there is no potential for any contribution for an in-combination effect to occur on such features and designated sites. It is also worth noting that the screening process followed a precautionary approach and where potential for an LSE has been identified alone it has been assumed that potential for LSE should also be considered in-combination in Section 12. Therefore, with respect to offshore ornithology, screening alone has been undertaken in an extremely precautionary manner, with that level of precaution being taken into account within the subsequent in-combination assessment.

9.2.37 Therefore, for clarity and in response to the precautionary screening undertaken for offshore ornithology alone, the subsequent assessment in-combination in Section 12. is focused on those designated sites and species for which there is potential for a material contribution from VE alone (as confirmed in the assessment alone in Section 11). Where an effect from VE alone was determined to be a trivial and inconsequential that would be well within the error margins of the assessment (as confirmed in the assessment alone in Section 11), such features and designated sites are not assessed further as there is no potential for any contribution for an in-combination effect to occur.

9.2.38 Additional consideration has been given to the potential for in-combination effects on non-breeding waterbird species from European and Ramsar sites. Non-breeding waterbirds from these sites may pass through or visit the VE array area during the non-breeding season and are considered for assessment (see below).

MIGRATORY FISH

9.2.39 The Screening Report identified the designated sites and relevant plans and projects to include for in-combination assessment (plans or projects which are located within 50 km of the designated site). For migratory fish, the only site screened in for in-combination assessment is:

- Vlaamse Banken SAC

9.2.40 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 9.8.

Table 9.8: Projects screened into the migratory fish in-combination assessment

Project/Plan				Range to SACs (km)
Development type	**Project**	**Status**	**Tier**	**Vlaamse Banken SAC**
OWF	East Anglia ONE North	Consented	1	86.68
	North Falls	In-planning	2	34.0
	IJmuiden Ver	Planned	3	132.13
	Scroby Sands	Operational	1	130.08
Aggregate Areas	Tarmac Marine Ltd (509/1)	Operational	1	64.68
	Tarmac Marine Ltd (509/2)	Operational	1	64.77
	CEMEX UK Marine Ltd (510/2)	Operational	1	51.03
	Tarmac Marine Ltd (509/3)	Operational	1	51.86
	Britannia Aggregates Ltd (508)	Operational	1	51.86
	CEMEX UK Marine Ltd (507/1)	Operational	1	61.54
	CEMEX UK Marine Ltd (507/3)	Operational	1	69.11
	CEMEX UK Marine Ltd (507/4)	Operational	1	66.26
Disposal Sites	TH052 Inner Gabbard	Operational	1	58.85
	EC-5TH073 Whitstable C	Operational	1	85.23
	TH213 Wrabness Beach	Operational	1	95.91
	TH216 Copperas	Operational	1	91.73
	TH217 Erwarton Track	Operational	1	90.90

Project/Plan				Range to SACs (km)
Development type	**Project**	**Status**	**Tier**	**Vlaamse Banken SAC**
	TH027 Harwich Haven	Operational	1	66.57
	TH064 Maldon Saltings 3	Operational	1	114.88
	TH221 EA One Route EC-2	Operational	1	80.47
	TH153 TEOW Disposal site 1	Operational	1	39.43
	TH154 TEOW Disposal site 2	Operational	1	41.74
	TH155 TEOW Disposal site 3	Operational	1	49.09
	TH058 Northey Island	Operational	1	113.09
	TH229 Wrabness Beach East	Operational	1	95.60
	TH230 Horsey.	Operational	1	86.19
Electricity Interconnector Cables Consented	NeuConnect Interconnector	Operational	1	47.47
Electricity Interconnector Cables Proposed	Nautilus Multi-Purpose Interconnector (MPI)	Operational	1	18.40
	Sealink	Operational	1	21.13
	Grid Link	Operational	1	21.13

9.2.41 For the plans and projects highlighted in Table 9.8, it is considered that there is potential for LSE in-combination with VE with respect to underwater noise impacts on twaite shad of Vlaamse Banken SAC. The potential for such an effect will vary, depending on parameters such as the timing of works and the nature of those works, with these to be considered in full in the determination of AEoI.

9.2.42 The effects considered in-combination for migratory fish are the same as those screened in for potential LSE for the project alone in Table 9.1. No potential for any meaningful contribution to an in-combination effect resulting from VE has been identified in relation to those effects screened out from potential LSE alone.

ONSHORE ECOLOGY

9.2.43 The Screening Report identified the designated sites and relevant plans and projects to include for in-combination assessment (plans or projects which are located within 50 km of the designated site). For Onshore Ecology, the sites screened in for in-combination assessment are:

- Hamford Water SAC;
- Hamford Water SPA
- Hamford Water Ramsar;
- Stour and Orwell Estuary SPA;
- Stour and Orwell Estuary Ramsar;
- Colne Estuary SPA;
- Colne Estuary Ramsar site;
- Abberton Reservoir SPA;
- Abberton Reservoir Ramsar;
- Blackwater Estuary SPA; and
- Blackwater Estuary Ramsar.

9.2.44 In terms of plans and projects to be considered, the conclusions of the screening for other plans and projects considered relevant for onshore are provided in Table 9.9.

Table 9.9 Project screened into the in-combination onshore ecology assessment

Project/Plan				Approximate Distance to Designated Sites (km)										
Development Type	**Project**	**Status**	**Tier**	**Hamford Water SAC**	**Hamford Water SPA**	**Hamford Water Ramsar**	**Stour and Orwell Estuary SPA**	**Stour and Orwell Estuary Ramsar**	**Colne Estuary SPA**	**Colne Estuary Ramsar**	**Abberton Reservoir SPA**	**Abberton Reservoir Ramsar**	**Blackwater Estuary SPA**	**Blackwater Estuary Ramsar**
OWF	North Falls	Pre-planning Application. If consent is granted the project will be constructed at the same time as VE and will be operational by 2030	3	0.28	0.28	0.28	3.30	3.30	7.26	7.26	11.93	11.93	14.25	14.25
Nuclear Power Station	Bradwell B	Pre application	2	22.25	22.25	22.25	25.06	25.06	3.52	3.52	8	8	0	0
Community Garden	Tendring/Colchester Borders Garden Community	Pre application	3	13.87	13.87	13.87	6.65	6.65	2.90	2.90	6.13	6.13	8.83	8.83
Electrical Cable	Bramford to Twinstead Electrical Line	Pre application	3	21.64	21.64	21.64	5.98	5.98	20.57	20.57	17.66	17.66	21.98	21.98
	Sea Link Electrical Line Suffolk to Kent	Pre application	2	34.21	34.21	34.21	30.20	30.20	53.08	53.08	58.25	58.25	59.97	59.97
Road improvements	A12 Chelmsford to A120 Widening Scheme	Examination	2	25.49	25.49	25.49	16.89	16.89	10.61	10.61	6.40	6.40	5.37	5.37
	Improvements to the A120 to Harwich and Harwich Freeport	Pre application	3	7.95	7.95	7.95	4.34	4.34	5.99	5.99	12.59	12.29	13.77	13.77
Onshore Electrical Infrastructure	Rivenhall Integrated Waste Management Facility (IWMF) and Energy Centre	Pre application	3	35.62	35.62	35.62	27.22	27.22	19.64	19.64	11.54	11.54	13.93	13.93
	Norwich to Tilbury (new high voltage network reinforcement	Pre application	3	11.29	11.29	11.29	3.87	3.87	8.67	8.67	7.16	7.16	9.83	9.83

Project/Plan			Approximate Distance to Designated Sites (km)											
	between Norwich, Bramford and Tilbury)													
Mixed Use Development	22/00979/DETAIL Land to the south of Thorpe Road, Weeley, CO16 9AJ	Awaiting decision	1	3.96	3.96	3.96	8.89	8.89	5.08	5.08	15.49	15.49	15.26	15.26
Energy	22/02117/FUL/ 23/00008/REFUSE	Refused, appeal lodged against refusal	1	1.88	1.88	1.88	9.81	9.81	8.95	8.95	20.02	20.02	19.26	19.26
Residential	20/00179/FUL	Approved (18 Jan 2022)	1	5.38	5.38	5.38	12.91	12.91	6.90	6.90	18.59	18.59	17.42	17.42
Residential	17/01988/FUL	Approved (11 Jun 2019)	1	1.99	1.99	1.99	11	11	10.64	10.64	22.19	22.19	21.45	21.45
Local Plans	Tendring	N/A	3	0	0	0	0	0	0	0	4.99	4.99	5.03	5.03
Local Plans	Babergh	N/A	3	3.82	3.82	3.82	0	0	18.02	18.02	20.32	20.32	22.31	22.31
Local Plans	Colchester	N/A	3	14.55	14.55	14.55	0	0	0	0	0	0	0	0
Local Plans	Maldon	N/A	3	24.78	24.78	24.78	24.79	24.79	4.41	4.41	3.41	3.41	0	0
Local Plans	Suffolk Coast	N/A	3	11.54	11.54	11.54	0	0	29.40	29.40	38.78	38.78	38.89	38.89

9.2.45 For the plans and projects highlighted in Table 9.5, it is considered that there is potential for LSE in-combination. The potential for such an effect will vary, depending on parameters such as the timing of works and the nature of those works, with these to be considered in full in the determination of AEoI.

9.2.46 The effects considered in-combination for onshore ecology are the same as those screened in for potential LSE for the project alone in Table 9.1. No potential for any meaningful contribution to an in-combination effect resulting from VE has been identified in relation to those effects screened out from potential LSE alone.

10 SUMMARY OF DESIGNATED SITES

10.1.1 Summary information on each designated site screened in for potential LSE alone and/ or in combination is provided in Volume 5, Report 4, Annex 4.4, including the designated feature(s), key literature sources describing the site and the features/ effects screened in under potential LSE. In addition to Volume 5, Report 4, Annex 4.4, the conservation objectives for each site are also described within each assessment, e.g. the conservation objectives for the SNS SAC can be found within the beginning of the site assessment in Section 11.3, paragraph 11.3.63.

11 ASSESSMENT OF ADVERSE EFFECTS ALONE

11.1.1 Where potential for LSE on a European site has been identified, there is a requirement to consider whether those effects will adversely affect the integrity of the site in view of its conservation objectives. The conclusion on potential LSE for VE alone and/ or in-combination is presented in Table 14.1, with the conservation objectives for all relevant sites provided in Volume 5, Report 4, Annex 4.4. The information is presented below according to the following receptor groupings:

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

11.1.2 Step one in the assessment is to 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.

11.1.3 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 ES. 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 14.1.

11.2 BENTHIC AND INTERTIDAL ECOLOGY

11.2.1 **Table 9.1** the results of the HRA screening assessment for VE alone presents the sites and associated impacts identified in the HRA screening process through which the construction, operation, maintenance and decommissioning of VE has the potential to cause LSE on sites designated for Benthic and Intertidal Ecology features.

ASSESSMENT SUMMARY

11.2.2 The potential for an AEoI applies in relation to the following designated sites and their relevant features (i.e., the feature/s screened in for potential LSE):

- Margate and Long Sands SAC (1110: Sandbanks which are slightly covered by sea water all the time);
  - Physical habitat loss/ disturbance (all phases);
  - Suspended sediment/ deposition (all phases);
  - INNS (all phases);
  - EMF (O&M only); and
  - Changes to physical processes (O&M only).
- Essex Estuaries SAC (1130: Estuaries, 1140: Mudflats and sandflats not covered by seawater at low tide, 1310: Salicornia and other annuals colonizing mud and

sand, 1320: Spartina swards (*Spartinion maritimae*), 1330: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), 1420: Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruitocosi*), and 1110: Sandbanks which are slightly covered by sea water all the time).

- Physical habitat loss/ disturbance (all phases);
- Suspended sediment/ deposition (all phases);
- INNS (all phases);
- EMF (O&M only); and
- Changes to physical processes (O&M only).

11.2.3 This assessment for AEoI is presented as follows:

- Assessment Criteria (a summary of the approach to the assessment);
- Description of Significance (a detailed description of the potential effects and their relevance to the Benthic and Intertidal Ecology receptor group, including);
  - An introduction to all the identified impacts relevant to this assessment (including mitigation); and
  - The relevant MDS'.
- The full assessment considered for the Margate and Long Sands SAC; and
- The full assessment considered for the Essex Estuaries SAC.

ASSESSMENT CRITERIA

11.2.4 The study area, assessment criteria and conclusions presented within the ES Volume 6, Part 2, Chapter 5: 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 ES conclusions on significance being considered here specifically in the context of the conservation objectives of the designated sites being assessed. The final assessment for each effect is based upon expert judgement. Where possible, parameters are quantified, and predicted changes presented.

11.2.5 Full detail of the assessment criteria and assignment of significance applied within the ES are provided within Section 5.5 of Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, and take account of the following:

- Sensitivity/ importance of the environment (drawing on the Marine Life Information (MarLIN) Marine Evidence based Sensitivity Assessment (MarESA)[3] sensitivity categories);
- Magnitude of impact (the degree of change from baseline, in terms of spatial extent, duration, timing, seasonality and/ or frequency, based on the EIA methodology chapter; and
- Significance of potential effect in terms of high/ medium/ low and negligible (defined in a matrix combining sensitivity and magnitude, based on the EIA methodology chapter).

[3] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

11.2.6 As described in Table 9.1 there are two European sites (Margate and Long Sands SAC and Essex Estuaries SAC) which have the potential to be affected through impacts on Benthic and Intertidal Ecology. These are described and assessed in turn below.

CONSTRUCTION AND DECOMMISSIONING

PHYSICAL HABITAT LOSS/ DISTURBANCE

11.2.7 There are a number of effects which may lead to physical habitat loss/ disturbance associated with the project alone during construction and decommissioning, with these identified within ES Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology. These include foundation seabed preparation, the use of jack-up vessels and anchoring operations, cable seabed preparation and installation, and the burial of inter-array cables. This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides the detailed offshore physical environment assessment.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.8 There are a number of sources of increases in suspended sediment/ deposition associated with the project alone during construction and decommissioning, with these identified within ES Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology. Temporary localised increases in suspended sediment concentration (SSC) and associated sediment deposition and smothering are expected from foundation and cable installation works (including HDD installation) and seabed preparation works (including sandwave clearance). This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides the detailed offshore physical environment assessment (including project specific spreadsheet modelling of sediment plumes).

INNS

11.2.9 There is a risk that increased vessel movements during construction will contribute to the risk of introduction or spread of Marine INNS through ballast water discharge (Eno *et al*., 1997). ES Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology identifies approximately 4,311 round trips to port during the construction phase. However, the movement of commercial vessels is common throughout the region (Volume 6, Part 2, Chapter 9: Shipping and Navigation) and this provides an existing and potentially more likely method of transport for Marine INNS species (due to the higher variety of ports and passage routes).

11.2.10 It should be noted that there is a wide-spread presence of Marine INNS across the southern North Sea. The Marine INNS *Crepidula fornicata* has successfully established to an extent that it outcompetes indigenous species causing large scale habitat changes across coastal areas of the UK (EMU Limited, 2012). Moreover, the most problematic Marine INNS off the Suffolk coast are the Turkish crayfish (*Astacus leptodactylus*), Chinese mitten crab (*Eriocheir sinensis*), leathery sea squirt (*Styela clava*) and wireweed (*Sargassum muticum*). Demonstrating that the region is not a pristine environment in terms of the absence of Marine INNS (Dittel *et al*., 2009; Holdich ., 2009; Macleod ., 2016 and Nehls ., 2006).

OPERATION AND MAINTENANCE

PHYSICAL HABITAT LOSS/ DISTURBANCE

11.2.11 The presence of 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 could lead to physical habitat loss/ disturbance (for the design life duration of VE), and it is considered to have a potential negative effect (due to the potential shift in the baseline condition), although it is noted that this also has the potential to comprise beneficial effects, providing new habitats for different faunal assemblages to colonise, resulting in a likely increase in biodiversity and biomass.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.12 Similar to the construction and decommissioning phases, any works undertaken within the array area and ECC could result in increases in suspended sediment/ deposition. This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides the detailed offshore physical environment assessment (including project specific spreadsheet modelling of sediment plumes).

INNS

11.2.13 In addition to the potential effects described above for the construction and decommissioning phases, there is also a potential that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by invasive/ non-indigenous species that might otherwise not have had a suitable habitat for colonisation, thereby enabling their spread. This along with the movement of vessels in and out of the array areas and offshore ECC during operation has the potential to impact upon benthic ecology and biodiversity locally and in the broader region.

EMF

11.2.14 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 6, Part 2, Chapter 1: Offshore Project Description). 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.

11.2.15 Impacts from changes in EMFs arising from cables, are not considered to result in a significant effect on benthic ecology and intertidal receptors. EMFs are likely to be generated by subsea cables and 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, as detailed within Table 11.1, any behavioural responses are likely to be mitigated.

11.2.16 It is considered unlikely that EMFs will result in a significant behavioural response that will cause a change in benthic communities within the benthic ecology study area and that any potential negative effects will be confined to a localised area surrounding the cables.

CHANGES TO PHYSCIAL PROCESSES

11.2.17 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

11.2.18 The use of correctly designed scour protection at foundations and sufficiently buried cables will prevent scour occurring. Scour will therefore only occur if and where scour protection has not been applied.

11.2.19 The exact form of cable protection to be used will depend upon local ground conditions, hydrodynamic processes, and the selected cable protection contractor. Where cable protection is used, some scouring is predicted to occur throughout the operational phase at these features. The extent of this scouring is predicted to be local, occurring around the perimeter of rock berms.

MAXIMUM DESIGN SCENARIO

11.2.20 The assessment undertaken for Benthic and Intertidal Ecology is based on the MDS within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, which is repeated in Table 11.1 for clarity.

Table 11.1: The Maximum Design Scenario considered for Benthic and Intertidal Ecology as established within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology.

Potential effect	Maximum design scenario assessed	Justification
Construction and Decommissioning[4]		
Physical habitat loss/ disturbance	**Total temporary habitat disturbance within Order Limits = 36,513,188 m^2** **<u>Array areas:</u>** **Total temporary habitat disturbance within array areas = 21,771,734 m^2** Foundation seabed preparation = 298,400 m^2 > Seabed preparation for 79 small Gravity Base Structure (GBS) (Wind Turbine Generator (WTG)) foundations for WTG = 284,400 m^2; > Seabed preparation for 2 GBS foundations for Offshore Substation Platform (OSP) = 14,000 m^2; and > Areas impacted by placement of gravel bed would be within the footprint of the seabed preparation and so are not considered to be additive. Jack-up vessels (JUV) and anchoring operations = 1,183,275 m^2 > Seabed disturbance per jacking-up operation = 1,100 m^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 HDD works is included.

[4] The nature and extent of the environmental impacts arising during decommissioning is assumed (for the purposes of this assessment) to be similar to (or likely less) than that described for the equivalent activities during the construction phase and have therefore been presented based on the worst-case construction impacts.

Potential effect	Maximum design scenario assessed	Justification
	> 504 JUV operations (6 operations per WTG (70 WTGs), 2 jacking-up operations per accommodation vessels (2 vessels) and commissioning vessels (3 vessels)). > Total JUV impact area for WTG and OSP installation in the array = 554,400 m^2 > Anchor footprints for WTG and OSP installation (inclusive of topside installation) =379,080 m^2 > Anchor footprints- array cable installation= 249,795 m^2 Cable seabed preparation and installation in the array areas = 20,290,059 m^2 > 100% of the inter-array cable route may require boulder clearance > Total area of seabed disturbed by boulder clearance for inter-array cables = 900,000 m^2 > 100% of the inter-array cable route may require pre-lay grapple run. > Total area of seabed disturbed by pre-lay grapple run is = 6,000,000 m^2 (as this area overlaps it has only been calculated once to form the total) > 75% of the inter-array cable route may require sandwave clearance > Total area of seabed disturbed by sandwave clearance of inter-array cable routes= 10,690,059 m^2	

Potential effect	Maximum design scenario assessed	Justification
	> Total area of seabed disturbed by burial of inter-array cables (total length 200 km length) = 3,600,000 m^2 **<u>Offshore ECC:</u>** **Total temporary habitat disturbance within Offshore ECC = 14,739,204 m^2** Cable seabed preparation and installation in the offshore ECC = 14,439,000 m^2 > 100% of the export cable route may require boulder clearance > Total area of seabed disturbed by boulder clearance for export cables = 879,750 m^2 > 100% of the export cable route may require pre-lay grapnel run > Total area of seabed disturbed by pre-lay grapple run is = 5,865,000 m^2 (as this area overlaps with boulder clearance it has only been calculated once to form the total) > 50% of the export cable route may require sandwave clearance > Total area of seabed disturbed by sandwave clearance = 5,054,000 m^2 > Burial of export cables (total length 195.5 km length per cable) = 3,520,000 m^2	

Potential effect	Maximum design scenario assessed	Justification
	> The seabed footprint for cable jointing is within the design envelope for seabed preparation and cable installation. JUV and anchoring operations = 242,604 m^2 > Maximum area of habitat disturbance from anchoring footprints = 242,604 m^2 Seabed preparation for export cable vessel laydown areas = 57,600 m^2 > Seabed preparation for 8 vessel laydown areas resulting in disturbance of 57,600 m^2 of sediment. **Temporary intertidal habitat disturbance = 2,250 m^2** Temporary habitat disturbance from horizontal directional drilling (HDD) exit pit excavation within the intertidal (or shallow subtidal): > HDD pits will be in either the intertidal or below lowest astronomical tide; > Stage 1: Up to 3 HDD exit pits (10 m width x 75 m length x 2.0-2.5 m depth) excavated via backhoe dredge (or similar) with material side-cast for backfill; > Stage 2: Once the ducts are in place, the exit pits will likely be temporarily backfilled until ready for cable pull-through. The ducts will then need to be re-exposed to pull in the cable; and > Any inter-tidal cable installation is captured within the MDS for the installation of export cables in the offshore ECC.	

Potential effect	Maximum design scenario assessed	Justification
Suspended sediment/ deposition	**Total sediment volume released on Order Limits = 42,960,742 m^3** **<u>Array areas</u>** **Total sediment volume suspended in array areas = 32,728,589 m^3** Seabed preparation for foundations = 1,193,600 m^3 > 79 small GBS (WTG) foundations = 1,137,600 m^3; > 2 GBS foundations for OSP = 56,000 m^3 Drill arisings from foundation installation = 563,223 m^3 > 79 small steel monopile WTG foundations = 536,080m^3 (assumes 50% of locations are drilled) > 2 OSP monopile foundations = 27,143 m^3 Cable trenching = 3,150,000 m^3 > Installation of 200 km of inter-array cables by mass flow excavator (MFE) resulting in the suspension of 3,150,000 m^3 of sediment Sandwave clearance for cable installation= 22,795,580 m^3 > Sandwave clearance for 150 km of array cables resulting in the suspension of 22,795,580 m^3 of sediment JUV and anchoring operations = 4,686,000 m^3 > JUV disturbance volumes for WTG and OSP installation in the array = 8,316,000m^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 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 HDD works is included. 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.

Potential effect	Maximum design scenario assessed	Justification
	> Anchor disturbance volumes WTG and OSP installation in array area = 1,516,320 m^3 > Anchor disturbance volumes for array cables= 374,693 m^3 **<u>Offshore ECC</u>** **Total sediment volume suspended in offshore ECC = 10,487,073 m^3** Sandwave clearance for cable installation = 6,988,922 m^3 > Sandwave clearance for 98 km of export cables resulting in the suspension of 6,968,922 m^3 of sediment. Seabed preparation for export cable vessel laydown areas = 57,600 m^3 > Seabed preparation for 8 vessel laydown areas resulting in suspension of 57,600 m^3 of sediment. Cable trenching = 3,079,125 m^3 > Installation of 196 km of export cables by mass flow excavator resulting in the suspension of 3,079,125 m^3 of sediment. JUV and anchoring operations = 363,906 m^3 > Anchor disturbance volumes in ECC (ECC installation) = 363,906 m^3 **Intertidal sediment volume = 17,520 m^3** > Three offshore HDD exit pits require excavation which will be side-cast onto the adjacent seabed. Backfilling of exit	

Potential effect	Maximum design scenario assessed	Justification
	pits will recover a similar amount from the surrounding seabed, as required. It has not been confirmed whether exit pits will occur in the subtidal or intertidal. > Maximum volume of drilling fluid that is expected to be released from the HDD into the intertidal/subtidal = 14,820 m^3 > Indicative maximum volume of cuttings expected to be released from the HDD into the intertidal / subtidal = 2,700 m^3	
Increased risk of introduction or spread of Marine INNS	The MDS for the total number of vessel return trips made during construction (or decommissioning) = 4,311 (based on 79 WTGs installed)	Maximum design scenario with regards to maximum number of vessel movements during construction activities in relation to the maximum number of WTG (79).
Operation and Maintenance		
Physical habitat loss/ disturbance	**Total habitat loss within Order Limits 3,415,083 m^2** **Array Areas** **Total habitat loss within array areas = 3,112,079 m^2** > Turbine total structure footprint including scour protection, based on 79 GBS (WTG-type) foundations = 1,313,537 m^2 > OSP total structure footprint including scour protection, based on two GBS monopile foundations = 81,656 m^2 > It is assumed that up to 20% of scour protection may be replaced over the lifetime of VE (Total scour area for all foundations = 1,395,286 m^2	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 drilling and drill arisings is of a smaller magnitude than presence of project infrastructure.

Potential effect	Maximum design scenario assessed	Justification
	> Maximum array cable rock berm protection = 321,600 m^2 **<u>Offshore ECC</u>** **Total habitat loss within offshore ECC = 303,004 m^2** > Total area of seabed covered by rock berm cable protection (10% of export cables) = 178,304 m^2 > Removable cable protection (if required) within the M&LS SAC = 5,400 m^2 (6 m width protection over 900 m) > Total of 56 cable crossings associated with export cables. Footprint of crossing protection material (rock berms and mattresses) = 119,300 m^2	Additional justification for the mitigation strategy and cable protection within the M&LS SAC is presented within Volume 9, Report 13: M&LS SAC Benthic Mitigation Plan.
	Total direct disturbance to seabed within Order Limits= 734,894 m^2 **<u>Array areas</u>** **Total direct disturbance within array areas in Project lifetime: 589,052 m^2** Major component replacement events for WTG's and platforms (jacking-up activities) > Seabed disturbance per jacking-up event = 1,100 m^2 > Maximum number of major component replacement events for 'WTG's and platforms (jacking-up activities) during Project lifetime= 284 > Total seabed disturbance by jacking-up activities through Project lifetime = 312,400 m^2 Array cable repairs	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 for array cable repairs per event= 25,200 m^2 (8 array cable repairs in project lifetime) > Additional seabed disturbance area to be considered for array cable repairs carried out by vessel utilising anchors per repair = 9,382 m^2 (8 array cable repairs in project lifetime) > Total seabed disturbed by array cable repairs through Project lifetime = 276,652 m^2 **<u>Offshore ECC</u>** **Total direct disturbance within Offshore ECC in Project lifetime = 145,842 m^2** Export cable repairs > Seabed disturbance for export cable repairs per event= 10,000 m^2 (9 export cable repairs in Project lifetime) > Additional seabed disturbance to be considered for export cable repairs carried out by vessel utilising anchors per repair= 6,205 m^2 (9 export cable repairs in Project lifetime)	

Potential effect	Maximum design scenario assessed	Justification
Increased risk of introduction or spread of Marine INNS	**Total surface area of introduced hard substrate in the water column of the array areas = 3,651,745 m^2 (see Impact 7)** Total of 1,776 annual round trips for all O&M vessels within Order Limits.	Maximum scenario for introduced hard substrate is as for the maximum scenario for loss of habitat. MDS with regards to maximum number of vessel movements during O&M activities.
Changes in physical processes	See MDS presented in Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes.	Full justification of the worst-case scenarios can be found within Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes.
EMF effects generated by inter-array and export cables during operational phase	**Inter-array cables** > Up to 200 km of inter-array cable, operating up to 132 kV > Inter-array cable depth = 0 – 3.5 m **Offshore export cables** > Up to 196 km of export cable, operating up to 275 kV > Export cable depth = 0 – 3.5 m	The maximum adverse scenario is associated with the use of 79 WTGs as this results in the greatest length of inter-array cable and export cables as this results in the longest total length of cable.

ASSESSMENT OF ADVERSE EFFECTS ON INTEGRITY ALONE

MARGATE AND LONG SANDS SAC

11.2.21 The conservation objectives of the site are as follows (Natural England, 2018):

- 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.

CONSTRUCTION AND DECOMMISSIONING

PHYSCIAL HABITAT LOSS/ DISTURBANCE

11.2.22 This section addresses the potential for AEoI associated with the potential for physical habitat loss or disturbance expected from construction and decommissioning activities. It should be noted that during the construction and decommissioning phase that any habitat loss or disturbance is considered temporary. Any potential permanent habitat loss is discussed in the O&M section for each site. This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides further detail on the potential effect from temporary habitat disturbance.

11.2.23 The VE ECC overlaps with 1.26 km^2 of the SAC, and the total area that is expected to be disturbed by sandwave clearance is 0.63 km^2 (see Volume 6, Part 2, Chapter 5: benthic and Intertidal Ecology), which equates to 0.09 % of the total SAC.

11.2.24 As shown in Figure 5.4 of Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, site specific surveys identified that the sediments of the VE ECC in the area coinciding with the Margate and Long Sands SAC, are characterized by circalittoral coarse sediments. The biotope complex could not be classified further following analysis of the infaunal data, owing to the paucity of fauna. The ES highlighted (Table 5.15, Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology) that the majority of the expected sand and mixed sediment communities were determined as having a low sensitivity to an impact such as sandwave clearance. The biotopes described are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. The communities that predominantly characterise these biotopes include infaunal mobile species such as polychaetes and bivalves. Such species can re-enter the substratum following a temporary habitat disturbance of this nature. The recoverability of such communities is likely to occur as a result of a combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within one to ten years (based on the MarESA assessments, Table 5.15 and 5.16 within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology).

11.2.25 The ES concluded (Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology) that as the duration of this impact is short-term (as it is limited to the duration of construction activities), intermittent and with high reversibility, it is predicted that the impact will affect the receptor directly, and whilst this is a nationally designated feature, the magnitude is low adverse due to the limited extent. 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 and of national value. The sensitivity of the Margate and Long Sands SAC is therefore, regarded as medium within the ES.

11.2.26 Natural England's "Advice on Operations," indicated that all sub-features (subtidal sand, subtidal coarse sediment and subtidal mixed sediments) of the Margate and Long Sands SAC are considered sensitive to the pressures "Abrasion/ disturbance of the substrate on the surface of the seabed" ("not sensitive," to "medium" pressure range) and "Penetration and/ or disturbance of the substratum below the surface of the seabed, including abrasion" ("low," to "medium" pressure range), with a medium to high risk profile. The Advice directs that such an effect could be expected during construction and decommissioning associated with cable works. The pressure benchmark for both pressures is "Damage to sub-surface/ surface features." Considering this, and given the impacts are likely to be short term in duration (as it is limited to the duration of construction and decommissioning activities), and 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 and of national value, it is therefore predicted, and as determined within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, that the impact of physical habitat loss/ disturbance on benthic habitats is concluded to be minor adverse.

11.2.27 In relation to seabed preparation and installation for foundations within the array area it is unlikely that any temporary disturbance resulting from these activities would have an impact upon the features of the Margate and Long Sands SAC. Both array areas are a significant distance (23.61 km at its closest point) from the SAC and therefore there is no direct interaction during these works within the SAC.

11.2.28 Therefore, it is concluded that given the short-term nature of the disturbance, the existing tolerance of the benthic habitats to disturbance within this area, and the predicted medium to high recoverability of the biotopes, that the sites conservation objectives (as detailed in Section 11.2.21) will be maintained in the long-term. There is, therefore, no potential for an AEoI, having regard to the conservation objectives of the feature “sandbanks which are slightly covered by sea water all the time” of the Margate and Long Sands SAC, in relation to physical habitat loss/ disturbance from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.

11.2.29 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.30 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 sandwave clearance). This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides the detailed offshore physical environment assessment (including project specific modelling of sediment plumes). Table 5.12 within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology also presents the MDS associated with increases in SSC and deposition.

11.2.31 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 ZoI (Figure 11.1). 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).

11.2.32 Volume 6, Part 5, Annex 2.2 Physical Processes Model Design and Validation 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.

11.2.33 The ECC overlaps with 1.26 km^2 of the SAC, therefore it is important to consider the potential effects upon the features, sub-features and associated benthic communities of the site from SSC and associated deposition.

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Essex Estuaries SAC

Margate and Long Sands SAC

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Benthic Ecology Study Area
- Screened Benthic Designated Sites

0 2.5 5 10

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Designated Sites Screened in for Assessment in relation to the Benthic Study Area

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	AdB

DRAWING NUMBER: 11.1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:400,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

11.2.34 The Margate and Long Sands SAC is dominated by the sub-feature subtidal sand which is found throughout the site and forms the majority of the sediment type within the SAC (Figure 11.2). It is heavily influenced by strong tidal currents in this area, and as a result is highly mobile, forming large sandwaves and sandbanks, which is the reason for the sites designation with the designated feature being sandbanks which are slightly covered by seawater all the time. Other sub-features include subtidal coarse sediment, located predominantly in the southern section of the site and subtidal mixed sediments, which is only located at the north-eastern tip of the site.

11.2.35 More specifically, and as shown in Figure 5.4 in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, site specific surveys identified that the sediments of the VE ECC in the area coinciding with the Margate and Long Sands SAC, are characterized by circalittoral coarse sediments. Additionally, the wider area of the Margate and Long Sands SAC which overlaps with the ZoI is characterised with other non-designated benthic communities, including polychaete worms and amphipods. Within the troughs and on the bank slopes a higher diversity of polychaetes, crustacea, molluscs and echinoderms are found. Mobile epifauna includes crabs and brown shrimp, along with squid and commercially important fish species such as sole and herring. S. spinulosa reef is also present, however, it is worth noting that site is not designated for this feature and the available data indicates that the distribution of *S. spinulosa* is patchy, or that the aggregations form crusts rather than reefs. Areas of high *S. spinulosa* density support a diverse attached epifauna of bryozoans, hydroids, sponges and tunicates, and additional fauna including polychaetes, bivalves, amphipods, crabs and lobsters. These diverse communities are usually found on the flanks of the sandbanks and towards the troughs, and as described by the conservation objectives will need to be maintained.

11.2.36 As mentioned above, the area is characterised as being highly mobile with high levels of physical disturbance and thus with often high SSC and associated deposition. Therefore, it can be considered these habitats will be highly tolerant of an effect of this nature.

11.2.37 Further evidence of this tolerance is detailed within the SAC documentation[5] where it states that the structure of these banks is dynamic and there have been significant movements of the bank edges over time. Inhabiting fauna are therefore likely to be relatively tolerant to increases in SSC and associated deposition.

[5] https://sac.jncc.gov.uk/site/UK0030371

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LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Benthic Ecology Study Area
- Margate and Long Sands SAC
- Annex I Sandbanks (JNCC)
- Annex I Biogenic Reefs

0 1 2 4
Kilometers

Data Sources:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Margate and Long Sands SAC sub-features and ECC

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	BJ

DRAWING NUMBER: 11.2

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:125,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

11.2.38 The ES concluded that the impacts to the M&LS SAC from smothering and deposition impacts that are most likely to significantly disturb benthic communities is within the 0-50 m area from construction activities, and whilst this will occur within the SAC where the offshore ECC overlaps (0.09% of the offshore ECC overlaps with the SAC), the magnitude of the impact is considered to be low adverse and the impact is expected to be localised. Considering the importance of the designated sandbank feature within the SAC, the overall sensitivity value of medium was assessed which is considered precautionary based on the limited extent of any predicted heavy smothering and deposition. Natural England's "Advice on Operations," indicates that all sub-features are considered sensitive to the pressure "*smothering and siltation rate changes (Light)" and "changes in suspended solids (water clarity)*" (apart from subtidal coarse sediments). The advice directs that such an effect could be expected during construction and decommissioning associated with cable works, however it is considered that elevations in SSC created by the construction works will not reach a sufficient scale or magnitude to significantly alter the annual mean values. As a result, the overall significance of effect for all habitats and features within this range, including the designated sandbank features at this site (as determined within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology) is considered to be minor adverse and **therefore is also considered to have no potential for AEoI.**

11.2.39 In relation to seabed preparation for foundations within the array area it is unlikely that any SSC or associated deposition resulting from these activities would have an impact upon the features of the SAC. Both array areas are a significant distance (23.61 km at its closest point) from the SAC and in line with the main zones of effect described above, there would be no measurable thickness of deposition, and any suspended material would consist of mainly fines that would be dispersed by tidal currents.

11.2.40 It is concluded that given the short-term and temporary nature of the change in SSC, the predicted lack of any significant accumulation of sediment within the SAC due to the high mobility of sediment, ensuring that impacts to the feature are not significant; that the sites conservation objectives (as detailed in Paragraph 11.2.22) will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of the feature "sandbanks which are slightly covered by sea water all the time" of the Margate and Long Sands SAC, in relation to temporary and localised increased SSC and associated deposition from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.41 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

INNS

11.2.42 This section addresses the potential for AEoI from effects associated with the increased risk of the introduction or spread of INNS during construction and decommissioning activities.

11.2.43 Through increased vessel movements during construction and decommissioning there is a risk that vessels could contribute to the potential introduction or spread of Marine INNS through ballast water discharge (Eno *et al*., 1997). There will be up to 4,311 round trips to port during the construction phase (based on 79 WTGs installed). However, the movement of commercial vessels is common throughout the region (Volume 6, Part 2, Chapter 9: Shipping and Navigation) and this provides an existing and potentially more likely method of transport for Marine INNS (due to the higher variety of ports and passage routes).

11.2.44 It should be noted that there is a wide-spread presence of Marine INNS across the southern North Sea. The Marine INNS *C*. *fornicata* has successfully established to an extent that it outcompetes indigenous species causing large scale habitat changes across coastal areas of the UK (EMU Limited, 2012). The most problematic Marine INNS off the Suffolk coast are the Turkish crayfish (*Astacus leptodactylus*), Chinese mitten crab (*Eriocheir sinensis*), leathery sea squirt (*Styela clava*) and wireweed (*Sargassum muticum*), also demonstrating that the region is not a pristine environment in terms of the absence of Marine INNS (Dittel ., 2009; Holdich ., 2009; Macleod ., 2016 and Nehls ., 2006).

11.2.45 There is a lack of evidence to date from other OWF developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS. Most vessel movements associated with the construction of the array area will be at a significant distance (23.61 km at its nearest point) from Margate and Long Sands SAC, therefore offering further limited potential for a linkage between any INNS and the SAC.

11.2.46 Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology concluded that the magnitude of the impact from the potential introduction of INNS was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were deemed to be at a worst case "high", given the lack of evidence for a potential impact of this nature. Overall, it was concluded that the significance of the residual effect is minor adverse.

11.2.47 Natural England's "Advice on Operations" indicates that the sub-features (namely the 'typical species' associated with the site rather than the designated sandbanks themselves) of the SAC are sensitive to the pressure "Introduction or spread of invasive non-indigenous species (INIS)," however it is given a low risk profile of pressure. The advice states that "the risk of this will increase as result of non-compliance to legislation, codes of conduct or best practice." It should be noted that VE, and as detailed in table 5.13 in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, has mitigation measures which includes following best practice guidelines and standard operating practices (as managed through the PEMP and biosecurity plan) which will ensure that the risk of potential introduction and spread of Marine INNS from increased vessel activity is minimized.

11.2.48 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore wind farms, the project level commitments to mitigate the risk and the ES conclusion of minor adverse significance, there is a low risk of promoting the spread of INNS within the Margate and Long Sands SAC during the construction and decommissioning phase. The conclusion is supported by the distance between the array and the SAC boundary (23.61 km at its nearest point), where the majority of vessel movements will occur (within the array boundary and therefore offering further limited potential for a linkage between any INNS and the SAC); all supporting the conclusion that the sites conservation objectives will be maintained in the long-term. **There is, therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.22) of the sandbanks which are slightly covered by sea water all the time feature of the Margate and Long Sands SAC in relation to spread of INNS from VE alone and therefore, subject to natural change, the feature will be maintained.**

11.2.49 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

ACCIDENTAL POLLUTION

11.2.50 This section addresses the potential for AEoI from effects associated with accidental pollution from works during construction and decommissioning activities.

11.2.51 The potential for accidental pollution to affect benthic subtidal and intertidal habitats is not considered in the ES assessments and was screened out of the assessment, however it has since been re-introduced following consultation. The primary source of the pollution risk from the project comes from vessel movements and construction activities, which are all managed through the PEMP, ensuring that there are no adverse environmental effects from the works. **Therefore, there is no potential for an AEoI to the conservation objectives of the designated features at the Margate and Long Sands SAC in relation to accidental 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.**

OPERATION AND MAINTENANCE

PHYSICAL HABITAT LOSS/ DISTURBANCE

11.2.52 This section addresses the potential for AEoI from the potential habitat loss and/ or disturbance upon which is expected to occur during the O&M phase.

11.2.53 The presence of 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 a permanent habitat loss (for the design life duration of VE) and a permanent change of habitat. It is assessed here as permanent habitat loss and a potential negative effect (due to the potential shift in the baseline condition), although it is noted that this also has the potential to comprise beneficial effects, providing new habitats for different faunal assemblages to colonise, resulting in a likely increase in biodiversity and biomass.

11.2.54 As the ECC crosses the SAC (Figure 11.2), the focus of this assessment will be on the potential effects of cable protection within this area, particularly on the Annex 1 habitat: "*sandbanks which are slightly covered by seawater at all times."*

11.2.55 For the purposes of this assessment, as detailed within the Margate and Long Sands SAC Benthic Mitigation Plan (Volume 9, Report 13), the Project have committed to no more than 5,400 m^2 of cable protection, which is 0.0008% of the total area of the SAC.

11.2.56 The cable crosses the SAC in an area which is characterised by circalittoral sediment and is where the sub-feature of the site subtidal sand occurs. This is an area which is heavily influenced by strong tidal currents, and as a result the sediments within this area are highly mobile, forming large sandbanks and sandwaves (a primary reason for the sites designation). The benthic community within these areas is characteristic of species poor, mobile sand environments and is dominated by polychaete worms and amphipods.

11.2.57 Whilst it is acknowledged that the impact may be larger in the immediate vicinity, and compromise a change in seabed habitat, the loss is very small in comparison to the total area available within the SAC, with the impact being highly localised. As the seabed in this area is considered to be dynamic, with a capacity to recover from disturbance and observed natural migration of the bedforms it is reasonable to assume that the cable protection may undergo periods of being buried and uncovered, which means that the impact of habitat loss may not be fully permanent, particularly as the maximum height of the cable protection is only 1.1 m.

11.2.58 Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology concluded the magnitude of the impact for Margate and Long Sands SAC is regarded as negligible due to the scale of the overall impact of habitat loss upon the SAC (0.0008% of the SAC area) and the sensitivity of the receptors was deemed to be high, therefore the overall significance of effect was deemed to be minor adverse.

11.2.59 Natural England's "Advice on Operations" indicates that all sub-features for the feature Annex 1 habitat: "*sandbanks which are slightly covered by seawater at all times*" are sensitive to the pressure "*Physical change (to another seabed type).*" A medium-high risk profile pressure is provided, with the pressure benchmark stated as "*Change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.*" Whilst this pressure benchmark could be reached in the small area where the cable crosses the SAC, it will not exceed the benchmark in a significant way due to the small area which will be impacted.

11.2.60 Furthermore, additional mitigation measures have been developed within the M&LS SAC. The full details of this mitigation strategy are presented within M&LS SAC Benthic Mitigation Plan (Volume 9, Report 13). This mitigation plan has been developed in line with Natural England's mitigation hierarchy for designated sites. The mitigation that has been applied includes the following commitments:

- The area of cable protection in the SAC will not exceed 5,400 m^2;
- Final cable routing will seek to take the shortest route through the M&LS SAC where possible, and considering the required separation to North Falls cables and from the pilot boarding area - this routing work will also consider the potential for successful cable burial with the objective of avoiding the need for cable protection using the cable burial hierarchy set out above;

- Should burial not be achieved at the first attempt the burial hierarchy principles will be followed in line with Section 5;
- Rock dumping using loose rock will not be considered a feasible protection in the M&LS SAC; and
- Should protection be required, then mattresses or another form of protection that is equivalent or less in terms of footprint or impact will be used. Cable protection selection will also take into account the ability to remove the protection at the end of the life of the cables.

11.2.61 It is concluded that given the small area of the SAC which will undergo a permanent habitat change, and the implementation of the Benthic Mitigation Plan, the change is very small compared to total area of habitat available within the SAC and therefore the sites conservation objectives (as detailed in Section 11.2.20 will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of the feature "sandbanks which are slightly covered by sea water all the time" of the Margate and Long Sands SAC, in relation to permanent habitat loss during the O&M phase, and associated deposition from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.62 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.63 This section addresses the potential for AEoI from effects associated with the dispersion of suspended sediments and any associated deposition and smothering, expected to occur during the O&M phase as a result of, for example, cable remedial burial, replacement and repairs.

11.2.64 O&M works that cause increases in SSC and associated deposition will be from cable works within the ECC and from inter-array cable works within the array area. As described above for the construction and decommissioning phase, any O&M works are likely to cause sediment plumes. Plume modelling undertaken highlights that sediment plumes caused by seabed preparation and construction activities are expected to be restricted within a single tidal excursion from the point of release. Therefore, O&M works are likely to have a similar or less than extent.

11.2.65 As highlighted above, Section 9, Volume 6, Part 5, Annex 2.2 Physical Processes Model Design and Validation provides a more quantitative understanding of where the main zones of effect will be, following the modelling. There are 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.

11.2.66 As noted previously, the area of the ECC which overlaps with the SAC (1.26 km^2) is characterised by circalittoral coarse sediments and is heavily influenced by strong tidal currents in the area which act to create large sandbanks and sandwaves. Additionally, the wider area of the Margate and Long Sands SAC which overlaps with the ZoI is characterised with other non-designated benthic communities, including being dominated by polychaete worms and amphipods. Within the troughs and on the bank slopes a higher diversity of polychaetes, crustaceans, molluscs and echinoderms are found. Mobile epifauna includes crabs and brown shrimp, along with squid and commercially important fish species such as sole and herring. S. spinulosa reef is also present, however, it is worth noting that the available data indicates that the distribution of S. spinulosa is patchy, or that the aggregations form crusts rather than reefs. Areas of high S. spinulosa density support a diverse attached epifauna of bryozoans, hydroids, sponges and tunicates, and additional fauna including polychaetes, bivalves, amphipods, crabs and lobsters. These diverse communities are usually found on the flanks of the sandbanks and towards the troughs. This is considered a very dynamic area, with movement of the sandwaves and banks occurring regularly, and is reasonable to assume that the benthic communities are relatively tolerant to increases in SSC and deposition.

11.2.67 As with the construction and decommissioning phases, Natural England's "Advice on Operations" indicates that all sub-features are considered sensitive to the pressure "smothering and siltation rate changes (Light)" and "*changes in suspended solids (water clarity)*" (apart from subtidal coarse sediments). The Advice directs that such an effect could be expected during O&M when undertaking works associated with the ECC. The pressure benchmark would be exceeded if up to 5 cm of fine material were added to the habitat in a single event. Given that the works are occurring in an area of coarser sediment (sand and gravels), it is likely that most suspended sediments will be deposited quickly, with greatest levels of deposition occurring within the immediate vicinity of the works, within the 0-50 m zone as described above. Whilst this deposition is likely to occur in a small area of the SAC it is unlikely to exceed the pressure benchmark in a significant way, particularly as O&M works are likely to be on a smaller scale when compared to construction and decommissioning. As such, the overall significance of effect of minor adverse, as determined within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, can be applied here.

11.2.68 In relation to O&M works for inter-array cables within the array area, it is unlikely that any SSC or associated deposition resulting from such activities would have an impact upon the features of the SAC. Both array areas are a significant distance (23.7 km at its nearest point) from the SAC, as such there would be no measurable thickness of deposition and any suspended material would consist of mainly fines that would be dispersed by tidal currents.

11.2.69 It is concluded that given the short-term and temporary nature of the change in SSC, the existing levels of SSC in the area, the predicted lack of any accumulation of sediment within the SAC (and therefore any impact being likely less than the pressure benchmark) due to the high mobility of sediment within the SAC ensuring that the benchmarks for impact to the features are not reached; 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 the feature "sandbanks which are slightly covered by sea water all the time" of the Margate and Long Sands SAC, in relation to temporary and localised increased SSC during the O&M phase, and associated deposition from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.70 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

INNS

11.2.71 This section addresses the potential for AEoI from effects associated with the increased risk of the introduction or spread of INNS during the O&M phase.

11.2.72 There is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate INNS that might otherwise not have had a suitable habitat for colonisation, thereby enabling their spread. This along with the movement of vessels in and out of the array areas and the ECC has the potential to impact upon benthic ecology and biodiversity locally and in the broader region.

11.2.73 Table 5.12 within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, highlighted the MDS for new hard substrate that will be introduced into the array areas and the ECC. For completeness, this is 3,651,745 m2 (total area of introduced hard substrate at seabed level), however this will be significantly less for the area of the ECC which interacts with the SAC. Additionally, the number of annual round trips for all O&M vessels is 1,776. Again, the number of vessels interacting with the area of the ECC within the SAC will be significantly less.

11.2.74 As above for the construction and decommissioning phases, there is a wide-spread presence of marine INNS across the southern North Sea, however there is a lack of evidence to date from other OWF developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS.

11.2.75 The ES concluded that the magnitude of the impact from the potential introduction of INNS for the O&M phase was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were deemed to be at a worst case "high", given the lack of evidence for a potential impact of this nature, reflecting that at worst-case benthic receptors have 'none' or 'low' resistance (tolerance) to an impact of this nature. Overall, the ES concluded that the significance of the residual effect is minor adverse.

11.2.76 Natural England's "Advice on Operations" indicates that the sub-features of the SAC are sensitive to the pressure "*Introduction or spread of invasive non-indigenous species (INIS)*," however it is given a low risk profile of pressure. The advice states that "*the risk of this will increase as result of non-compliance to legislation, codes of conduct or best practice*." It should be noted that VE, and as detailed in Table 5.13 in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, has committed to environmental measures which includes following best practice guidelines and standard operating practices (as managed through the PEMP and biosecurity plan), which will ensure that the risk of potential introduction and spread of marine INNS from the introduction of hard substrate and increased vessel activity is minimised.

11.2.77 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore wind farms, the project level commitments to mitigate the risk and the ES conclusion of minor adverse significance, there is a low risk of promoting the spread of INNS during the O&M phase. The conclusion is supported by the small area in which hard substrate will be introduced to the SAC and distance between the array and the SAC boundary (23.61 km at its nearest point), where the majority of vessel movements will occur during the O&M phase; all supporting the conclusion that the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.21) of the sandbanks which are slightly covered by sea water all the time feature of the Margate and Long Sands SAC in relation to spread of INNS from VE alone and therefore, subject to natural change, the feature will be maintained.

11.2.78 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

EMF

11.2.79 This section addresses the potential for AEoI from effects associated with the potential impacts from EMF during O&M activities.

11.2.80 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.

11.2.81 Impacts from changes in EMFs arising from cables, are not considered to result in a significant effect on benthic ecology and intertidal receptors. EMFs are likely to be generated by subsea cables and 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.

11.2.82 For invertebrate receptors species, there is a patchwork of different studies currently available which make it difficult to translate the knowledge about individual-level EMF effects into assessments of biologically or ecologically significant impacts on populations. However, it is predicted that EMFs will have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

11.2.83 The ES concluded that the magnitude of the impact from the introduction of EMFs for the O&M phase was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were considered to be low adverse. Overall, the ES concluded that the significance of the residual effect is negligible.

11.2.84 A small section of the ECC intersects with the SAC and therefore there is the potential for an impact upon the benthic communities within the site. Natural England's Advice on Operations highlights that there is currently insufficient evidence to determine a sensitivity category for the sub-features of the site. This is in line with the current evidence and studies that have been published and highlighted within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology. As mentioned above, the cables will be buried or protected and as a result it is considered unlikely that EMFs will result in a significant behavioural response that will cause a change in benthic communities within the SAC, therefore it is predicted that EMFs will have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

11.2.85 It is therefore concluded that due to the lack of conclusive evidence of any adverse effect from EMF upon benthic communities, the project level commitments to mitigate the risk by burying and/ or protecting the cables and the ES conclusion of negligible significance, there is a low risk from the effect of EMF upon the SAC. There is, **therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.23) of the sandbanks which are slightly covered by sea water all the time feature of the Margate and Long Sands SAC in relation to the effects of EMF from VE alone and therefore, subject to natural change, the feature will be maintained.**

11.2.86 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

CHANGES TO PHYSCIAL PROCESSES

11.2.87 This section addresses the potential for AEoI on benthic communities that could result from changes to physical processes during the O&M phase.

11.2.88 As the ECC intersects with the SAC the presence of cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species. The use of correctly designed scour protection at foundations and sufficiently buried cables will prevent scour occurring. Scour will therefore only occur if and where scour protection has not been applied.

11.2.89 Currently as a worst-case scenario, the project has committed to no more than 5,400 m2 of cable protection within the SAC. This equates to 0.0008% of the total SAC area. As a result, where this cable protection is used there may be some highly localised scour occurring. The raised profile of the protection may cause a limited amount of localised secondary scouring at the edges of the protection in line with the dominant flow or wave direction. The depth and extent of any scour will be limited in proportion to the diameter of the individual rocks used (typically graded between 0.05 m to 0.5 m) which may be reduced by embedment or settling over time.

11.2.90 Furthermore, the presence of any scour protection will have very limited potential to modify patterns of sediment transport: a very small volume of sediment could be trapped within the rock voids, whilst a similarly small volume of material could also accumulate on the updrift side of the berms, before the slope reaches an equilibrium position defined by the angle of repose of the accumulated material. Thereafter, sediment can reasonably be expected to be transported at the same rate (and in the same direction) as under baseline conditions. Any indirect changes to sediment transport arising from modification of tidal currents and waves as they interact with the berms will be highly spatially restricted - order of 10's of metres (maximum) from the feature. Given that only very minor changes are expected to the sediment transport regime, any associated morphological impacts are also expected to be very limited.

11.2.91 Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes has determined that the potential impacts from changes to hydrodynamic and wave regimes will not be significant to coastal and physical processes and will therefore not result in any significant changes to sediment transport and consequently will not have any significant impacts on benthic ecology. The overall level of effect has therefore been assessed as being of minor adverse.

11.2.92 Natural England's "Advice on Operations" indicates that only the subtidal sand sub-feature is sensitive to the pressure "*Water flow (tidal current) changes, including sediment transport considerations*," however the pressure is considered a low risk profile. The advice states that the pressure benchmark for this feature is "*a change in peak mean spring bed flow velocity of between 0.1m/s to 0.2m/s [would occur] for more than 1 year.*" Although flow speed around cable protection may be locally elevated, the pressure benchmark is not expected to be exceeded in a significant way and thus the sub-feature would not be sensitive at the proposed level of impact.

11.2.93 It is concluded that given that any changes in physical processes will be highly localised and small scale within the SAC, including any potential impact from cable protection ensuring that the benchmarks for impacts to the features are not reached and 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 the feature "sandbanks which are slightly covered by sea water all the time" of the Margate and Long Sands SAC, in relation to any potential changes to physical processes during the O&M phase, from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.94 Additionally, it is determined that the relevant conservation objectives (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

ACCIDENTAL POLLUTION

11.2.95 This section addresses the potential for AEoI from effects associated with accidental pollution from works during O&M activities.

11.2.96 The primary risk of pollution during this phase is from the vessel movements to and from the site. As established during the construction and decommissioning phase, the implementation of the PEMP ensures that there is no adverse impact on the surrounding environment from any works associated with the project. **Therefore, there is no potential for an AEoI to the conservation objectives of the designated features at the Margate and Long Sands SAC in relation to accidental pollution from the Project alone during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term.**

ESSEX ESTUARIES SAC

11.2.97 The conservation objectives of the site are as follows (Natural England, 2018):

- 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.

CONSTRUCTION AND DECOMMISSIONING

PHYSCIAL HABITAT LOSS/ DISTURBANCE

11.2.98 This section addresses the potential for AEoI from effects associated with physical habitat loss/ disturbance during construction and decommissioning activities. All SAC features listed in Table 9.1 are considered together here and are not split into subtidal and intertidal habitats.

11.2.99 The vast majority of subtidal and intertidal habitat loss/ disturbance will arise within VEs Order Limits, with any impacts on benthic habitats predicted to be of local spatial extent, short term duration, intermittent and high reversibility. The Essex Estuaries SAC sits outside the Order Limits, however the benthic study area, secondary ZoI does intersect the site. Nevertheless, it is expected there will be no direct impacts upon the SAC and thus there is a very limited potential for any impacts to occur.

11.2.100 It is concluded, given the distance (7.37 km to the EEC corridor at its nearest point) of the site to potential direct interaction with construction and decommissioning activities, that the sites conservation objectives (as detailed in Section) will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of the feature and sub-features of the Essex Estuaries SAC, in relation to physical habitat loss/ disturbance from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.101 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.102 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 HDD installation) and seabed preparation works (including sandwave clearance) during construction and decommissioning activities. For this effect, the assessment has been split into two different sections to assess the potential impacts both from the array and the ECC i.e., within subtidal areas and at landfall i.e., within the intertidal areas. This is due to the distribution of the designated features within these two different zones and the differing potential impacts.

11.2.103 This assessment should be read in conjunction with Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 5, Annex 2.1: Physical Processes Baseline Technical Report which provides the detailed offshore physical environment assessment (including project specific modelling of sediment plumes).

ARRAY AREA AND OFFSHORE ECC

11.2.104 The Essex Estuaries SAC is approximately 64.38 km from the array areas at its nearest point, therefore seabed preparations for foundations and laying of inter-array cables and any associated increase in SSC are unlikely to interact or effect the subtidal features and sub-features of the SAC. Therefore, the focus of this assessment will be on the potential effects from laying the export cable and associated activities, such as sandwave clearance and cable trenching. It should be noted that the SAC does not interact directly with the ECC (Figure 11.3).

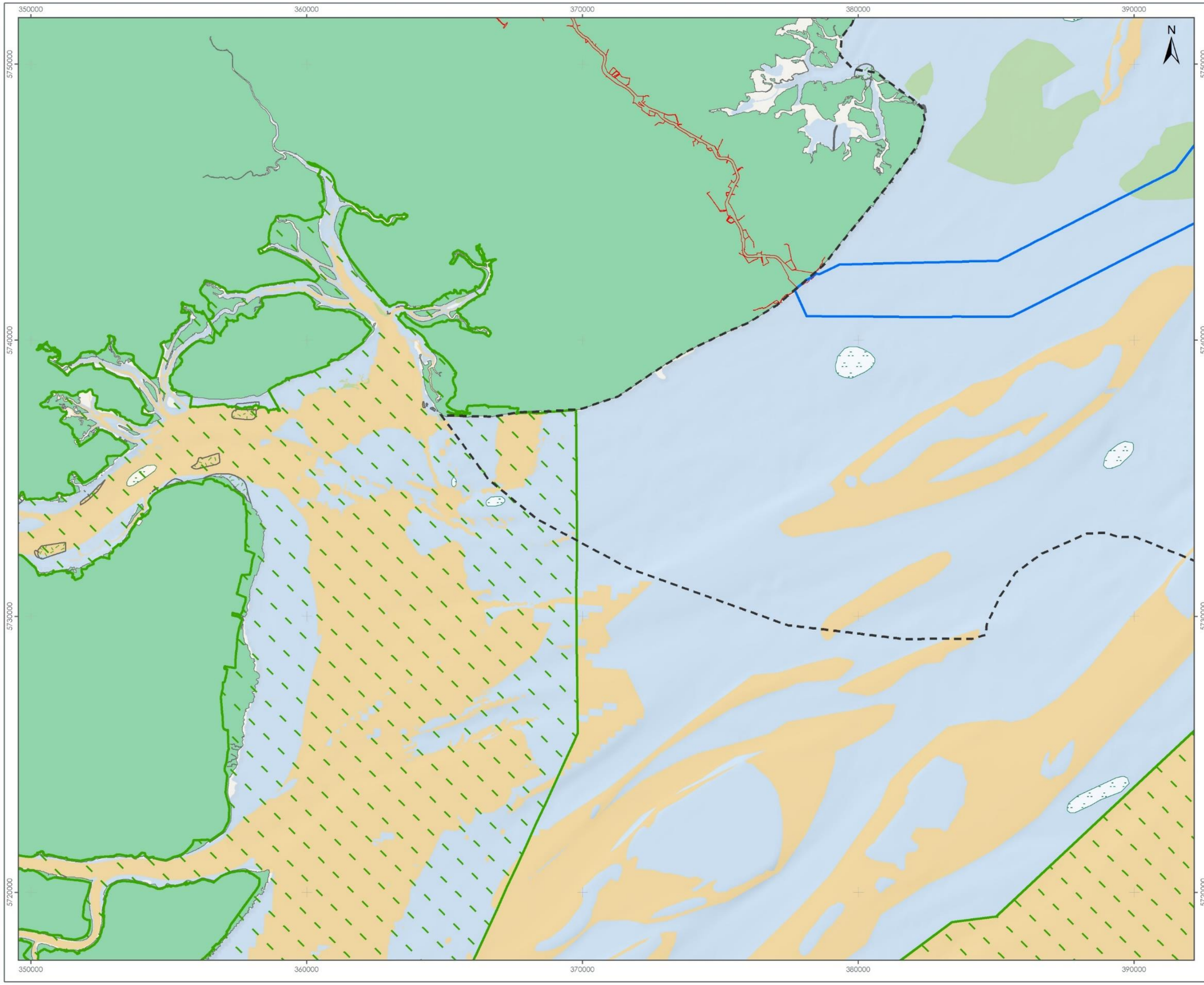
11.2.105 The main subtidal feature in the SAC is Annex I Sandbanks, which includes a number of sub-features including: subtidal seagrass beds, subtidal coarse sediments, subtidal mixed sediments, subtidal mud and subtidal sand. As noted, whilst no direct interaction with these features is expected, a small area of the site interacts with the benthic study area and secondary ZoI.

11.2.106 As can be expected, the highest increase in SSC and greatest likely thickness of deposition will occur in the 0-50 m zone (see Section 11.3.32), where all gravel sized sediment and 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.

11.2.107 It is therefore likely that effects of SSC and associated deposition from ECC works for VE would be limited primarily to the immediate vicinity of the works, with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally.

11.2.108 The northern tip of the Essex Estuaries SAC sits within the "*500m to the tidal excursion buffer*" (see Section 11.3.32) zone and thus it is unlikely that there will be any persistent and significant SSC and associated deposition as a result of the ECC construction and decommissioning activities. The subtidal features within this area are predominantly Annex I Sandbanks and the sub-feature subtidal mud. Particularly in a highly tidal and dynamic estuarine area, the benthic communities within these features will be tolerant to any increases in SSC and associated deposition.

11.2.109 The ES concluded (Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology) that the impact of increased SSC and deposition is considered to be low adverse magnitude, and the sensitivity of receptors affected is predicted to be at worst-case medium, with overall significance of the residual effect concluded to be minor adverse. Natural England's "Advice on Operations," indicates that all intertidal sub-features are considered sensitive to the pressure "*smothering and siltation rate changes (Light)*" and "*changes in suspended solids (water clarity)*" (apart from subtidal coarse sediments). The Advice directs that such an effect could be expected during construction and decommissioning associated with cable works. The pressure benchmark would be exceeded if up to 5 cm of fine material were added to the habitat in a single event. Given that works within the ECC are occurring approximately 7.37 km away from the SAC and the greatest levels of deposition would occur within the immediate vicinity of the works, within the 0-50 m zone as described above, it is unlikely to exceed the pressure benchmark in a significant way.



LEGEND

- Offshore Export Cable Corridor
- Onshore Order Limits
- Benthic Ecology Study Area
- Margate and Long Sands SAC
- Annex I Sandbanks (JNCC)

Annex I Reefs by Subtype (JNCC)

- Bedrock
- Bedrock / Mixed
- Biogenic
- Stony

0 1 2 4
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Essex Estuaries SAC sub-feature and ECC

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Information	BPHB	BJ

DRAWING NUMBER: 11.3

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:125,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

INTERTIDAL AT LANDFALL

11.2.110 Temporary increases in SSC and associated sediment deposition in the intertidal area are expected from the cable installation works and the release of drill cuttings and drilling mud from the HDD works. There is a requirement to use drilling mud, such as bentonite (or another inert mud), in order to undertake HDD activities and make landfall. This in turn may result in the release of drilling mud within the intertidal area at the punch out points.

11.2.111 Bentonite is a clay-based substance, and thus may persist in suspension for hours to days, becoming diluted to low concentrations within timescales of around one day. Any fine material being dispersed from the exit pits during excavation is likely to be widely dispersed and quickly form part of the background concentration of SSC along the nearshore. Due to the distance from the landfall area to the SAC, it is not expected that the bentonite in suspension would be measurable against background SSC and would not be deposited in any measurable thickness within the SAC.

11.2.112 The ES concluded (Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology) that the magnitude of the impact at landfall was assessed as low adverse, and the sensitivity of receptors affected is predicted to be at worst-case medium, with overall significance of the residual effect concluded to be minor adverse. Natural England's "Advice on Operations," indicates that the majority of the sub-features, of the Annex I habitats Estuaries and Mud flats and sand flats, are considered sensitive to the pressure "smothering and siltation rate changes (Light)" and "changes in suspended solids (water clarity)". The features which are not sensitive are those which are in the upper intertidal zone such as Atlantic Salt Meadows.

11.2.113 For those features which are sensitive to these pressures, the Advice directs that such an effect could be expected during construction and decommissioning associated with cable works. The pressure benchmark would be exceeded if up to 5 cm of fine material were added to the habitat in a single event. Given that the works are occurring approximately 7.4 km away from the SAC and the greatest levels of deposition would occur within the immediate vicinity of the works, within the 0-50 m zone as described above, it is unlikely to exceed the pressure benchmark in a significant way.

CONCLUSIONS

11.2.114 Overall, for potential impacts from increased suspended sediment concentrations and associated deposition from construction and decommissioning activities within the intertidal and subtidal areas, it is concluded that the conservation objectives (as detailed in Section 11.3.47) will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of the features of the Essex Estuaries SAC, in relation to temporary and localised increased SSC and associated deposition from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.115 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

INNS

11.2.116 This section addresses the potential for AEoI from effects associated with the increased risk of the introduction or spread of INNS during construction and decommissioning activities. All SAC features listed in Section 10 are considered together and are not split into subtidal and intertidal habitats.

11.2.117 Figure 11.3 highlights that the ECC does not interact with the Essex Estuaries SAC directly, however the benthic ecology study area, which is defined by a secondary ZoI, crosses the Essex Estuaries SAC. As such, there is a risk that through increased vessel movement during the construction and decommissioning phases could contribute to the risk of introduction or spread of Marine INNS, primarily through ballast water discharge (Eno ., 1997). There will be up to 5,110 round trips to port during the construction phase (based on 79 WTGs installed). However, the movement of commercial vessels is common throughout the region (Volume 6, Part 2, Chapter 9: Shipping and Navigation) and this provides an existing and potentially more likely method of transport for Marine INNS species (due to the higher variety of ports and passage routes).

11.2.118 It should be noted that there is a wide-spread presence of Marine INNS across the southern North Sea already (see Section 11.2.44), plus there is a lack of evidence to date from other OWF developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of marine INNS. Most vessel movements associated with the construction of the array area will be at a significant distance (64.38 km at its nearest point) from the Essex Estuaries SAC, therefore offering further limited potential for a linkage between any INNS and the SAC.

11.2.119 Nevertheless, as the export cable transitions onto the land it is acknowledged that there will be works within the intertidal zone, primarily for any HDD works or open cut installation. However, the intertidal works are expected to complete within a few weeks, with minimal vessel movements compared to offshore works. Again, these works will be at a significant distance (approximately 7.37 km) from the SAC, limiting potential for a linkage between any INNS and the SAC.

11.2.120 Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology concluded that the magnitude of the impact from the potential introduction of INNS was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were deemed to be at a worst case "high", given the lack of evidence for a potential impact of this nature. Overall, it was concluded that the significance of the residual effect is minor adverse.

11.2.121 Natural England's "Advice on Operations" indicates that the majority of the features and sub-features of the SAC are sensitive to the pressure "Introduction or spread of invasive non-indigenous species (INIS)," however it is given a low risk profile of pressure. The advice states that "the risk of this will increase as result of non-compliance to legislation, codes of conduct or best practice." It should be noted that VE, and as detailed in Table 5.13 in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, has committed to environmental measures which include a PEMP with a biosecurity plan and will ensure that the risk of potential introduction and spread of Marine INNS from construction and decommissioning activities will be minimised.

11.2.122 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore wind farms, the project level commitments to mitigate the risk and the ES conclusion of minor adverse significance, there is a low risk of promoting the spread of INNS within the Essex Estuaries SAC during the construction and decommissioning phases. The conclusion is supported by the distance between the ECC landfall location, plus the array area, and the SAC boundary, (approximately 7.37 km and 64.38 km respectively), where the majority of vessel movements will occur (within the array boundary and therefore offering further limited potential for a linkage between any INNS and the SAC); all supporting the conclusion that the sites conservation objectives will be maintained in the long-term. There is, **therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.49) of the features of the Essex Estuaries SAC in relation to spread of INNS from VE alone and therefore, subject to natural change, the feature will be maintained.**

11.2.123 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

ACCIDENTAL POLLUTION

11.2.124 This section addresses the potential for AEoI from effects associated with accidental pollution from works during construction and decommissioning activities.

11.2.125 The potential for accidental pollution to affect benthic subtidal and intertidal habitats is not considered in the ES assessments and was screened out of the assessment, however it has been re-introduced following consultation. The primary source of the pollution risk from the project comes from vessel movements and construction activities, which are all managed through the PEMP, ensuring that there are no adverse environmental effects from the works. **Therefore, there is no potential for an AEoI to the conservation objectives of the designated features at the Essex Estuaries SAC in relation to accidental 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.**

OPERATION AND MAINTENANCE

PHYSCIAL HABITAT LOSS/ DISTURBANCE

11.2.126 This section addresses the potential for AEoI from effects associated with temporary physical habitat loss/ disturbance during the O&M phase on the Essex Estuaries SAC. All SAC features listed in Section 10 are considered together here and are not split into subtidal and intertidal habitats.

11.2.127 As mentioned above for the construction and decommissioning phases, the vast majority of impacts from physical habitat loss/ disturbance will occur within the VEs Order Limits. As the ECC does not interact with or intersect the Essex Estuaries SAC, there will be no direct impacts upon the SAC and therefore no permanent habitat loss or disturbance. It is noted that the benthic study area, secondary ZoI does intersect the site, but as there will be no direct interaction with the site itself, it is expected there will be no impact.

11.2.128 It is concluded, given the distance (approximately 7.37 km) of the site to potential direct interaction with O&M activities, 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 the feature and sub-features of the Essex Estuaries SAC, in relation to physical habitat loss/ disturbance from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.129 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

SUSPENDED SEDIMENT/ DEPOSITION

11.2.130 This section addresses the potential for AEoI from effects associated with the dispersion of suspended sediments and any associated deposition and smothering, expected to occur during the O&M phase as a result of, for example, cable remedial burial, replacement and repairs.

11.2.131 For this effect, the assessment has been split into two different sections to assess the potential impacts both from the array and the ECC i.e., within subtidal areas and at landfall i.e., within the intertidal areas. This is due to the distribution of the designated features within these two different zones and the differing potential impacts.

ARRAY AREA AND OFFSHORE ECC

11.2.132 As described above, the Essex Estuaries SAC is approximately 64.38 km from the array areas, therefore the focus of this assessment will be on the potential effects from cable works within the O&M phase.

11.2.133 The potential impacts from any O&M activities within the ECC are likely to be equal to or less than those assessed during the construction and decommissioning, and thus the potential effects upon the relevant features can also be considered under the same auspices.

11.2.134 In relation to Natural England's "Advice on Operations," and for cable works during the O&M phase, they indicate that all subtidal sub-features, are considered sensitive to the pressure "smothering and siltation rate changes (Light)" and "changes in suspended solids (water clarity)" (apart from subtidal coarse sediments). The Advice directs that such an effect could be expected during construction and decommissioning associated with cable works. The pressure benchmark would be exceeded if up to 5 cm of fine material were added to the habitat in a single event. Given that the works are occurring approximately 7.37 km away from the SAC and the greatest levels of deposition would occur within the immediate vicinity of the works, within the 0-50 m zone as described above, it is unlikely to exceed the pressure benchmark in a significant way.

INTERTIDAL AT LANDFALL

11.2.135 Temporary increases in SSC and associated sediment deposition in the intertidal area are expected from the cable remedial works during the O&M phase. However, as mentioned previously the effects of SSC and associated deposition will most likely occur in the immediate vicinity of the works and due to the distance of the SAC to the area of the intertidal works, it is likely to disperse significantly over this spatial extent and thus unlikely to settle with any measurable thickness within these areas and interact with the features of the SAC.

11.2.136 In relation to Natural England's "Advice on Operations," and for cable works during the O&M phase, they indicate that the majority of the sub-features, of the Annex I habitats Estuaries and Mud flats and sand flats, are considered sensitive to the pressure "*smothering and siltation rate changes (Light)*" and "*changes in suspended solids (water clarity)*" (apart from subtidal coarse sediments). The features which are not sensitive are those which are in the upper intertidal zone such as Atlantic Salt Meadows.

11.2.137 For those features which are sensitive to these pressures, the Advice directs that such an effect could be expected during the O&M phase associated with cable works. The pressure benchmark would be exceeded if up to 5 cm of fine material were added to the habitat in a single event. Given that the works are occurring approximately 7.37 km away from the SAC and the greatest levels of deposition would occur within the immediate vicinity of the works, within the 0-50 m zone as described above, it is unlikely to exceed the pressure benchmark in a significant way.

CONCLUSIONS

11.2.138 Overall, for potential impacts from increased suspended sediment concentrations and associated deposition from O&M activities within the intertidal and subtidal areas, it is concluded that the conservation objectives (as detailed in Section 11.2.47) will be maintained in the long-term. There is, **therefore, no potential for an AEoI, having regard to the conservation objectives of the features of the Essex Estuaries SAC, in relation to temporary and localised increased SSC and associated deposition from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.139 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

INNS

11.2.140 This section addresses the potential for AEoI from effects associated with the increased risk of the introduction or spread of INNS during O&M activities. All SAC features listed in Section 9 are considered together and are not split into subtidal and intertidal habitats.

11.2.141 As described in Section 11.2.68, the introduction of hard substrate and the movement of vessels could encourage the spread of INNS during the O&M phase.

11.2.142 It should be noted that although the benthic study area i.e., the secondary ZoI interacts with the Essex Estuaries SAC, the ECC itself sits at a significant distance away from the site (approximately 7.37 km), further minimizing the potential introduction and interaction of marine INNS with the site. However, in the nearshore area of the ECC, where there is the potential for interaction with intertidal areas, out to 1,600 m seaward of mean high-water springs (MHWS), any cable remedial protection methods will be buried. This minimises the amount of hard substrate within this area and thus reduces the potential colonisation by INNS and reduces the risk this area is used as a steppingstone which could impact the SAC.

11.2.143 The ES concluded that the magnitude of the impact from the potential introduction of INNS for the O&M phase was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were deemed to be at a worst case "high", given the lack of evidence for a potential impact of this nature, reflecting that at worst-case benthic receptors have 'none' or 'low' resistance (tolerance) to an impact of this nature. Overall, the ES concluded that the significance of the residual effect is minor adverse.

11.2.144 Natural England's "Advice on Operations" indicates that the majority of the features and sub-features of the SAC are sensitive to the pressure "*Introduction or spread of invasive non-indigenous species (INIS)*," however it is given a low risk profile of pressure. The advice states that "*the risk of this will increase as result of non-compliance to legislation, codes of conduct or best practice*." It should be noted that VE, and as detailed in Table 5.13 in Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, has mitigation measures which include a PEMP with a biosecurity plan, which will ensure that the risk of potential introduction and spread of marine INNS from the introduction of hard substrate and increased vessel activity is minimised.

11.2.145 It is concluded that due to the lack of evidence of any adverse effect from INNS and offshore wind farms, the project level commitments to mitigate the risk and the ES conclusion of minor adverse significance, there is a low risk of promoting the spread of INNS within the Essex Estuaries SAC during the O&M phases. The conclusion is supported by the distance between the ECC landfall location, plus the array area, and the SAC boundary, (approximately 7.37 km and 64.38 km respectively), where the majority of vessel movements will occur (within the array boundary and therefore offering further limited potential for a linkage between any INNS and the SAC); all supporting the conclusion that the sites conservation objectives will be maintained in the long-term. There is, **therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.49) of the features of the Essex Estuaries SAC in relation to spread of INNS from VE alone and therefore, subject to natural change, the feature will be maintained.**

11.2.146 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

EMF

11.2.147 This section addresses the potential for AEoI from effects associated with the potential impacts from EMF during O&M phase. All SAC features listed in Section 10 are considered together and are not split into subtidal and intertidal habitats.

11.2.148 As the ECC does not directly interact with the SAC, and the distance from the ECC to the SAC is approximately 7.37 km it is considered that there will be no impact upon the features of the SAC due to EMF. Additionally, the cable will be buried within the intertidal and subtidal areas, which will increase the distance between species that may be affected by EMF and thus mitigate any potential behavioural effects.

11.2.149 The ES concluded that the magnitude of the impact from the introduction of EMFs for the O&M phase was considered to be negligible, whereas the sensitivity of the receptors within the benthic study area were considered to be low adverse. Overall, the ES concluded that the significance of the residual effect is negligible.

11.2.150 Although the ECC does not intersect the Essex Estuaries SAC it is best practice to consider the sensitivity of the features and sub-features from the potential effects of EMF. Natural England's Advice on Operations highlights that there is currently insufficient evidence to determine a sensitivity category for the sub-features of the site. This is in line with the current evidence and studies that have been published and highlighted within Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology. As mentioned above, the cables will be buried or protected, and will not intersect the SAC, and as a result it is considered unlikely that EMFs will result in a significant behavioural response that will cause a change in benthic communities within the SAC and associated features and sub features, both within the subtidal and intertidal areas, therefore it is predicted that EMFs will have no significant impact.

11.2.151 It is therefore concluded that due to the lack of conclusive evidence of any adverse effect from EMF upon benthic communities, the project level commitments to mitigate the risk by burying protecting the cables, and the consideration that the ECC does not intersect the SAC, plus the ES conclusion of negligible significance, there is a very low risk from the effect of EMF upon the Essex Estuaries SAC. There is**, therefore, no potential for an AEoI to the conservation objectives (as detailed in Section 11.2.49) of the features and sub-features of the Essex Estuaries SAC in relation to the effects of EMF from VE alone and therefore, subject to natural change, the feature will be maintained.**

11.2.152 Additionally, it is determined that the relevant target attributes (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

CHANGES TO PHYSCIAL PROCESSES

11.2.153 This section addresses the potential for AEoI on benthic communities that could result from changes to physical processes during the O&M phase.

11.2.154 The presence of cable protection in the nearshore areas has the potential to introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology.

11.2.155 It should be noted that the Essex Estuaries SAC is approximately 7.37 km away and therefore any potential changes to sediment transport or wave regimes will be very localised and will not impact upon the designated features of the site. It is acknowledged that the benthic study area, secondary ZoI does overlap with the features Annex I Sandbanks. However, sandbanks are tidally induced bedforms, with sand bank formation principally governed by sediment availability and the prevailing tidal current regime rather than the action of waves. Therefore, any blockage of sediment, particularly in the nearshore where the ECC makes landfall, with the presence of cable protection measures will be extremely small in absolute terms, relative to the sediment volume of the banks.

11.2.156 Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes has determined that the potential impacts from changes to hydrodynamic and wave regimes will not be significant to coastal and physical processes and will therefore not result in any significant changes to sediment transport and consequently will not have any significant impacts on benthic ecology. The overall level of effect has therefore been assessed as being of minor adverse.

11.2.157 Natural England's "Advice on Operations" indicates that a number of sub-features (including sub-tidal sand are sensitive to the pressure "*Water flow (tidal current) changes, including sediment transport considerations*," however the pressure is considered a low risk, risk profile of pressure. The advice states that the pressure benchmark would be exceeded if "*a change in peak mean spring bed flow velocity of between 0.1m/s to 0.2m/s [would occur] for more than 1 year*." Although flow speed around cable protection may be locally elevated, the pressure benchmark is not expected to be exceeded in a significant way and thus the sub-feature would not be sensitive at the proposed level of impact. Furthermore, the features are located at a significant distance from the ECC and any associated cable protection.

11.2.158 It is concluded that given the distance from the ECC to the SAC and that any changes in physical processes will be highly localised and small scale close to the ECC, including any potential impact from cable protection, ensuring that the benchmarks for impacts to the features of the Essex Estuaries SAC are not reached and 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 the features and sub-features of the Essex Estuaries SAC, in relation to any potential changes to physical processes during the O&M phase, from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

11.2.159 Additionally, it is determined that the relevant conservation objectives (to maintain the: Distribution: presence and spatial distribution of biological communities, Extent and distribution and Structure and function: presence and abundance of key structural and influential species) would not be hindered.

ACCIDENTAL POLLUTION

11.2.160 This section addresses the potential for AEoI from effects associated with accidental pollution from works during O&M activities.

11.2.161 The primary risk of pollution during this phase is from the vessel movements to and from the site. As established during the construction and decommissioning phase, the implementation of the PEMP ensures that there is no adverse impact on the surrounding environment from any works associated with the project. **Therefore, there is no potential for an AEoI to the conservation objectives of the designated features at the Essex Estuaries SAC in relation to accidental pollution from the Project alone during O&M and therefore, subject to natural change, the designated features will be maintained in the long-term.**

11.3 MARINE MAMMALS

ASSESSMENT SUMMARY

11.3.1 Table 9.1 presents the sites and their associated impacts, as identified in the HRA screening process through which the construction, operation, maintenance and decommissioning of VE has the potential to cause LSE on marine mammal receptors. The potential for an AEoI therefore applies in relation to those designated sites and relevant features presented within Table 9.1.

11.3.2 This assessment for AEoI is presented as follows:

- Assessment Criteria (a summary of the approach to the assessment);
- Description of Significance (a detailed description of the potential effects and their relevance to the marine mammal's receptor group, including);
  - An introduction to all the identified impacts relevant to this assessment (including mitigation); and
  - The relevant MDS'.
- The full assessment considered for the Southern North Sea SAC;
- The full assessment considered for the Wash and North Norfolk Coast SAC;
- The full assessment considered for the transboundary sites for harbour seals;

- The full assessment considered for the Humber Estuary SAC;
- The full assessment considered for the Humber Estuary Ramsar;
- The full assessment considered for the Berwickshire and North Northumberland SAC; and
- The full assessment considered for the Transboundary sites for grey seal.

ASSESSMENT CRITERIA

11.3.3 A range of effects were identified for marine mammals, as described within Table 9.1. Of the effects to be considered, underwater noise is the most complex and additional information is provided below for context. For full detail see Volume 6, Part 2, Chapter 7: Marine Mammals Ecology.

11.3.4 The risk of injury to all marine mammal features has been identified by expected increases in underwater noise which is manifested through the onset of a permanent threshold shift, or PTS during construction and decommissioning. The risk of injury has also been identified by the physical presence of vessels and the associated collision risk during all phases of VE. Further, the assessment of the risks for harbour porpoise has been guided by the draft 2010 advice issued by JNCC, CCW and Natural England, titled 'The protection of marine European Protected Species from injury and disturbance', and the 2020 guidance published by JNCC titled "Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland)".

11.3.5 The risk of disturbance to all marine mammal features has been identified by expected increases in underwater noise which is manifested through behavioural responses and displacement of animals, and the presence of both construction activities and vessels during all phases of VE, both in the subtidal environment and near seal haul out sites.

11.3.6 To quantify the injurious impacts of noise, the PTS and disturbance impact ranges (both impulsive and cumulative in the area around piling locations and UXO clearances within which the noise levels exceed the PTS thresholds) have been determined using the recent threshold presented by Southall . (2019), both SPL_{peak} and SEL_{cum}[6]. Southall . (2019) recommends the application of SEL_{cum} for the individual activity alone (i.e., not for multiple activities occurring within the same area or over the same time). To inform the assessments for marine mammal features, the SEL_{cum} over a piling event from sound propagation modelling has been considered. Where scenarios with more than one piling event are likely within 24 hours, these scenarios have also been modelled.

11.3.7 Based on agreed density estimates for harbour porpoise, grey seal and harbour seal presented in Volume 6, Part 5, Annex 7.1: Marine Mammal Baseline Characterisation, the number of animals expected within the PTS and disturbance impact ranges have been calculated and presented as a proportion of the relevant (estimated) population size.

[6] The SEL_{cum} threshold for PTS-onset considers the accumulated exposure over the duration of an activity within a 24-hour period.

11.3.8 For disturbance effects specifically caused by UXO and piling, assessments for all marine mammal features have been undertaken using a species-specific dose response approach using site-specific density estimates, rather than a fixed behavioural threshold approach (in line with the approach used in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

11.3.9 For harbour porpoise, the assessment of disturbance then follows the SNCB guidance (JNCC, 2020). JNCC (2020) is informed by the report produced by the Marine Evidence Group (Tougaard . (2014)) which reviewed available literature and empirical data on direct observations collected during wind farm construction at projects across Europe.

11.3.10 Using this evidence, Tougaard . (2014) were able to establish an Effective Deterrent Radius (EDR) of 26 km for percussive piling (monopiles). The EDRs are informed by published ranges where the bulk of the effect (reduction in porpoise vocal activity or sightings) had been detected. They are not equivalent to 100% deterrence/disturbance in the associated area (i.e. some animals show greater reaction than others) but nor do they represent the limit range at which effects have been detected. It should be noted that more noise-tolerant animals will lose less than this mean area, while less noise-tolerant animals would lose more. Furthermore, it is acknowledged in the JNCC advice that there is a potential for a reduced EDR should project specific details (i.e., mitigation) allow. For example, the final advice (JNCC, 2020) provided an EDR for pin piles of 15 km and an EDR for monopiles with noise abatement of 15 km.

11.3.11 When considering seismic surveys (i.e., air guns that may be used during acoustic or geophysical surveys), the JNCC advice identified an EDR of 12 km, reducing to 5 km for high resolution geophysical survey techniques. It is worth noting that seismic surveys are not a static point source, and the JNCC 2023 Marine Noise Registry (MNR) also applies a daily disturbance footprint of 1,759 km for the 12 km EDR, and a 256 km2 footprint for the 5 km EDR. Similarly, it is understood that should further evidence be provided to demonstrate that a smaller EDR is applied in assessments, then the relevant EDR could be refined further. The RIAA has assumed an EDR of 5 km applies (unless the survey specifically identifies the use of air guns).

11.3.12 The advice from JNCC (2020) advises that an effective deterrence range of 26 km around the UXO source location is used to determine the impact area from high-order UXO detonation (neutralisation of the UXO through full detonation of the original explosive content) with respect to disturbance of harbour porpoise in SACs. The JNCC MNR disturbance tool (JNCC, 2023) provides default and worst-case EDRs for various noise sources, and lists the default low-order UXO clearance EDR as 5 km. In the absence of any further data, this 5 km EDR for low-order UXO clearance will be assumed here.

11.3.13 Table 11.2 summarises the EDRs applied for harbour porpoise assessments in the RIAA for the four noise sources discussed above.

Table 11.2 EDRs applied for harbour porpoise assessments

Noise source	EDR (km)	Daily disturbance footprint (km^2)
Piling (monopiles)	26	2,124
Piling (pin piles or mitigated monopiles)	15	707
Surveys (no air gun)	5	256
Surveys (with air gun)	12	1,759
UXO clearance (high-order)	26	2,124
UXO clearance (low-order)	5	79

11.3.14 Disturbance assessment for harbour porpoise of the SNS SAC assesses both spatial and temporal aspects. The spatial area of disturbance, as informed by the relevant EDRs, has a threshold above which disturbance would be considered significant. That threshold is 20% (JNCC, 2020) of the relevant area on any given day (determined here as a 24-hour period).

11.3.15 The temporal element, as defined through the use of the temporal threshold, is 10% of the relevant area when averaged across a season (summer defined as April to September inclusive, winter as October to March inclusive) (JNCC, 2020).

11.3.16 For seals, the approach to assessing disturbance considers potential for site connectivity and the conservation objectives of the relevant sites.

DESCRIPTION OF SIGNIFICANCE

11.3.17 A description of the significance of the project level effect upon the only receptor grouped under 'marine mammals, as relevant to the designated sites and its associated features screened in for potential LSE, is provided below.

CONSTRUCTION AND DECOMMISSIONING

UNDERWATER NOISE

11.3.18 The following assessment is in relation to the potential for effects of underwater noise during construction only. The Screening Report determined that the potential for LSE in relation to underwater noise during decommissioning would be similar to and potentially less than those outlined in the construction phase. Therefore, potential for effect during decommissioning would fall within, and be no worse than, the degree of effect during construction, with any such decommissioning being subject to the relevant licensing requirements at that time.

11.3.19 The potential for an AEoI as a result of an increase in underwater noise on marine mammals during construction relates to the following designated sites and the relevant feature (i.e. those features screened in for potential LSE).

- Southern North Sea SAC (harbour porpoise);

- Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (for harbour seal), specifically Doggersbank (Netherlands) SAC, Klaverbank SCI (Netherlands) and Vlaamse Banken (Belgium) SAC; and
- Transboundary sites (twelve sites for grey seal), specifically Doggersbank (Netherlands) SAC, Klaverbank (Netherlands) SCI, Bancs des Flandres (France) SCI, Vlaamse Banken (Belgium) SAC, SBZ 1 (Belgium) SCI, SBZ 2 (Belgium) SCI, SBZ 3 (Belgium) SCI, Vlakte van de Raan (Netherlands) SCI, Westerschelde & Saeftinghe (Netherlands) SCI, Voordelta (Netherlands) SCI, Noordzeekustzone (Netherlands) SCI and Waddenzee (Netherlands) SCI.

11.3.20 There are a number of sources of underwater noise associated with the project alone during construction, with these identified within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with those screened in for potential LSE here (in line with Section 9.1 of the current report) being:

- Underwater noise from percussive piling;
- Underwater noise during UXO clearance;
- Underwater noise from acoustic/geophysical surveys;
- Acoustic deterrent devices; and
- Seabed preparation and cable installation activities (including vessel movements, dredging, drilling, cable laying, rock placement and trenching).

11.3.21 The importance of underwater noise for the relevant marine mammal features is discussed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. That information, together with the underwater noise that may result from the above activities 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, including the relevance for the features identified.

UNDERWATER NOISE FROM PERCUSSIVE PILING

MDS FOR PILING

11.3.22 The MDS for marine mammals (see Table 11.11) includes percussive piling during the installation of the foundation structures. The full project description is provided in ES Volume 6, Part 2, Chapter 1: Offshore Project Description. In summary, at ES stage, it is expected that VE will include up to 79 WTGs, two OSPs within the array area and cofferdams in the intertidal area.

11.3.23 There are currently up to six foundation options being considered for WTGs and OSPs with the multi-leg pin-piled jacket option presenting the MDS for piling temporally and the monopiles presenting the MDS for piling spatially. In total, for 81 monopile foundations, there will be a total of 328 pin-piles installed for the multi-leg jacket option, with a piling construction duration of one year and either 81 total piling days (assuming one monopile per day) or 85 total piling days (for the multi-leg jacket option).

PTS, TTS AND DISTURBANCE FROM PERCUSSIVE PILING

11.3.24 Volume 6, Part 5, Annex 6.2: Underwater Noise Technical Report provides the technical evidence base for underwater noise, with ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology providing the context for marine mammals (including harbour porpoise, harbour seal and grey seal), in relation to the potential for auditory injury and impairment.

11.3.10 Auditory injury is addressed through consideration of the risk of onset of PTS, while auditory impairment is assessed through considering the risk of TTS of an animal's hearing ability. The threshold values applied for PTS and TTS in relation to impulsive noise according to Southall *et al*. (2019) are presented in Table 11.3 and are used as the basis for the assessments within this report.

Table 11.3 TTS-onset and PTS-onset threshold for impulsive noise from Southall ., 2019

Auditory weighting functions	**Very High Frequency (VHF) Cetacean: Harbour porpoise**	**Phocids (PCW): Grey seal Harbour seal**
Cumulative PTS (SEL_{cum} dB re 1 µPa2s weighted)	155	185
Instantaneous PTS (SPL_{peak} dB re 1 µPa unweighted	202	218
Cumulative TTS (SEL_{cum} dB re 1 µPa2s weighted)	140	170
Instantaneous TTS (SPL_{peak} dB re 1 µPa unweighted)	196	212

11.3.25 The full assessments of potential impact from risk of onset of PTS and TTS in harbour porpoise, grey seal and harbour seal are presented in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. The assessments draw on results from underwater noise modelling at three separate locations: south array SW corner (S-SW), north array NE corner (N-NE) and north array N edge (N-N).

11.3.26 Table 11.4 summarises the predicted impact area, the number of individuals impacted and the percentage of the species-specific MU populations that are expected to experience cumulative PTS-onset from percussive piling at the piling location that represents the maximum effect. The modelled adverse effects are shown to be for cumulative PTS (SELcum) present at monopile locations (7,000 kJ), according to ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology; therefore, only data for monopiling is shown, with no other scenarios presented (e.g. instantaneous PTS/TTS).

11.3.27 Table 11.5 shows the same information, but for cumulative TTS-onset from percussive piling.

11.3.28 The full quantitative assessment of disturbance from pile driving on marine mammal species using the Graham *et al*. (2017) dose response function for harbour porpoise and the dose response function based on the data presented in Whyte . (2020) for both seal species is also presented in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. This assessment also draws on results from underwater noise modelling at the three locations mentioned above.

11.3.15 Table 11.6 summarises the predicted maximum unmitigated potential behavioural disturbance from single event and concurrent monopiling, in the context of number of animals affected (as a function of dose-response) and the area of habitat lost within the SAC as a result of the disturbance (as a function of the EDR for harbour porpoise). Effects from pin-pile driving are not displayed since the modelled maximum design effects are shown to be for at monopile locations (7,000 kJ), not at pin-pile locations (3,000 kJ), according to ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.

Table 11.4 Maximum unmitigated potential behavioural disturbance from single event.

Feature	Piling location with maximum effect	Impact area (km^2)		No. of individuals impacted		Impacted pop. % of MU	
		SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}
Harbour porpoise	N	1.7	**180**	3	**334**	0.001	**<0.1**
Harbour seal	SW	0.01	**0.2**	<1	**<1**	<0.02	**<0.1**
Grey seal	NE N			<1	**<1**	<0.01	**<0.01**

Table 11.5 Maximum monopile unmitigated TTS-onset impact area and estimated number of individuals affected.

Feature	Piling location with maximum effect	Impact area (km^2)		No. of individuals impacted		Impacted pop. % of MU	
		SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}
Harbour porpoise	N	10	**2100**	18	**3,822**	0.01	**1.10**
Harbour and grey seal	SW NE N	0.07	**560 (N)**	<1	**<1 harbour (N)** **27 grey (N)**	<0.02 harbour <0.002 grey	**<0.02 harbour (N)** **0.04 grey (N)**

Table 11.6 Maximum unmitigated potential behavioural disturbance as a function of dose response from single event and concurrent monopiling.

Feature	Impact	Piling scenario		Area impacted (km^2)	No. of individuals impacted	Mean impacted pop. % of MU
Harbour porpoise	PTS Onset (unmitigated)	Monopile	Sequential (30 hours)	190	344	0.10
			Sequential (24 hours)	190	344	0.10
			Concurrent (15 hours)	800	1,467	0.42
		Pin Pile	Sequential (32 hours)	110	202	0.06
			Concurrent (16 hours)	640	1,167	0.34
	TTS Onset (unmitigated)	Monopile	Sequential (30 hours)	2,100	3,821	1.10
			Sequential (24 hours)	2,100	3,821	1.1
			Concurrent (15 hours)	3,600	6,623	1.91
		Pin Pile	Sequential (32 hours)	1,700	3,127	0.90
			Concurrent (16 hours)	3,155	5,743	1.66
Harbour seal	PTS Onstet (unmitigated)	Monopile	Sequential (30 hours)	0.4	<1	<0.02
			Sequential (24 hours)	0.4	<1	<0.02

Feature	Impact	Piling scenario		Area impacted (km^2)	No. of individuals impacted	Mean impacted pop. % of MU
			Concurrent (15 hours)	140	7	0.14
		Pin Pile	Sequential (32 hours)	<0.1	<1	<0.02
			Concurrent (16 hours)	-	6	0.12
	TTS Onset (unmitigated)	Monopile	Sequential (30 hours)	570	<1	<0.01
			Sequential (24 hours)	570	<1	<0.01
			Concurrent (15 hours)	1,500	<1	<0.01
		Pin Pile	Sequential (32 hours)	470	<1	<0.01
			Concurrent (16 hours)	1,300	<1	<0.01
Grey seal	PTS Onset (unmitigated)	Monopile	Sequential (30 hours)	0.4	<1	<0.01
			Sequential (24 hours)	0.4	<1	<0.01
			Concurrent (15 hours)	140	<1	<0.01
		Pin Pile	Sequential (32 hours)	<0.1	<1	<0.01
			Concurrent (16 hours)	-	<1	<0.01
	TTS Onset (unmitigated)	Monopile	Sequential (30 hours)	570	28	0.04
			Sequential (24 hours)	570	28	0.04
			Concurrent (15 hours)	1,500	76	0.12
		Pin Pile	Sequential (32 hours)	470	22	0.03
			Concurrent (16 hours)	1,300	67	0.10

Table 11.7 Difference between the unmitigated and mitigated PTS-onset maximum range (assuming 10 dB reduction in source level).

Species	Modelling location	Unmitigated cumulative PTS Range	Mitigated cumulative PTS range
Harbour porpoise	N	8.6 km	0.68 km
Seals	N	0.33 km	<0.1 km

11.3.29 As unmitigated maximum values, the predicted cumulative PTS onset impact area for harbour porpoise for the monopile piling scenario presented within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology is 180 km^2: for cumulative TTS onset the predicted impact area is 2,100 km^2. The maximum number of harbour porpoise predicted to be within the PTS onset impact area, and therefore at risk of auditory injury, is 337 animals (representing <0.1% of the North Sea MU population): for cumulative TTS onset the maximum number of individuals at risk of auditory impairment is 3,822 (representing 1.10% of the North Sea MU population).

11.3.30 Additionally, a piling MMMP will be developed in accordance with the Outline MMMP 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.

11.3.31 In the context of the predicted range of unmitigated risk of onset of cumulative PTS and TTS from percussive piling, together with the planned mitigation within the outline piling MMMP (as outlined within Table 8.1), the conclusion drawn is of negligible adverse significance for harbour porpoise, which is not significant in EIA terms.

11.3.32 The predicted cumulative PTS onset impact area for harbour seal and grey seal for the monopile piling scenario presented within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology is at most less than 0.2 km^2. The maximum number of harbour seal or grey seal predicted to be within the PTS onset impact area, and therefore at risk of auditory injury, is <1 animal, representing <0.02% of the harbour seal population associated with the South East England MU and 0.01% of the grey seal combined populations of the South East and North East England MUs.

11.3.33 For cumulative TTS onset the predicted impact area is 560 km2 for both species of seal, with a maximum of <1 harbour seal and 27 grey seals predicted to be within the TTS onset impact area. This represents <0.02% of the harbour seal population associated with the South East England MU, and 0.04% of the grey seal combined populations of the South East and North East MUs.

11.3.34 As for harbour porpoise, the predicted range of unmitigated risk of onset of PTS and TTS from percussive piling for both seal species, together with the planned mitigation within the piling MMMP, results in a conclusion of negligible adverse significance which is not significant in EIA terms.

11.3.35 The location with the maximum harbour porpoise disturbance effect caused by piling is predicted to occur at the N location for sequential monopiling over either 24 or 30 hours, where 3,821 individuals could be affected, representing 1.10% of the North Sea MU population. Where concurrent piling will occur, the locations with the maximum disturbance effect on harbour porpoise will affect 6,623 individuals, representing 1.9% of the MU population.

11.3.36 Based on the predicted TTS-onset impact ranges, Table 11.5 presents the maximum harbour porpoise habitat loss associated with concurrent piling, which occurs at the N location. Concurrent piling at these locations causes a maximum of 2,000 km^2 overlap with the SNS SAC, based on an EDR of 26 km.

11.3.37 The location with the maximum harbour seal single pile disturbance effect is predicted to occur is at either the SW, N or NE location where a mean of 1 individual will be affected, representing 0.02% of the South East England MU. Where concurrent piling will occur, 7 individuals are anticipated to be affected, representing 0.14% of the MU population.

11.3.38 For grey seal, a maximum of 28 individuals are predicted to be disturbed during single event pile driving at the N location, representing 0.04% of the combined populations of the South East and North East MUs. For concurrent piling, this increases to 76 individuals, representing 0.12% of the combined MU populations.

MITIGATION

11.3.39 Project specific mitigation specifically included for pile driving is identified in Table 9.1 includes the following:

- Mitigation;
  - Project design;
    - Identification of maximum hammer energy to be used during pile driving (7,000 kJ for monopile, 3,000 kJ for pin-pile), as secured within the dML;
    - Inclusion of soft-start and ramp up procedures for pile driving; and
    - Maximum of 2 simultaneous (concurrent) piling events (two piling operations occurring at exactly the same time from two separate vessels); and
    - Maximum of 4 sequential (consecutive) piling events within 24 hours (four pin piles installed one after another within 24 hours – for jackets only).
  - Marine Mammal Mitigation Protocol (MMMP) (Piling specific);
    - A piling MMMP will be implemented as a condition in the deemed Marine Licence.
  - Southern North Sea (SNS) SAC Site Integrity Plan (SIP)
    - A SNS SAC SIP will be implemented in accordance with the outline SNS SAC SIP, as a condition in the deemed Marine Licence
    - The SIP provides for timing controls to keep noise emissions within agreed thresholds for significant impacts and, if required, additional mitigation such as Noise Abatement Systems.
  - Decommissioning Plan;
    - A Decommissioning Plan will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the mitigation measure will be similar to those for

the construction phase. The Decommissioning Plan will be secured as a condition in the Marine Licence.

- MMMP (decommissioning)
  - Implementation of a decommissioning MMMP subject to a separate Marine License application prior to decommissioning should this be required.

11.3.40 The above measures, as well as compliance with best and established practice (Section 8), will manage and mitigate the impacts from piling on marine mammal features.

11.3.41 It should be remembered that the information presented in Table 11.4 to Table 11.6 represent the maximum in the absence of any mitigation. However, it is important to note that the project is committed to a piling MMMP (as referenced in Table 8.1), with ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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' in EIA terms.

UNDERWATER NOISE FROM UXO CLEARANCE

UXO CLEARANCE MAXIMUM DESIGN SCENARIO

11.3.42 Experience from other OWF projects in the Southern North Sea suggests that there is the potential for UXO to occur within the VE Order Limits and that it is likely that UXO clearance work may be required in some cases; however, it should be noted that the preferred action for VE is for no UXO clearance to occur.

11.3.43 In this instance, a risk assessment will be undertaken and items of UXO will either be avoided, removed or detonated *in situ*. Recent advancements in the available methods for UXO clearance mean that high-order detonation may be avoided. The methods of UXO clearance considered for VE may include:

- High-order detonation;
- Low-order detonation (deflagration);
- Removal/ relocation; and
- Other less intrusive means of neutralising the UXO.

11.3.44 As the detailed pre-construction surveys have not yet been completed, it is not possible at this time to determine how many items of UXO will require clearance. It is anticipated that UXOs have the potential to be present in the area due to its close proximity to coastal areas with historical industrial/commercial significance, such as Clacton on Sea, which may have been subject to bombing during World War II. However, the majority of the coastal area is classified as low risk for UXOs, with higher risk areas such as Little Bentley being located further inland and, therefore, not of relevance to VE. Where possible, the ECR will also be positioned to avoid areas considered potential risk for UXOs.

11.3.45 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; therefore, the Applicant is not seeking to license the disposal of UXO in this application, but it is included in the assessments herein on an illustrative basis.

11.3.46 The MDS for marine mammals (see Volume 6, Part 2, Chapter 7: Marine Mammal Ecology) includes UXO clearance (high-order detonation with a maximum charge size of 698 kg) during site preparation works prior to foundation installation (broadly Q1 2026 – Q3 2026) for which a separate Marine Licence (with associated EPS Licence application) will be sought. The full project description is provided in ES Volume 6, Part 2, Chapter 1: Offshore Project Description. In summary, at ES stage, the expected number of potential UXO targets are 2,000, with up to 60 requiring clearance in the pre-construction phase. The maximum number of clearance events within 24 hours is two with a total indicative duration of 30 days.

PTS, TTS AND DISTURBANCE FROM UXO CLEARANCE

11.3.47 Consideration of impact from UXO is made on a risk of injury basis (defined as risk of onset of PTS) and a disturbance element. ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers how onset of PTS is defined and predicted in Section 1.1.1 based on unmitigated scenarios, with that information summarized in Table 11.8for the maximum effect which is high-order denotation only. Depending on the charge weight of the UXO, it is clear (based on Table 1.15 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 ES, it is expected that should UXO clearance be required for VE, there will be a requirement to implement a UXO specific MMMP to ensure that the risk of PTS is reduced to negligible. The Outline UXO MMMP has been submitted as part of the application for information (Volume 9, Report 14.2).

11.3.48 Furthermore, the Applicant is aware of the potential option for UXO clearance using low-order detonation (small shape charge to penetrate the casing and vaporize the explosive material) as opposed to the commonly used high-order detonation where the explosive material is detonated, with low-order detonations being used as appropriate. It is understood that the potential for this approach (and others) and evidence of its noise impact ranges are currently being investigated further within a project under DESNZ and through the SEA process, with initial findings indicating that as detonation is much smaller, impact ranges will be significantly reduced (through the Offshore Energy SEA Sub-Contract OESEA-19-107[7]).

11.3.49 Natural England and JNCC advise that a buffer of 26 km and 5 km around the source location is used to determine the impact area from high order and low order UXO clearance respectively to determine disturbance of harbour porpoise in the Southern North Sea SAC.

11.3.50 The potential for residual behavioural disturbance in marine mammals from UXO detonations associated with VE assessments presented below include the results for TTS onset thresholds as a proxy for disturbance (Table 11.8).

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1079548/Offshore_Energy_SEA_-_Recent_Research_Summary_-_May_2022.pdf

11.3.51 It is acknowledged that the understanding of the effect of disturbance from UXO detonation is very limited, and, as such, the assessment can only provide an indication of the number of animals potentially at risk of disturbance given the limited evidence available.

Table 11.8 Maximum unmitigated (high-order, 698 kg + donor) UXO detonation PTS-onset impact ranges, number of animals and percentage of MU affected.

Feature	Impact range (km)		Number of individuals impacted		Impacted pop. % of MU	
	SPL_{peak}	SEL_{ss}	SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}
Harbour porpoise	**13**	1.5	**966**	13	**0.28%**	<0.01
Harbour seal	**2.7**	1.9	**<1**	<1	**<0.02**	<0.02
Grey seal			**2**	1	**<0.01**	<0.01

Table 11.9 Disturbance from high-order UXO clearance using an EDR of 26 km.

Species	Density (Number/km2)	Area (km2)	Number impacted	MU pop	% MU disturbed
Harbour porpoise	1.82	2,123.72	3,865	346,601	1.12
Harbour seal	0.018	2,123.72	38	4,868	0.78
Grey seal	0.106	2,123.72	225	65,505	0.34

Table 11.10 Maximum unmitigated (high-order, 698 kg + donor) UXO detonation TTS-onset impact ranges (used as a proxy for disturbance), number of animals and percentage of MU affected.

Feature	Impact range (km)		Number of individuals impacted		Impacted pop. % of MU	
	SPL_{peak}	SEL_{ss}	SPL_{peak}	SEL_{ss}	SPL_{peak}	SEL_{ss}
Harbour porpoise	**25**	4.1	**3,574**	96	**1.03**	0.03
Harbour seal	5	**22**	1	**27**	0.02	**0.55**
Grey seal			8	**161**	0.01	**0.25**

11.3.52 Section 1.11 of ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concluded the significance of impact for all marine mammals from the risk of instantaneous PTS from UXO detonation to be Negligible, rising slightly to Minor for disturbance in harbour porpoise, but remaining as Negligible for disturbance to harbour seal and grey seal.

11.3.53 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.

MITIGATION

11.3.54 As part of any future consent for UXO removal the Applicant will be required to implement a UXO-specific MMMP to ensure that the effect significance of PTS is reduced to negligible. The Outline UXO MMMP has been submitted as part of the DCO application for information (Volume 9, Report 14.2). However, multiple measures are available and have been implemented elsewhere for UXO clearance, such as the use of ADDs and scarer charges to displace animals to beyond the PTS impact range, or noise abatement techniques where appropriate. In ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology the magnitude of this impact is therefore considered to be reduced to **Negligible (Neutral)** for all marine mammal species with the implementation of mitigation.

UNDERWATER NOISE FROM ACOUSIC AND GEOPHYSICAL SURVEYS

11.3.55 Geophysical survey, by definition, results in the emission of underwater noise. The pre-construction geophysical survey for VE is likely to occur within the pre-construction phase, broadly 2027-2028, however no specific information is yet available (in terms of timing, nature, extent or duration) and so a maximum design scenario assessment is not provided. The use of a SIP (see Section 9.2.22) ensures that the assessment for the SNS SAC will be revisited for VE according to the timeframe set out within the Outline SNS SAC SIP and will therefore include geophysical survey known at that time.

11.3.56 The type of geophysical survey carried out for OWF is not typically considered likely to result in PTS in marine mammals and any such a risk is mainly derived from surveys in water >200 m and/or using airguns[8].It is noted that acoustic surveys for an underwater pipeline in northwest Ireland resulted in a decline in harbour porpoise detections, however there was a considerable increase in detections after construction-activities ended which suggests that any impact is localised and temporary (Todd ., 2020).

11.3.57 In any case, if a risk of impacts through acoustic or geophysical were deemed to be present (which would be related to the type and nature of any seismic survey eventually proposed) the risk would be addressed through appropriate licensing measures at that time. **Therefore, with respect to PTS risk for all marine mammal species from geophysical surveys, it is considered that there is no pathway for effect and therefore this will not be considered further in the assessment below.**

11.3.58 To that end, the potential for disturbance in marine mammals from geophysical surveys (given that any such surveys for VE are as yet unknown) are addressed further in the in-combination section only (where plans for such surveys are known). As no information on the detail of surveys at VE is known, the need for such surveys will be addressed within the SIP process.

[8] http://archive.jncc.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf

UNDERWATER NOISE FROM OTHER CONSTRUCTION (SEABED PREPERATION AND CABLE INSTALLATION)

11.3.59 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) although it is difficult to disentangle the confounding effects of each variable.

11.3.60 Information regarding the sensitivity of marine mammals to other construction activities is currently limited; nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology provides an assessment and concludes that the effect significance of disturbance to harbour porpoise Minor and the effect significance of disturbance to seals is Negligible, neither of which are significant in EIA terms.

11.3.61 The assessment is based on studies undertaken at the Beatrice and Moray East offshore wind farms (for harbour porpoise) and the Lincs windfarm (for seals). These report that although harbour porpoise occurrence decreased during non-piling construction periods, they continued to regularly use both sites throughout the three-year construction period. Furthermore, displaced animals resumed foraging once a certain distance (10-25 km) from the noise source and exhibited potential compensation behaviour for lost foraging/ increased energy expenditure of fleeing (Benhemma-Le Gall ., 2020). Therefore, while porpoise may be sensitive to disturbance from other construction-related activities, it is expected that they are able to compensate for any short-term local displacement, and thus it is not expected that individual vital rates would be impacted.

11.3.62 With regard to seals, at the Lincs windfarm, seal usage in the vicinity of construction activity was not significantly decreased during breaks in the piling activities and displacement was limited to within 2 hours of the piling activity (Russell *et al*., 2016a). There was no evidence of displacement during the overall construction period, and the authors recommended that environmental assessments should focus on short-term displacement to seals during piling rather than displacement during construction as a whole. The VE array area is located in a low-density area for both species of seal, and thus it is not expected that any short term-local displacement caused by construction related activities would result in any changes to individual vital rates.

11.3.63 Given the insignificance of the impacts (through noise) of other construction activity, as determined in the ES, **with respect to PTS risk for all marine mammal species, in relation to underwater noise during other construction activities for VE, it is considered that there is no pathway for effect and therefore this will not be considered further in the assessment below.**

VESSEL COLLISION RISK

11.3.64 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). 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 VE are identified.

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

11.3.65 The potential for vessel collision risk with marine mammals alone has been assessed within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with a summary provided below.

11.3.66 The existing vessel traffic movements within the VE array area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see Volume 9, Report 10: Navigational Risk Assessment). Therefore, the introduction of additional vessels during construction is not a novel impact for marine mammals present in the area.

11.3.67 During construction of the wind farm, 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 . 2001) and indirectly by ambient noise levels underwater (which is assessed in ‘Vessel Disturbance’ above) and the behaviour the marine mammal is engaged in.

11.3.68 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. As reported in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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.

11.3.69 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 (Nowacek . 2001, Lusseau 2003, 2006). The adoption of best practice vessel handing protocols (e.g. following the Codes of Conduct provided by the WiSe Scheme[10], Scottish Marine Wildlife Watching Code[11] or Guide to Best Practice for Watching Marine Wildlife[12]) during construction will minimise the potential for any impact by ensuring that vessel traffic moves along predictable routes and will define how vessels should behave in the presence of marine mammals.

11.3.70 Additionally, 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. It is not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

11.3.71 All marine mammal receptors are deemed to be of low vulnerability given that vessel collision is not considered to be a key source of mortality highlighted from post-mortem examinations of stranded animals. However, should a collision event occur, this has the potential to kill the animal and thus marine mammals have a Very High sensitivity to collisions. Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect is of **minor adverse significance**, which is not significant in EIA terms.

11.3.72 Given the **minor adverse significance** of the impacts of vessel collision concluded in the ES, **a conclusion of no AEoI on all marine mammal features of all designated sites in relation to vessel collision for VE alone 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.**

[9] CSIP (2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018)
[10] https://www.wisescheme.org/
[11] https://www.nature.scot/scottish-marine-wildlife-watching-code-smwwc-part-1
[12] https://www.nature.scot/guide-best-practice-watching-marine-wildlife-smwwc-part-2

VESSEL DISTURBANCE

11.3.73 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). As for Underwater Noise impacts presented above, the potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase.

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (two sites for harbour seal); and
- Transboundary sites (twelve sites for grey seal).

11.3.74 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with a summary provided here.

11.3.75 The area surrounding VE already experiences a reasonable amount of vessel traffic throughout the year (see Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during construction is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations.

11.3.76 Increased vessel traffic during construction has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels, as well as increases in underwater noise. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. Volume 6, Part 2, Chapter 1: Offshore Project Description states there will be 101 total construction vessels with an indicative peak number of vessels on site simultaneously as 35. This level of activity is unlikely to occur across the entire VE array area at any one time. Furthermore, during the period of piling operations, it is considered unlikely that vessel noise will impact marine mammal receptors at levels additional to the piling activity itself.

11.3.77 Harbour porpoise have a high frequency generalised hearing range (275 Hz – 160 kHz) and, therefore, the majority of additional vessel traffic noise will fall below their range of hearing. However, they are known to exhibit an avoidance response to vessels that contain low levels of high frequency components of up to 4 km from construction vessels (Benhemma la Gall ., 2021, Dyndo . 2015). Studies have shown that, whilst there may be short-term effects on foraging (including an up to 33% decline due to the presence of vessels prior to piling activities, Benhemma la Gall ., 2023), harbour porpoise show a quick recovery time to responses to vessel traffic, remaining in heavily trafficked areas (Wisniewska *et al*. 2018). There appears to be little fitness cost to exposure to vessel noise and any local scale responses taken to avoid vessels. It is also likely that porpoise may become habituated where vessel movements are regular and predictable.

11.3.78 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.

11.3.79 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 (within a 5 km2 area). Vessel traffic in the VE area, even considering the addition of construction traffic, will still be below this figure.

11.3.80 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that harbour porpoise and seals are relatively small and highly mobile, and given observed responses to noise, they are expected to detect vessels in close proximity and largely avoid them, noting that it is highly likely that a proportion of vessels will be stationary or slow moving throughout construction activities for significant periods of time. Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek . 2001, Lusseau 2003, 2006) and the adoption of best practice vessel handing protocols (e.g. following the Codes of Conduct provided by the WiSe Scheme, Scottish Marine Wildlife Watching Code or Guide to Best Practice for Watching Marine Wildlife) during construction will further minimise the potential for any impact. 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.

11.3.81 It is therefore not expected that the level of vessel activity during the construction of VE would cause a significant increase in the risk of disturbance by vessels either at sea or at haul out locations. The adoption of the Working in Proximity to Wildlife in the Marine Environment (Volume 9, Report 18.1), Table 8.1 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 and 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.

11.3.82 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect (in terms of disturbance) is of minor adverse significance for cetaceans and negligible significance for seals, neither of which are significant in EIA terms. There is, therefore, **no potential for an AEoI, having regard to the conservation objectives of the relevant features in relation to vessel disturbance from VE alone and therefore, subject to natural change, the feature will be maintained in the long term.**

ACCIDENTAL POLLUTION AND CHANGES IN WATER QUALITY

11.3.83 The potential for an AEoI as a result of accidental pollution and changes in water quality 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). The potential for LSE during decommissioning would be similar to and potentially less than those outlined in the construction phase.

CHANGES TO PREY

11.3.84 Given that marine mammals are dependent on fish prey, there is the potential for indirect effects on marine mammals as a result of impacts upon fish species or the habitats that support them. The key prey species for each marine mammal feature are listed in Table 7.27 of ES Volume 6, Part 2, Chapter 7: Marine Mammals Ecology.

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

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal)
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary sites (two sites for harbour seal); and
- Transboundary sites (twelve sites for grey seal).

11.3.86 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/TTS/disturbance from underwater noise and the potential for removal/change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed within the underwater noise assessments for all three features below (by default via consideration of the conservation objectives of the relevant sites). The assessments presented draw on conclusions presented in the assessments in ES Volume 6, Part 2, Chapter 7: Marine Mammals Ecology, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

HABITAT LOSS

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

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

11.3.88 The potential for seal habitat loss during construction and decommissioning is a function of direct removal of supporting habitat. The extent of these effects on marine mammals during construction and decommissioning is described using the details presented in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK

11.3.89 The potential for an AEoI as a result of vessel collision risk with marine mammals during O&M relates to the following designated sites and the relevant feature (i.e., those features screened in for potential LSE). The relevant conservation objectives for these sites are cited in Volume 5, Report 4, Annex 4.4:

- Southern North Sea SAC (harbour porpoise)
- Humber Estuary SAC (grey seal)
- Humber Estuary Ramsar (grey seal)
- Berwickshire and North Northumberland Coast SAC (grey seal)
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI)
- Transboundary grey seal sites (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, Waddenzee SCI).

CHANGES TO PREY

11.3.90 Any change in fish abundance and/or distribution as a result of VE operations is important to assess as, given marine mammals are dependent on fish as prey species, there is the potential for indirect effect on marine mammals. The key prey species for each marine mammal feature are listed in Table 7.27 of ES Volume 6. Part 2, Chapter 7: Marine Mammals.

11.3.91 The potential for an AEoI on marine mammals as a result of changes to prey during O&M relates to the following designated sites and the relevant features (i.e., those features screened in for potential LSE due to foraging ranges and the distance from VE to the site):

- Southern North Sea SAC (harbour porpoise);
- The Wash and North Norfolk Coast SAC (harbour seal);
- Humber Estuary SAC (grey seal);
- Humber Estuary Ramsar (grey seal);
- Berwickshire and North Northumberland Coast SAC (grey seal);
- Transboundary harbour seal sites (Doggersbank (Netherlands) SAC and Klaverbank SCI); and
- Transboundary grey seal sites (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, Waddenzee SCI).

11.3.92 The potential for changes to prey during O&M is a function of direct removal of fish supporting habitat (e.g., spawning, nursery and feeding habitats) and the potential impacts of EMF. The extent of these effects on marine mammals during O&M are discussed in ES Volume 6, Part 2, Chapter 7: Marine Mammals Ecology, and ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; the conclusions of which are drawn on here.

VESSEL DISTURBANCE AT HAUL OUT

11.3.93 The potential for an AEoI as a result of vessel disturbance at haul out 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).

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

MAXIMUM DESIGN SCENARIO

11.3.94 The assessment undertaken for Marine Mammals is based on the MDS within Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, which is repeated in Table 11.11 for clarity.

Table 11.11 The Maximum Design Scenario considered for marine mammals as established within Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.

Potential Effect	Maximum design scenario assessed	Justification
Construction		
PTS from UXO	**UXO clearance:** > 2000 expected potential UXO targets; > 950 potential UXO predicted to require inspection; > 60 expected UXO that will require clearance in pre-construction phase: > Maximum of 2 clearance events within 24 hours; > Indicative duration of 30 days; > MDS clearance method is high-order detonation; > Expected to occur prior to foundation installation; > Max charge size is 698 kg; and > Low order (deflagration) charge size is 0.5 kg. > UXO clearance campaign expected 2028	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. VE OWFL is not seeking to licence the disposal of UXO in this application, but it is included in the impact assessment and for information an outline UXO MMMP has also been submitted (Volume 9, Report 14.2: Outline UXO MMMP).
Disturbance from UXO		

Potential Effect	Maximum design scenario assessed	Justification
PTS from piling TTS (piling) Disturbance from piling	**Monopile WTG:** > Max 79 WTGs > Max 15 m pile diameter; > Max hammer energy: 7,000 kJ; > Max 7.5 hours per pile; > Max 24 hours piling per day; > Max 2 simultaneous piling events. > Max total piling time (hours) = 592.5 > Max number of piling days = 79 (assuming 1 pile per day) **Monopile other structures:** > Max 2 Offshore Substation Platforms (OSP); > Max pile diameter 15 m; > Max hammer energy 7,000 kJ; and > Max 7.5 hours piling per monopile. > Max total piling time (hours) (2 OSP) = 15 > Max number of piling days = 2 **Mult-leg jacket WTG:** > Max 79 WTG; > 4 legs per foundation;	The maximum number of piled foundations (and therefore maximum number of piling days) would represent the temporal maximum design scenario for disturbance. The maximum predicted impact range for underwater noise for piled foundations would represent the spatial maximum design scenario for disturbance.

Potential Effect	Maximum design scenario assessed	Justification
	> 1 pin-pile per leg; > Max 316 pin-piles in total; > Max pin-pile diameter 3.5 m; > Max hammer energy 3,000 kJ; > Max 4 hours per pile; > Max 24 hours piling per day; > Max 2 simultaneous piling events; > Max total piling time (hours) = 1,264 > Max number of piling days = 79 (assuming 4 piles per day) **Multi-leg jacket OSP:** > Number of jacked foundations: 2 > Number of legs per foundation: 6 > Max 12 legs; > 2 pin piles per leg; > Max 24 pin piles in total; > Max 4 hours per pile; > Max pin-pile diameter 3.5 m; > Max hammer energy 3,000 kJ; and > Maximum total piling time (hours) (2 OSP) = 96	

Potential Effect	Maximum design scenario assessed	Justification
	> Max number of piling days = 6 Foundation installation: 2029-2030 Piling construction duration: 1 year Total monopiles (WTG + OSPs): 81 Total pin-piles (WTG + OSPs): 340 Max piling days (WTGs+ OSP): 87 days	
PTS and disturbance from other construction activities	**Seabed preparation spoil volume for all foundations:** > 79 small Gravity Base Structures (GBS) foundations for WTG = 1,137,600 m³; and > 2 GBS foundations for OSP = 56,000 m³ **Cable route clearance methods:** > max flow excavation; and > dredging **Cable burial methods:** > jet trenching; > pre-cut and/or post-lay ploughing; > simultaneous lay and plough (such as burial sledge);	Maximum potential for underwater noise impacts from pre-construction works.

Potential Effect	Maximum design scenario assessed	Justification
	> mechanical trenching; > dredging (typically Trailer suction hopper dredger or water injection dredger); > max flow excavation; and > rock cutting. **Offshore construction indicative dates:** 2027-2030	
Collision risk from vessels	Max total construction vessels: 96 Max total round trips: 4,311 Indicative peak vessels on-site simultaneously: 35 Offshore construction indicative dates: 2027-2030 Max round trips over 4 years: 17,244	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance
Disturbance from vessels		
Change in water quality	Maximum amount of suspended sediment released during construction activities and associated duration - see Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and Volume 6, Part 2, Chapter 3: Marine Water and Sediment Quality.	
Change in fish abundance/distribution	Assessment is based on the MDS presented in Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.	
Habitat loss	Total temporary habitat disturbance within Order Limits is 36,513,188 m^2 **Array areas:**	The temporary disturbance relates to seabed preparation for foundations and cables, jack up and anchoring operations, and cable installation.

Potential Effect	Maximum design scenario assessed	Justification
	Total temporary habitat disturbance within array areas is 21,771,734 m^2 **Offshore ECC:** Total temporary habitat disturbance within Offshore ECC is 14,739,204 m^2	
Disturbance at seal haul out sites	Assessment is based on potential ports, distances to vessel transit routes and landfall.	
Operation		
Collision risk from vessels	Maximum total operation vessels: 27 Maximum total annual round trips: 1,776 Indictive peak vessels on-site simultaneously: 27	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.
Disturbance from vessels		
Change in fish abundance/distribution	Assessment is based on the MDS presented in Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.	
Habitat loss	Total permanent habitat lost within Order Limits is 3,415,083 m^2 **Array areas:** Total habitat lost within array areas is 3,112,079 m^2 **Offshore ECC:** Total habitat lost within Offshore ECC is 303,004 m^2	Permanent habitat loss defined by maximum area of seabed lost as a result of the placement of structures, scour protection, cable protection and cable crossings. Temporary habitat loss defined by maximum number of jack-up vessel operations and total cable replacement throughout the maintenance activities that could have an interaction with the seabed.

Potential Effect	Maximum design scenario assessed	Justification
	Total temporary habitat loss within Order Limits is 734,894 m^2 **Array areas:** Total temporary habitat disturbance within array areas is 589,052 m^2 **Offshore ECC:** Total temporary habitat disturbance within the Offshore ECC is 145,842 m^2	
Operational noise	Operational noise from offshore wind farms 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 scoped in as a precaution.	
Decommissioning		
PTS and disturbance	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 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) therefore maximum: > Maximum total decommissioning vessels: 96 > Maximum total annual round trips: 4,311	The maximum numbers of vessels and associated vessel movements represents the maximum potential for collision risk and disturbance.
Disturbance from vessels		

Potential Effect	Maximum design scenario assessed	Justification
	> Indicative peak vessels on-site simultaneously: 35	
Change in fish abundance/distribution	Assessment is based on the MDS presented in Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.	
Habitat loss	Assumed to be similar level (or less) to the construction phase	

11.3.95 There is one designated site for harbour porpoise in the North Sea MU: the SNS SAC (see Volume 5, Report 4, Annex 4.4 for a summary of this site). The VE array areas and most of the ECC are located within the winter area of the SNS SAC. The Conservation objectives for the site are:

- 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:
  - 1. Harbour porpoise is a viable component of the site;
  - 2. There is no significant disturbance of the species; and
  - 3. The condition of supporting habitats and processes, and the availability of prey is maintained.

11.3.96 The consideration of the risk of onset of PTS for harbour porpoise presented above is in the context of the total population of animals within the MU. The JNCC Advice[13], , notes the following relevant points as regards harbour porpoise population, numbers and viability within the site:

- "*The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent deterioration of harbour porpoise presence in the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU)"* and
- "*The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing conservation objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise."*

11.3.97 Together with the final point, perhaps most pertinently, made under the description of Conservation Objective 1 (which deals with viability and therefore injury risk):

- *'Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG 2012).'*

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

11.3.98 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 North Sea MU population (which in the context of the first conservation objective refers to measures that 'restrict the survivability and reproductive potential of harbour porpoise using the site').

11.3.99 Mitigation for risk of onset of PTS (injury) will be provided for within the MMMP process, a process that will be secured within the DML and requires sign off, regulator agreement and approval prior to works occurring. Mitigation for disturbance risk will be provided for separately within the SIP alongside the ES (as described in Section 9.2).

11.3.100 Given that the MMMP will provide for appropriate mitigation to minimise the risk of injury in harbour porpoise during pile driving to a negligible level (requiring prior approval by the regulator), with that conclusion drawn with respect to the MU population, it is concluded that VE alone does not have the potential to restrict the survivability and reproductive potential of harbour porpoise using the site.

11.3.101 There will not, **therefore, be an AEoI on the viability of harbour porpoise due to PTS (injury) as a result of pile driving at VE alone in relation to the SNS SAC. Subject to natural change, harbour porpoise will be maintained as a 'viable component' of the site in the long-term.**

11.3.102 The second conservation objective for the SNS SAC refers to 'no significant disturbance of the species. As discussed above, data on the behavioural disturbance to harbour porpoise is presented in terms of the number of animals affected (as a function of dose-response) and assessment of the extent of habitat loss/spatial overlap of piling impact through application of the relevant EDR, for which a 26 km EDR is relevant for monopiling. Only monopiling is reported for the purposes of the RIAA given that it causes the maximum design scenario for piling (see ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

11.3.103 Given that none of the SNS SAC conservation objectives pertain to a site-specific harbour porpoise population, for the purposes of the RIAA the disturbance assessment for harbour porpoise is based solely on the relevant EDR (and therefore is in a context of habitat availability and not numbers of animals).

11.3.104 The seasonal nature of the SNS SAC is important when assessing disturbance, with VE being 47.3 km distant from the summer extents of the SNS SAC at its closest point. As such, any noisy activity within the VE site that takes place in the summer season (April-September inclusive) would fall outside the need for assessment. Any noisy activity within the VE site during the winter season (October-March inclusive) would, however, require consideration through the HRA process and is covered below.

11.3.105 Using an EDR of 26 km, the daily unmitigated **maximum** area of overlap of a single monopiling event would be 2,123.7 km^2, representing 16.7% of the winter area of the SNS SAC. The daily unmitigated **minimum** area of overlap of a single monopiling event would be 1,836 km^2, representing 14.46% of the winter area of the SNS SAC (both maximum and minimum areas are presented in Figure 11.4). Neither of these exceed the 20% daily allowance within the winter area of the SNS SAC (24 hours).

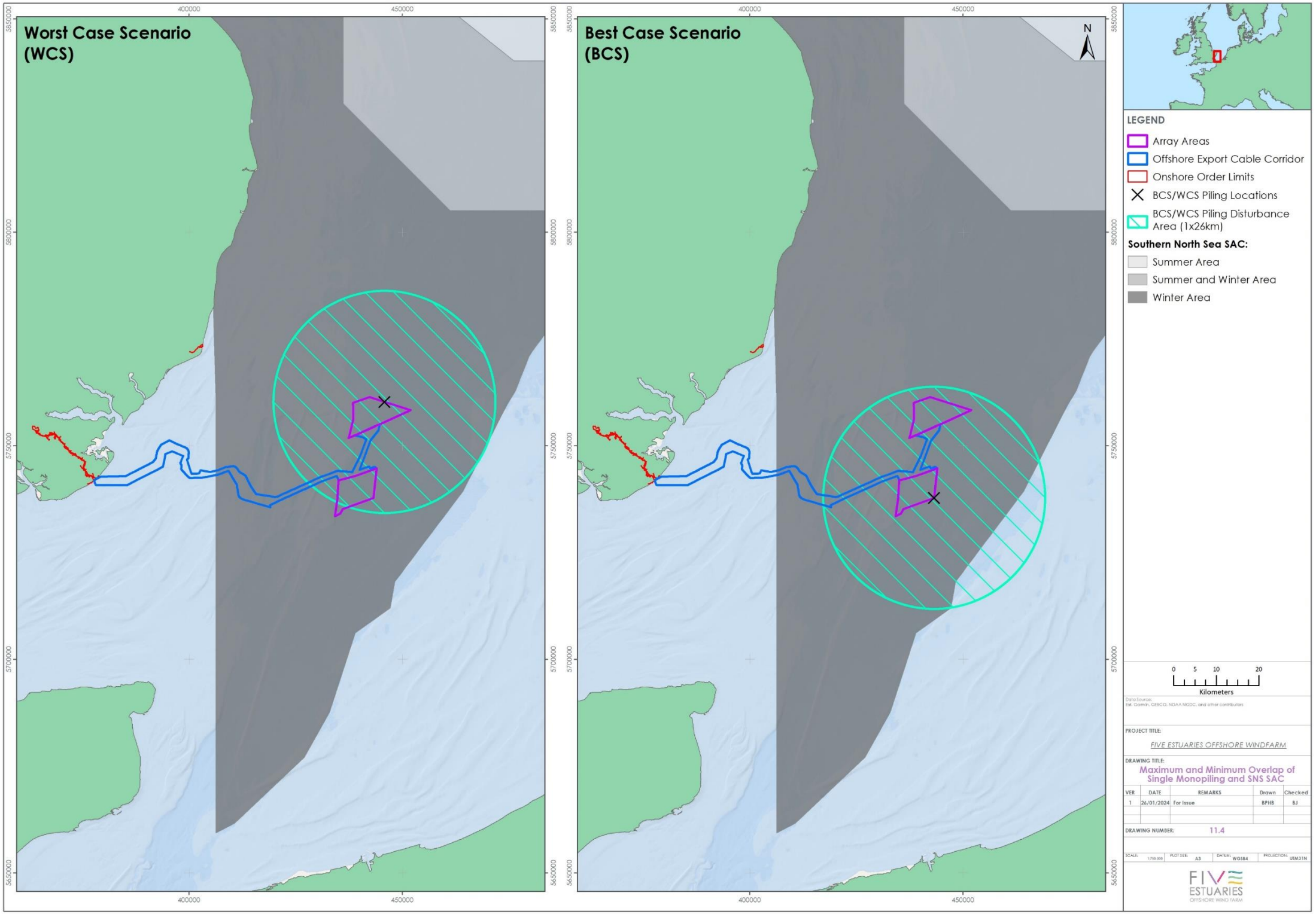
11.3.106 For concurrent monopiling the **maximum** area of overlap would be 3,453 km^2, representing 27.2% of the winter area of the site. The daily unmitigated **minimum** area of overlap for concurrent events is assumed to be the same as for the single event (1,836 km^2, representing 14.46% of the winter area of the SNS SAC), if locations of concurrent events are very close together (both maximum and minimum areas are presented in Figure 11.5). There is therefore only potential for the worst case (maximum overlap) concurrent monopiling to exceed the daily threshold of 20% per 24 hours when considering concurrent piling at two widely separated locations. However, this exceedance of the threshold will be mitigated through the implementation of the Site Integrity Plan (SIP).

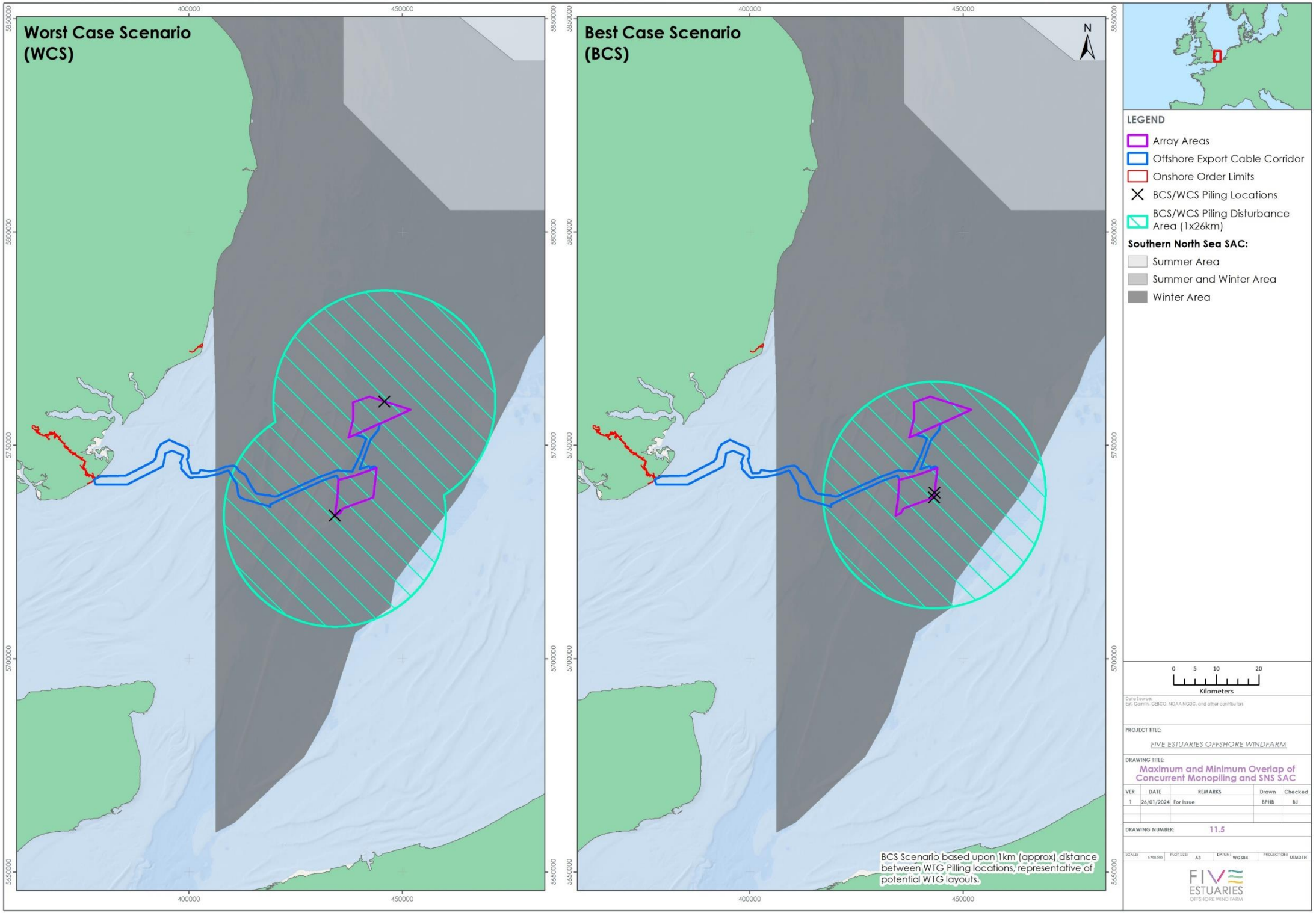
11.3.107 The SIP process will conclude in such a manner that it will preclude threshold exceedance temporally and will therefore not lead to a 'project alone effect'.

11.3.108 The Outline SNS SAC SIP (Volume 9, Report 15) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that the existing RIAA conclusions of no AEoI similarly remain valid. Therefore, the Outline SNS SAC SIP includes provision to confirm the conclusions presented here.

Table 11.12 Overlap with the winter area of the SNS SAC from single and concurrent piling and UXO events.

Activity		Area of overlap (km^2)	Winter area of SNS SAC (km^2)	Spatial overlap	Number of operational days	Number of days in the season	Temporal overlap (%)
Single event	Maximum	2,123.7	12,696	16.7%	81	182	7.4
	Minimum	1,836		14.46%			6.4
Concurrent events	Maximum	3,453		27.2%	41*		6.1
	Minimum	1,836		14.46%			3.3
*Note: calculation based on 2 events per day							


Worst Case Scenario
(WCS)
Best Case Scenario
(BCS)
N
400000
450000
5850000
5800000
5750000
5700000
5650000
LEGEND
Array Areas
Offshore Export Cable Corridor
Onshore Order Limits
BCS/WCS Piling Locations
BCS/WCS Piling Disturbance Area (1x26km)
Southern North Sea SAC:
Summer Area
Summer and Winter Area
Winter Area
0 5 10 20
Kilometers
Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM
DRAWING TITLE:
Maximum and Minimum Overlap of Single Monopiling and SNS SAC
VER | DATE | REMARKS | Drawn | Checked
1 | 26/01/2024 | For Issue | BPHB | BJ
DRAWING NUMBER: 11.4
SCALE: 1:750,000 | PLOT SIZE: A3 | DATUM: WGS84 | PROJECTION: UTM31N
FIVE ESTUARIES
OFFSHORE WIND FARM


Worst Case Scenario (WCS)
Best Case Scenario (BCS)
N
400000
450000
5850000
5800000
5750000
5700000
5650000
LEGEND
Array Areas
Offshore Export Cable Corridor
Onshore Order Limits
BCS/WCS Piling Locations
BCS/WCS Piling Disturbance Area (1x26km)
Southern North Sea SAC:
Summer Area
Summer and Winter Area
Winter Area
BCS Scenario based upon 1km (approx) distance between WTG Pilling locations, representative of potential WTG layouts.
0 5 10 20
Kilometers
Data Source: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM
DRAWING TITLE:
Maximum and Minimum Overlap of Concurrent Monopiling and SNS SAC
VER | DATE | REMARKS | Drawn | Checked
1 | 26/01/2024 | For Issue | BPHB | BJ
DRAWING NUMBER: 11.5
SCALE: 1:750,000 | PLOT SIZE: A3 | DATUM: WGS84 | PROJECTION: UTM31N
FIVE ESTUARIES
OFFSHORE WIND FARM

11.3.109 For the 10% temporal value, single event driving of monopiles creates a daily maximum area of overlap with the SNS SAC of 2,123 km^2, and a minimum overlap of 1,836 km2. On a highly precautionary basis, the maximum area of overlap is considered within this assessment. It is assumed that this piling could occur within the array for a maximum of 81 days. Therefore, calculated as a seasonal winter effect (over 182 days), this represents a seasonal habitat loss of 7.4% of the winter area of the SAC. However, in reality, use of concurrent piling would reduce the number of days required for piling (and in any case, logistics dictate that there will be non-piling days to account for weather and trips to port, etc.). Therefore, the seasonal effect in the winter from single event piling is considered to be precautionary but still within the 10% seasonal threshold.

11.3.110 Therefore, **it is concluded that there will not be an AEoI from disturbance during pile driving at VE alone on the Conservation Objective for harbour porpoise for the SNS SAC. Therefore, subject to natural change, in the long-term, there will be no significant disturbance of harbour porpoise.**

11.3.111 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 ES Volume 6, Part 2, Chapter 2 Marine Geology, Oceanography and Physical Processes. That chapter has concluded the potential for effect to be minor adverse at most (and therefore not significant in EIA terms). 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.

11.3.112 Although specific prey species for harbour porpoise in the SNS SAC are unknown, sandeels and herring are a known prey item for harbour porpoise[14]. The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to cause a minor significance effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider winter area of the SNS SAC. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring; however, the spatial extent of an effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout the wider winter area of the SNS SAC.

[14] http://data.jncc.gov.uk/data/206f2222-5c2b-4312-99ba-d59dfd1dec1d/SouthernNorthSea-SAC-selection-assessment-document.pdf

11.3.113 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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 significance of the effect of changes in water quality is concluded to be of negligible significance, which is not significant in terms of the EIA regulations. Given the conclusions in the ES, in the wider context of the scale of the SNS SAC relative to the scale of VE, no potential for adverse effect on supporting habitats and processes or availability of harbour porpoise prey has been identified.

11.3.114 **There is, therefore, no AEoI from piling to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from VE alone. Subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.**

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM VESSEL CLEARANCE

11.3.115 The only designated sites screened in for harbour porpoise is the SNS SAC. The conservation objectives for that site are given in Volume 5, Report 4, Annex 4.4.

11.3.116 Given that the anticipated requirement for a UXO-MMMP (An outline UXO MMMP has been submitted for information as part of the DCO application see Volume 9, Report 14.2) (Section 8) 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 VE alone will not have an AEoI on the viability of harbour porpoise of the SNS SAC: this satisfies the first conservation objective - ensuring that, subject to natural change, harbour porpoise will be maintained as a 'viable component' of the site in the long-term.**

11.3.117 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 both the application of TTS-onset ranges and the 26 km EDR.

11.3.118 With regard to seasonality, and as was the case for the piling assessment presented earlier, given the location of VE (in the winter extent, and over 47.3 km distant from the summer extent), only UXO clearance (high-order) activity within the VE site during the winter season (October-March inclusive) requires consideration throughout the HRA process.

11.3.119 Using TTS-onset as a proxy for behavioural disturbance: the impact range for harbour porpoise for high order UXO clearance of a 698 kg UXO (+ donor) was calculated at a maximum of 25 km, impacting 3,574 harbour porpoise, equating to 1.03% of the MU (Table 11.3). Given the number and proportion of the MU expected to be disturbed by high-order UXO clearance, the impact is assessed as Low (negative) magnitude in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.

11.3.120 As presented in Table 11.11 for piling, to assess impacts on habitat availability within a 24-hour period, the minimum and maximum overlap per individual high-order UXO clearance with the winter extents of the SNS SAC an EDR of 26 km has been applied. Therefore, based on the currently modelled parameters, the daily unmitigated maximum area of overlap of a single UXO clearance event (high-order) would be the same as for single event piling, at 2,123.7 km^2, representing 16.7% of the SNS SAC. The daily unmitigated minimum area of overlap of a single UXO clearance event (high-order) would be 0 km^2 since it is possible for UXO clearance to happen within the VE Order Limits and no overlap of noise effects to occur with SNS SAC (Figure 11.6). Neither of these exceed the 20% daily allowance (24 hours).

11.3.121 For two high-order UXO clearances, the maximum area of overlap would be 3,453 km^2, representing 27.2% of the site. The daily unmitigated minimum area of overlap is assumed to be the same as for the single event (0 km^2), if locations of both events are very close together (Figure 11.7) There is therefore potential for the worst case scenario of two UXO clearances (high-order) within the array area to exceed the daily threshold of 20% per 24 hours when considering the project alone.

Worst Case Scenario (WCS)

Best Case Scenario (BCS)

N

400000
450000
5850000
5800000
5750000
5700000
5650000

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- BCS/WCS UXO Locations
- BCS/WCS UXO Disturbance Area (1x26km)

Southern North Sea SAC:

- Summer Area
- Summer and Winter Area
- Winter Area

0 5 10 20
Kilometers

Data Sources:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Maximum and Minimum Overlap of a Single UXO Clearance Event and the SNS SAC

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 11.6

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:750,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

Worst Case Scenario (WCS)

Best Case Scenario (BCS)

N

400000
450000
5850000
5800000
5750000
5700000
5650000

LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- BCS/WCS UXO Locations
- BCS/WCS UXO Disturbance Area (2x26km)

Southern North Sea SAC:

- Summer Area
- Summer and Winter Area
- Winter Area

0 5 10 20
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Maximum and Minimum Overlap of Two UXO Clearance Events and the SNS SAC

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 11.7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:750,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

11.3.122 For the 10% temporal value, single event high-order UXO detonation creates a daily maximum area of overlap with the SNS SAC of 2,123 km^2. It is assumed that this clearance could occur within the array for a maximum of 30 days, which when calculated as a seasonal effect (over 183 days) represents a seasonal habitat loss of 2.7% of the winter area of the SAC. When considering the 10% temporal assessment using two UXO detonations simultaneously (3,453 km^2) the seasonal effect over 183 days represents a seasonal habitat loss of 4.5%. However, this assumes that all high-order UXO clearances are undertaken concurrently which is unlikely to be the approach adopted (in reality).

11.3.123 **Therefore, following the practical assumption that concurrent UXO is unlikely, it is not predicted for VE alone to exceed the 20% and 10% thresholds of reduction in habitat availability as a result of high-order UXO clearance. Therefore an AEoI will not occur as a result of disturbance to harbour porpoise from VE alone, during construction and decommissioning, as a result of high-order UXO clearances**.

11.3.124 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 ES, Volume 6, Part 2, Chapter 1: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect, which is not significant in EIA terms. The scale of any potential effect on habitat and physical processes specific to the SNS SAC from individual UXO clearance (high order) 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.

11.3.125 Although specific prey species for harbour porpoise in the SNS SAC are unknown, sandeels and herring are a known prey item for harbour porpoise. The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6. Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to cause a minor significance effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider winter area of the SNS SAC. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring; however, the spatial extent of an effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout the wider winter area of the SNS SAC.

11.3.126 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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 significance of the effect of changes in water quality is concluded to be of negligible significance, which is not significant in terms of the EIA regulations. Given the conclusions in the ES, in the wider context of the scale of the SNS SAC relative to the scale of VE, no potential for adverse effect on supporting habitats and processes or availability of harbour porpoise prey has been identified.

11.3.127 Furthermore, the assessment of impacts to prey is detailed below (paragraphs 11.3.129 to 11.3.133) and concludes that there is no AEoI on prey species of harbour porpoise at this site.

11.3.128 **There is, therefore, no AEoI to the supporting habitats and processes relevant to harbour porpoise and their prey for the SNS SAC from VE alone and therefore, subject to natural change, the availability and density of suitable harbour porpoise prey will be maintained in the long-term.**

ALL OTHER SOURCES FROM UNDERWATER NOISE FROM DISTURBANCE ALONE

11.3.129 The proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to SNS SAC and the harbour porpoise feature.

11.3.130 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.131 The Outline SNS SAC SIP (which will be provided in the DCO application) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that the existing RIAA conclusions of no AEoI similarly remain valid. Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.132 The relevant conservation objectives for harbour porpoise are cited in Volume 5, Report 4, Annex 4.4.

11.3.133 The first two conservation objectives of the SNS SAC address risk of injury and disturbance. ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.134 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.

11.3.135 **There is, therefore, no AEoI resulting from vessel collision risk on harbour porpoise of the SNS SAC from VE alone and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.136 Benhemma la Gall ., 2020 shows that the presence of vessels can result in disturbance of harbour porpoise up to 4 km away. However, it is considered that as the existing vessel traffic movements within the VE array area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction (see Volume 9, Report 10: Navigational Risk Assessment), 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, there would be no significant disturbance to any harbour porpoise associated with the SAC.

11.3.137 The relevant conservation objectives for harbour porpoise are cited in Volume 5, Report 4, Annex 4.4.

11.3.138 The first two conservation objectives address risk of injury and disturbance. ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found (in the context of existing shipping levels, the increase in those levels proposed during construction at VE and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) of VE is insufficient to result in significant disturbance in marine mammals. That conclusion is supported at a site-based level by Heinänen and Skov (2015) as above.

11.3.139 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[15] 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.

11.3.140 **There is, therefore, no AEoI in relation to harbour porpoise of the SNS SAC from vessel disturbance associated with VE alone and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.**

ASSESSMENT OF ACCIDENTAL POLLUTION AND CHANGES IN WATER QUALITY

11.3.141 The potential for accidental pollution and changes in water quality to affect marine mammals was not considered in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, given the project specific mitigation (contained within Table 7.14 of that chapter) and conclusion of no significant effect, which enabled the effect to be scoped out from assessment at ES. The reason for that is given as the development of a Marine Pollution Contingency Plan (MPCP), which will form part of a wider Project Environment Management Plan (PEMP). The PEMP will be secured as a condition in the Marine Licence. Nevertheless, the effect has been included for assessment in the RIAA.

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

11.3.142 The implementation of the PEMP, which will be 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 and changes in water quality from VE alone. Therefore, subject to natural change, the marine mammal feature will be maintained in the long term with respect to the potential for accidental pollution and changes in water quality.**

CHANGES TO PREY

11.3.143 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/TTS/disturbance from underwater noise and the potential for removal/change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.144 In the assessments during construction and decommissioning for this site, it was concluded that there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.

11.3.145 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider winter area of the SNS SAC. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures (primarily a seasonal piling restriction) to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6 for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout the wider winter area of the SNS SAC.

11.3.146 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that due to the lack of significant effect on prey species and given the generalist/ opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on harbour porpoise at the SNS SAC as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.147 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or underwater noise impacts on prey for the SNS SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECTS

11.3.148 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/disturbance from piling, the conclusions of the assessments of TTS/disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.149 For harbour porpoise at the SNS SAC, it was concluded that there is a lack of potential for AEoI as a result of disturbance from piling during construction. This is because even if daily and seasonal thresholds of disturbance could be exceeded by the project alone, impacts will be managed by the mitigation afforded by the SIP and the MMMP.

11.3.150 **There is, therefore, no AEoI resulting from barrier effect as a function of disturbance on the SNS SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.151 The maximum area of disturbance (and therefore loss of available habitat) to the site is 3,453 km, as caused by concurrent monopiling, equating to 27.2% of the winter area of the site. However, given the highly mobile nature of the species, the widely available comparable habitat, and the generalist/opportunist nature of harbour porpoise (ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, Pierce *et al*., 2007) meaning that they will be unlikely to be particularly sensitive to displacement from foraging grounds, means that it is considered that there is no adverse effect from a loss of available supporting habitat on harbour porpoise.

11.3.152 Furthermore, there is evidence that suggests that the presence of man-made structures and resulting reef formation attracts harbour porpoise and can have beneficial effects through increased foraging activities (Fernandex-Betelu, 2022). Therefore, it is considered that any supporting habitat lost in the long term by the physical presence of monopile structures, would not have an adverse effect on harbour porpoise at this site.

11.3.153 **There is, therefore, no AEoI resulting from supporting habitat loss at the SNS SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK AND DISTRUBANCE

11.3.154 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that less annual traffic will be present during the O&M phase of VE when compared to the construction phase (with an annual total of round trips at 1,776), however there will be a greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). Despite being less frequent annually, this vessel use will take place over a longer period of time e.g., the lifetime of VE. Therefore, vessel traffic increase will be greater during this phase than the construction phase. However, it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.155 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of disturbance, mortality, or injury in marine mammals through vessel presence and collisions.

11.3.156 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI to harbour porpoise at the SNS SAC in relation to vessel collision risk and disturbance during O&M from VE alone. Therefore, subject to natural change, features will be maintained in the long-term.**

CHANGES TO PREY

11.3.157 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 21,746,182 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.158 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be highly localised, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.159 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of harbour porpoises' diet (i.e., harbour porpoise are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance and distribution affecting the distribution of the harbour porpoise feature.

11.3.160 **There is, therefore, no AEoI resulting from changes to prey, as a result of changes/ loss of prey habitat or EMF impacts on prey, of harbour porpoises at the SNS SAC from VE alone. Therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.161 There is evidence that suggests that the presence of man-made structures and resulting reef formation attracts harbour porpoise and can have beneficial effects through increased foraging activities (Fernandex-Betelu, 2022). Therefore, it is considered that any supporting habitat lost in the long term by the physical presence of monopile structures, would not have an adverse effect on harbour porpoise at this site.

11.3.162 **There is, therefore, no AEoI resulting from supporting habitat loss at the SNS SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

THE WASH AND NORTH NORFOLK COAST SAC (HARBOUR SEAL)

CONSTRUCTION AND DECOMMISSIONING

ASSESSMENT OF PTS, TTS AND DISTRUBANCE FROM PILING

11.3.163 The conservation objectives for this site 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.

11.3.164 Additional site specific targets for this species as detailed within the 2023 supplementary advice (Natural England, 2023) include:

- Restrict the frequency, duration and/or intensity of disturbance affecting seals whilst hauled out to rest, moult, breed, or pup/suckle so that they are not significantly disturbed;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the extent and spatial distribution of the following supporting habitats: foraging and haulout sites;
- Maintain the abundance of preferred food items required by the species;
- Maintain the natural physico-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Reduce 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. This target was set using the Environmental Agency 2019 water body classifications data;
- Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels. This target was set using the Environmental Agency 2019 water body classifications data; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.

11.3.165 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. However, it is worth nothing that harbour seals associated with the SAC are not restricted to this area and will move beyond the boundary area (Carter ., 2022), which results in potentially connectivity to the Project as evidenced by telemetry data (Vincent ., 2017). The potential for impact on the physical habitat is considered within ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect (which is not significant in EIA terms). The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to have a minor significance effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a minor significance effect on spawning herring; with the spatial extent of an effect being even smaller than that of TTS or recoverable injury, therefore it is considered to also be too localised and of a short duration to cause any long-term negative effect on prey availability.

11.3.166 Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology further considers the impact of piling on 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. In every case, the impacts are concluded to be of negligible significance. Given these conclusions, in the wider context of the scale of the available habitat and the distribution of harbour seal at sea relative to VE (Carter ., 2020; 2022, Russell, 2017), all relative to the scale of VE, no potential for adverse effect has been identified.

11.3.167 There is, therefore, no AEoI to supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC from VE alone. Therefore, subject to natural change, the supporting habitat for harbour seal and their prey will be maintained in the long-term.

11.3.168 **The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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.**

11.3.169 The risk of onset of PTS in all marine mammal species will be addressed in the MMMP, 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).

11.3.170 **Therefore, it is concluded that VE alone will not have an AEoI on harbour seal as a result of mortality or injury resulting from percussive piling at VE.**

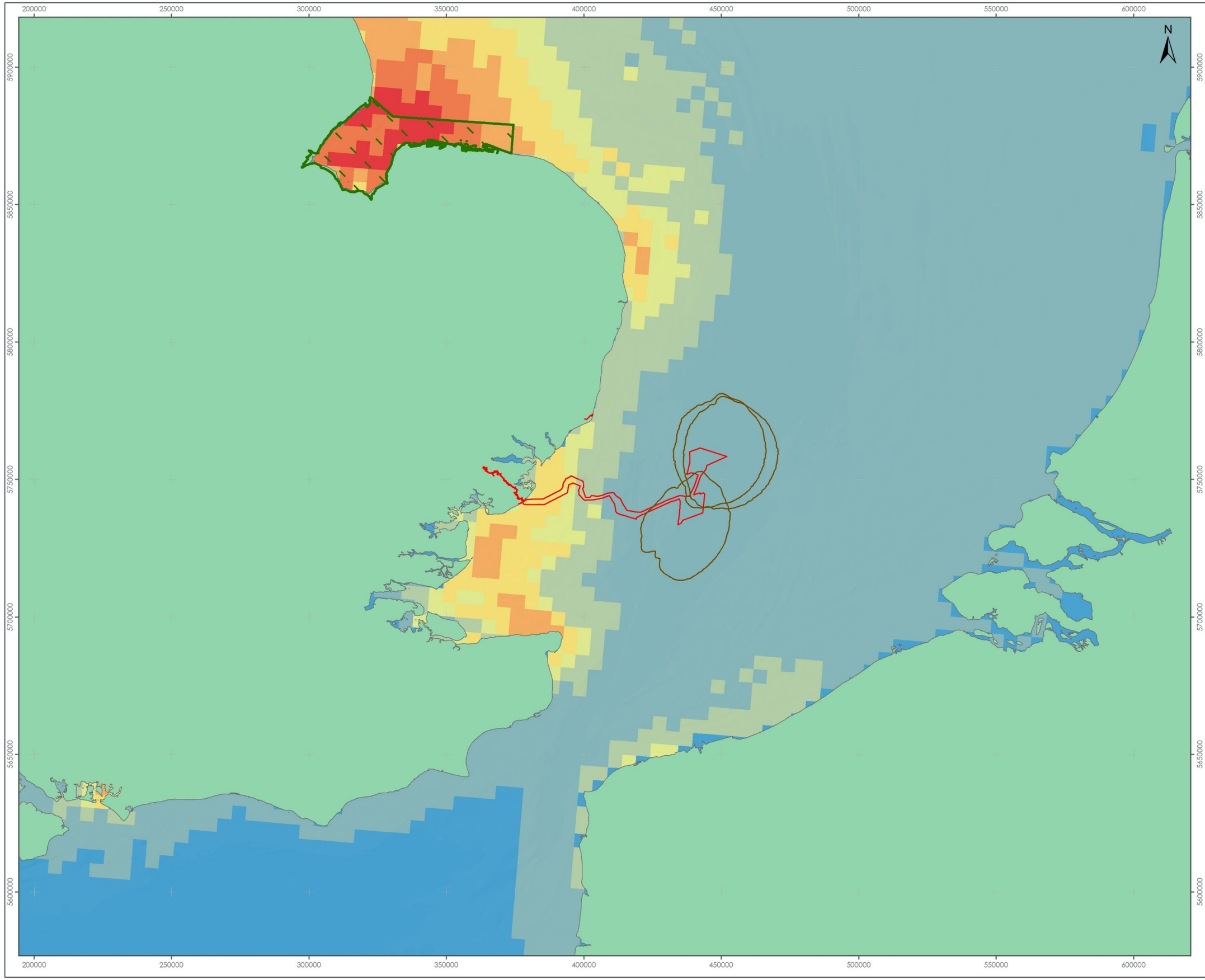
11.3.171 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers the number of harbour seal potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. The highest unmitigated disturbance levels were predicted for the concurrent monopiling, where while there is no direct overlap of noise contours with the SAC, 7 individuals are expected to be affected, representing 0.14% of the MU population (4,868).

11.3.172 At the time of designation, JNCC cites the harbour seal population at the Wash and North Norfolk Coast SAC as being 7% of the UK total[16], which is given by the JNCC as 48,000-56,000. These numbers would indicate that the Wash population was around 3,360-3,920 at the time of designation.

11.3.173 In recent years, the August moult count for harbour seals in the Wash and North Norfolk SAC has decreased by approximately 19%. In the count period 2019-2022 the mean count was 2,758 compared to a mean count of 3,399 in the 2015-2018 count period (SCOS, 2023). This means that the latest population size in the Wash SAC is estimated to be 3,831 harbour seals (August count scaled to account for the proportion of seals hauled at the time of the survey: 0.72 Lonergan ., 2013).

11.3.174 If all the harbour seals disturbed originate from the Wash, that would indicate that during an unmitigated worst-case scenario a total of 2 individual seals (0.18% of the current Wash SAC population of harbour seal) may be temporarily disturbed.

[16] https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0017075.pdf



LEGEND

- Project Order Limits
- The Wash and North Norfolk Coast SAC

Noise Contours, Fleeing Receptors

- 186dB

Harbour Seals (% At-Sea Population, per 25km²) (Carter *et al.* 2022)

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- >0.1

0 10 20 40

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Harbour Seal at Sea Density (based on Carter et al 2022)

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 11.8

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

11.3.175 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the area of sea within which noise sufficient to result in disturbance of harbour seal has a low population density, and therefore it is unlikely to be an important foraging ground for the species. Furthermore, the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days within a one-year construction window), intermittent and is reversible. Given their ability to store energy, and the fact that they are generalist and adaptable foragers, it is expected that harbour seals would require moderate-high levels of repeated disturbance before any effect is seen. Given the low number of harbour seals predicted to be impacted and the proportion of the population this represents, along with the short-term duration of the overall impact, the effect significance of disturbance from piling to harbour seal is negligible, which is not significant in EIA terms.

11.3.176 **There is, therefore, no AEoI as a result of disturbance, from piling, on the harbour seal populations and distribution of the Wash and North Norfolk Coast SAC, from VE alone. Therefore, subject to natural change, the populations of harbour seal within this site will be maintained in the long-term.**

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM UXO CLEARANCE

11.3.177 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a minor impact (which is not significant in EIA terms) and certainly insufficient to reach any habitat designated for harbour seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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 Wash and North Norfolk Coast SAC is located 105.3 km from VE, with the potential for effect on the habitats within the sites therefore inconsequential.

11.3.178 **There is, therefore, no AEoI resulting from UXO clearance on the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC from VE alone and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.**

11.3.179 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS) and disturbance.

11.3.180 The risk of onset of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP (See Volume 9, Report 14.2: Outline MMMP - UXO), which will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour seal during high-order UXO clearance (requiring prior approval by the regulator). Therefore, it is concluded that VE alone does not have an AEoI on harbour seal as a result of mortality or injury resulting from high-order UXO clearance.

11.3.181 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology applies the 26 km EDR for disturbance from UXO detonation for all marine mammal species; the chapter provides counts of individual animals that may be subject to disturbance and places this in the context of the overall population. Such counts vary with size of UXO (with such variability within the 26 km EDR), however given the very short duration, and intermittent nature, the significance was concluded to be slight, which is not significant in EIA terms.

11.3.182 As stated above, the current population at the Wash and North Norfolk SAC, is approximately 3,831. ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that the maximum number of harbour seal disturbed using the 26 km EDR is estimated to be 38, representing 0.73% of the MU population. Those at risk from onset of TTS during high-order UXO clearance is estimated to be 27 individuals which is equivalent to 0.53% of the MU reference population. With respect to the Wash and North Norfolk SAC citation population, 38 individuals (i.e. the worst-case impact) represents approximately 0.99% of the current SAC population. The potential for such a small proportion of the population for 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.

11.3.183 **There is, therefore, no AEoI resulting from UXO clearance on the harbour seal population and distribution with respect to the Wash and North Norfolk Coast SAC from VE alone and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.**

ALL SOURCES OF UNDERWATER NOISE FROM VE ALONE

11.3.184 The proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to this site and harbour seal features screened in for marine mammals.

11.3.185 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.186 The Outline SNS SAC SIP (Volume 9, Report 15) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that the existing RIAA conclusions of no AEoI similarly remain valid. Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.187 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels, the lack of project vessels going into the SAC, and the relevant project mitigation), the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions. applies equally to harbour seal that may be connected to any of the site, given the minimal nature of any effect.

11.3.188 **There is, therefore, no AEoI resulting from vessel collision risk on harbour seal for the Wash and North Norfolk Coast SAC from VE alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.189 The relevant conservation objectives for harbour seal are cited in Volume 5, Report 4, Annex 4.4.

11.3.190 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a negligible impact (which is not significant in EIA terms), and that does not extend to the designated sites themselves certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to harbour seal prey availability to be highly localised and negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect. Furthermore, no vessels are anticipated to go into the SAC.

11.3.191 **There is, therefore, no AEoI resulting from vessel disturbance on the supporting habitats relevant to harbour seal and their prey for the Wash and North Norfolk Coast SAC from VE alone and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.**

11.3.192 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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. Thomsen ., (2006) estimated that harbour seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of harbour seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.193 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.194 **There is, therefore, no AEoI resulting from vessel disturbance on harbour seal for the Wash and North Norfolk Coast SAC, from VE alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.**

CHANGES TO PREY

11.3.195 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/ TTS/ disturbance from underwater noise and the potential for removal/change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.196 In the assessments during construction and decommissioning for this site, it was concluded that there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.

11.3.197 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout VE area or the wider area.

11.3.198 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that due to the lack of significant effect on prey species and given the generalist/opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on harbour seal at the WNNC SAC as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.199 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/ loss of prey habitat or underwater noise impacts on prey for the WNNC SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECTS

11.3.200 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/ disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/ disturbance from piling, the conclusions of the assessments of TTS/ disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.201 For harbour seal at the WNNC SAC, it was concluded that there is a lack of potential for AEoI as a result of disturbance from piling during construction. This was concluded because the area of sea within which noise sufficient to result in disturbance of harbour seal has a low population density and therefore it is unlikely to be an important foraging ground for the species. Furthermore, the impact is predicted to be of local spatial extent, relatively short-term duration, is intermittent and is reversible.

11.3.202 **There is, therefore, no AEoI resulting from barrier effect as a function of disturbance on the WNNC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.203 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m2 within the array area, alternative and comparable habitats are present and widespread. Furthermore, only a relatively small proportion of the habitats are likely to be affected in the context of wider comparable habitats that are available in the area.

11.3.204 In any case, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that grey seals are highly adaptable to a changing environment due to their generalist diet, mobility, life history and adequate fat stores. Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds.

11.3.205 Given the low numbers of seals in vicinity of VE, it is not predicted that there will be any impacts on seal features as a result of supporting habitat loss from placement of structures, scour protection, cable protection and cable crossings within the vicinity of VE.

11.3.206 **There is, therefore, no AEoI resulting from supporting habitat loss at the WNNC SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL DISTURBANCE

11.3.207 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that less annual traffic will be present during the O&M phase of VE when compared to the construction phase (with an annual total of round trips at 1,776), however there will be a greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). Despite being less frequent annually, this vessel use will take place over a longer period of time e.g., the lifetime of VE. Therefore, vessel traffic increase will be greater during this phase than the construction phase. However, there will still be no project vessels within the SAC and it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.208 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.209 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI to harbour porpoise at the SNS SAC in relation to vessel collision risk during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.**

VESSEL COLLISION RISK

11.3.210 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that additional traffic will be present during the O&M phase of VE when compared to the construction phase, including an increased frequency and greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). This vessel use will also take place over a longer period of time e.g., the lifetime of VE with an annual total of round trips at 1,776. Therefore, vessel traffic increase will be greater during this phase. However, in addition to the project vessels not travelling into the SAC, it is highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.211 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.212 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI resulting from vessel collision risk to Harbour seal at the Wash and North Norfolk Coast SAC during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.**

CHANGES TO PREY

11.3.213 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.214 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be low, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.215 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of harbour seals' diet (i.e., harbour seals are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance affecting the distribution of harbour seal features.

11.3.216 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/ loss of prey habitat or EMF impacts on prey of harbour seals from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

VESSEL DISTURBANCE AT HAUL OUT

11.3.217 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with a summary provided here.

11.3.218 The area surrounding VE already experiences a reasonable amount of vessel traffic throughout the year (see Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during O&M is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations. There will be no direct effect on seals within the boundary of the SAC, no vessels will be within the boundary itself.

11.3.219 Increased vessel traffic during O&M has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. The existing vessel traffic movements within the Order Limits (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see Volume 9, Report 18.1: Working in Proximity to Wildlife in the Marine Environment) is unlikely to occur across the entire VE array area at any one time, without being within the boundary of the SAC or near the haul out sites.

11.3.220 It is therefore not expected that the level of vessel activity during the O&M of VE would cause a significant increase in the risk of disturbance by vessels at haul out locations. The adoption of the Working in Proximity to Wildlife in the Marine Environment (Table 8.1) that includes preferred transit routes and guidance for vessel operations in the vicinity of marine mammals and around seal haul-outs will minimize the potential for any impact. The impact is predicted to be of local, short-term duration and intermittent and 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.

11.3.221 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect (in terms of disturbance) is of negligible significance for harbour seals, which is not significant in EIA terms.

11.3.222 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that 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 co-occurrence, 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. Thomsen *et al*., (2006) estimated that harbour seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of harbour seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.223 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with O&M is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.224 **There is, therefore, no AEoI resulting from vessel disturbance the Wash and North Norfolk Coast SAC from VE alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.**

TRANSBOUNDARY SITES (DOGGERSBANK [NETHERLANDS] SAC, KLAVERBANK [NETHERLANDS] SCI, AND VLAAMSE BANKEN [BELGIUM] SAC) HARBOUR SEAL

CONSTRUCTION AND DECOMISSIONING

ASSESSMENT OF PTS, TTS AND DISTRUBANCE

11.3.225 Variable information exists on the conservation objectives at these sites, with the following drawn from UK sites where, subject to natural change, the following applies:

- 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.

11.3.226 Additional objectives for transboundary sites are:

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

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

11.3.228 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect (which is not significant in EIA terms). The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to have a minor significance effect on spawning herring. Additionally, these effects are considered to be localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a minor significance effect on spawning herring; with the spatial extent of an effect being even smaller than that of TTS or recoverable injury, therefore it is considered to also be too localised and of a short duration to cause any long-term negative effect on prey availability.

11.3.229 Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology further considers the impact of piling on 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. In every case, the impacts are concluded to be of negligible significance. Given these conclusions, in the wider context of the scale of the available habitat and the distribution of harbour seal at sea relative to VE (Carter *et al*., 2020; 2022, Russell, 2017), all relative to the scale of VE, no potential for adverse effect has been identified.

11.3.230 **There is, therefore, no AEoI due to percussive piling to the supporting habitats relevant to harbour seal and their prey for the Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banksen SAC from VE alone and therefore, subject to natural change, the supporting habitat for harbour seal and their prey will be maintained in the long-term.**

11.3.231 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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.

11.3.232 The risk of onset of PTS in all marine mammal species will be addressed in the MMMP, 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).

11.3.233 **Therefore, it is concluded that VE alone will not have an AEoI on harbour seal as a result of mortality or injury resulting from percussive piling at VE alone.**

11.3.234 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers the number of harbour seal potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. The highest unmitigated disturbance levels were predicted for the concurrent monopiling, where 7 individuals are expected to be affected, representing 0.14% of the MU population.

11.3.235 At the Doggersbank and Klaverbank SCIs, there are an estimated 6,000 harbour seal in the Dutch section of the North Sea and Wadden Sea[17]. No population level for either SCI has been sourced (the standard data forms both read a population of zero). Similarly the standard data forms for Vlaamse Banken SAC also state a population of zero, however a recent count of the Belgium Coast and Dutch Delta (the portion of the North Sea where the Vlaamse Banken SAC is located) provides an estimated population of 1550 individuals.

11.3.236 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 7 individuals. Even if all those individuals were attributed to each site, this would represent a worst-case impact of only 0.12% of the population associated with the Doggersbank and Klaverbank SCIs, and 0.45% of the population associated with the Vlaamse Banksen SAC. Therefore, no detectable change is predicted with respect to harbour seals associated with transboundary sites.

11.3.237 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the area of sea within which noise sufficient to result in disturbance of harbour seal has a low population density, and therefore it is unlikely to be an important foraging ground for the species. Furthermore, the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (it is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), intermittent and reversible. Given their ability to store energy, and the fact that they are generalist and adaptable foragers, it is expected that harbour seals would require moderate-high levels of repeated disturbance before any effect is seen. Given the low number of harbour seals predicted to be impacted and the proportion of the population this represents, along with the short-term duration of the overall impact, the effect significance of disturbance from piling to harbour seal is negligible, which is not significant in EIA terms.

11.3.238 **There is, therefore, no AEoI from disturbance as a result of piling on the harbour seal populations and distribution of the Doggersbank (Netherlands) SAC,Klaverbank SCI, or Vlaamse Banken SAC as a result of VE. Therefore, subject to natural change, the populations of harbour seal within these sites will be maintained in the long-term.**

[17] https://www.noordzeeloket.nl/en/policy/noordzee-natura-2000/gebieden/doggersbank/dogger-bank/beschermde-soorten/mammals/kopie-harbour-seal/

11.3.239 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a minor impact (which is not significant in EIA terms) and certainly insufficient to reach any habitat designated for harbour seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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. It is also considered that the distance of the harbour seal SACs from VE (> 34.75 km) also limits the potential for effect on the habitats within the sites, with the impacts being therefore inconsequential.

11.3.240 **There is, therefore, no AEoI due to UXO clearance to the supporting habitats relevant to harbour seal and their prey for Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the supporting habitat for harbour seal prey will be maintained in the long-term.**

11.3.241 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS) and disturbance.

11.3.242 As for consideration of harbour porpoise, 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 harbour seal during high-order UXO clearance (requiring prior approval by the regulator). Therefore, **it is concluded that VE alone does not have an AEoI on harbour seal as a result of mortality or injury resulting from high-order UXO clearance.**

11.3.243 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology applies the 26 km EDR for disturbance from UXO detonation for all marine mammal species; the chapter provides counts of individual animals that may be subject to disturbance and places this in the context of the overall population. Such counts vary with size of UXO (with such variability within the 26 km EDR), however given the very short duration, and intermittent nature, the significance was concluded to be slight, which is not significant in EIA terms.

11.3.244 With respect to the potential to effect harbour seals associated with a specific designated site, neither the Klaverbank SCI citation, Doggersbank (Netherlands) citation, nor the Vlaamse Banken SAC citation provide a population size. ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that the maximum number of harbour seal disturbed using the 26 km EDR is estimated to be 38, representing 0.73% of the MU population. Those at risk from onset of TTS during high-order UXO clearance is estimated to be 27 individuals which is equivalent to 0.53% of the MU reference population. This is a small proportion of the population for 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.

11.3.245 **There is, therefore, no AEoI due to UXO clearance for the harbour seal population and distribution with respect to Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banksen SAC from VE alone and therefore, subject to natural change, the population of harbour seal will be maintained in the long-term.**

ALL SOURCES OF UNDERWATER NOISE FROM VE ALONE

11.3.246 It is clear that the proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to these sites and harbour seal features screened in for marine mammals.

11.3.247 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.248 The Outline SNS SAC SIP (which will be provided in the DCO application) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, **that the existing RIAA conclusions of no AEoI similarly remain valid**. Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.249 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions. This applies equally to grey seal that may be connected to either of the sites, given the localised nature of any effect.

11.3.250 **There is, therefore, no AEoI resulting from vessel collision risk on harbour seal for Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.251 The relevant conservation objectives for harbour seal are cited in Volume 5, Report 4, Annex 4.4.

11.3.252 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a negligible impact (which is not significant in EIA terms) and that does not extend to the designated sites themselves certainly insufficient to reach any habitat designated for harbour seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to harbour seal prey availability to be highly localised and negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.

11.3.253 **There is, therefore, no AEoI resulting from vessel disturbance on the supporting habitats relevant to harbour seal and their prey for Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the supporting habitat for harbour seal and grey seal prey will be maintained in the long-term.**

11.3.254 The potential to affect the population and distribution of harbour seal and grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that 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 co-occurrence, 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 *.,* 2017). Thomsen *et al*., (2006) estimated that harbour seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of harbour seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.255 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.256 **There is, therefore, no AEoI resulting from vessel disturbance on harbour seal for the Doggersbank (Netherlands) SAC, Klaverbank SCI or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the harbour seal and grey seal will be maintained in the long-term.**

CHANGES TO PREY

11.3.257 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/ TTS/ disturbance from underwater noise and the potential for removal/ change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.258 In the assessments during construction and decommissioning for this site, it was concluded that **there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.**

11.3.259 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6 for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout VE area or the wider area.

11.3.260 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that due to the lack of significant effect on prey species and given the generalist/ opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on harbour seal at these sites as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.261 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/ loss of prey habitat or underwater noise impacts on prey for the Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECTS

11.3.262 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/ disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/ disturbance from piling, the conclusions of the assessments of TTS/ disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.263 For these sites, it was concluded that there is a lack of potential for AEoI as a result of disturbance from piling during construction. For harbour seal, this was concluded because the area of sea within which noise sufficient to result in disturbance of harbour seal has a low population density and therefore it is unlikely to be an important foraging ground for the species. Furthermore, the impact is predicted to be of local spatial extent, relatively short-term duration, is intermittent and is reversible.

11.3.264 **There is, therefore, no AEoI resulting from barrier effect as a function of disturbance on Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banksen SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.265 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable habitats are present and widespread. Furthermore, only a relatively small proportion of the habitats are likely to be affected in the context of wider comparable habitats that are available in the area.

11.3.266 In any case, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that grey seals are highly adaptable to a changing environment due to their generalist diet, mobility, life history and adequate fat stores. Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds.

11.3.267 Given the low numbers of seals in vicinity of VE, it is not predicted that there will be any impacts on seal features as a result of supporting habitat loss from placement of structures, scour protection, cable protection and cable crossings within the vicinity of VE.

11.3.268 **There is, therefore, no AEoI resulting from supporting habitat loss at the Doggersbank (Netherlands) SAC, Klaverbank SCI, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK

11.3.269 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that less annual traffic will be present during the O&M phase of VE when compared to the construction phase (with an annual total of round trips at 1,776), however there will be a greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). Despite being less frequent annually, this vessel use will take place over a longer period of time e.g., the lifetime of VE. Therefore, vessel traffic increase will be greater during this phase than the construction phase. However, it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.270 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.271 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI due to vessel collision risk to harbour seal at these transboundary sites during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.**

CHANGES TO PREY

11.3.272 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.273 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be highly localised, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.274 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of harbour seals' diet (i.e., harbour seals are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance and distribution affecting the distribution of harbour seal features.

11.3.275 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or EMF impacts on prey of harbour seals from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

VESSEL DISTURBANCE AT HAUL OUT

11.3.276 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with a summary provided here.

11.3.277 The area surrounding VE already experiences a reasonable amount of vessel traffic throughout the year (see ES Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during O&M is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations.

11.3.278 Increased vessel traffic during O&M has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. The existing vessel traffic movements within the VE area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see ES Volume 9, Report 10: Navigational Risk Assessment) is unlikely to occur across the entire VE array area at any one time.

11.3.279 It is therefore not expected that the level of vessel activity during the O&M of VE would cause a significant increase in the risk of disturbance by vessels at haul out locations. The adoption of the Working in Proximity to Wildlife in the Marine Environment (Table 8.1) 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 and 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.

11.3.280 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect (in terms of disturbance) is of negligible significance for harbour seals, which is not significant in EIA terms.

11.3.281 The potential to affect the population and distribution of harbour seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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 harbour seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of harbour seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.282 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with O&M is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.283 **There is, therefore, no AEoI resulting from vessel disturbance at haul out for Doggersbank (Netherlands) SAC, Klaversbank SAC, or Vlaamse Banken SAC from VE alone and therefore, subject to natural change, the harbour seal will be maintained in the long-term.**

HUMBER ESTUARY SAC – GREY SEAL

CONSTRUCTION AND DECOMISSIONING

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM PILING

11.3.284 The conservation objectives at the site 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.

11.3.285 The conservation objectives that address the natural habitats of grey seal are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect (which is not significant in EIA terms). The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to cause a minor significance effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider area. It is worth nothing that harbour seals associated with the SAC are not restricted to this area and will move beyond the boundary area (Carter ., 2022), which results in potentially connectivity to the Project as evidenced by telemetry data (Vincent ., 2017) but also proves a wide potential foraging range which enforces the low impact of prey movements. Potential mortality or mortal injury from VE underwater noise is expected to have a minor significance effect on spawning herring, and the spatial extent of an effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability.

11.3.286 Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology further considers the impact of piling on 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/ changes in prey availability. In every case, the impacts are concluded to be highly localised and of negligible significance. Given these conclusions, in the wider context of the scale of the available habitat and the distribution of grey seal at sea relative to VE (Carter ., 2020, 2022; Russell, 2017), all relative to the scale of VE, no potential for adverse effect has been identified.

11.3.287 **There is, therefore, no AEoI due to percussive piling to the supporting habitats relevant to grey seal and their prey for the Humber Estuary SAC. Therefore, subject to natural change, the supporting habitat for grey seal and their prey will be maintained in the long-term.**

11.3.288 The potential to affect the population and distribution of grey seal during construction is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS), disturbance and vessel collision risk.

11.3.289 The risk of onset of PTS in all grey seals will be addressed in the MMMP, which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during percussive piling operations (with prior approval by the regulator). **Therefore, it is concluded that VE alone does not have an AEoI on grey seal at the Humber Estuary SAC as a result of mortality or injury resulting from percussive piling at VE alone.**

11.3.290 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers the number of grey seal potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. As the same TTS and PTS thresholds apply for both species of seal, the assessment is made using a dose-response curve calculated for harbour seals, in the absence of a dose-response curve for grey seals. The highest unmitigated disturbance levels were predicted for the concurrent monopiling with 76 individuals anticipated to be affected, representing 0.12% of the combined MU populations.

11.3.291 However, grey seals are considered to be less sensitive to behavioural disturbance than harbour seals (see Section 1.5 of ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology), and recent studies of tagged grey seals have shown that there is vast individual variation is responses to pile driving, with some animals not showing any evidence of a behavioural response when within 12 km of the pile driving location (Aarts *et al*, 2018). Therefore, the adoption of the harbour seal dose response curve for grey seals is likely to over-estimate the potential for impact on grey seals.

11.3.292 The Humber Estuary SAC citation[18] gives the grey seal population at the Humber as being 1,800 individuals at the time of designation. The 2022 August haul-out count for grey seals in the Humber Estuary SAC was 3,463 grey seals (SCOS, 2023). It is estimated that 25.15% of the population are hauled-out at the time of the August count (SCOS, 2022: BP 21/03), therefore the total population size including those at sea at the time of the count is estimated to be 13,769 grey seals in the SAC.

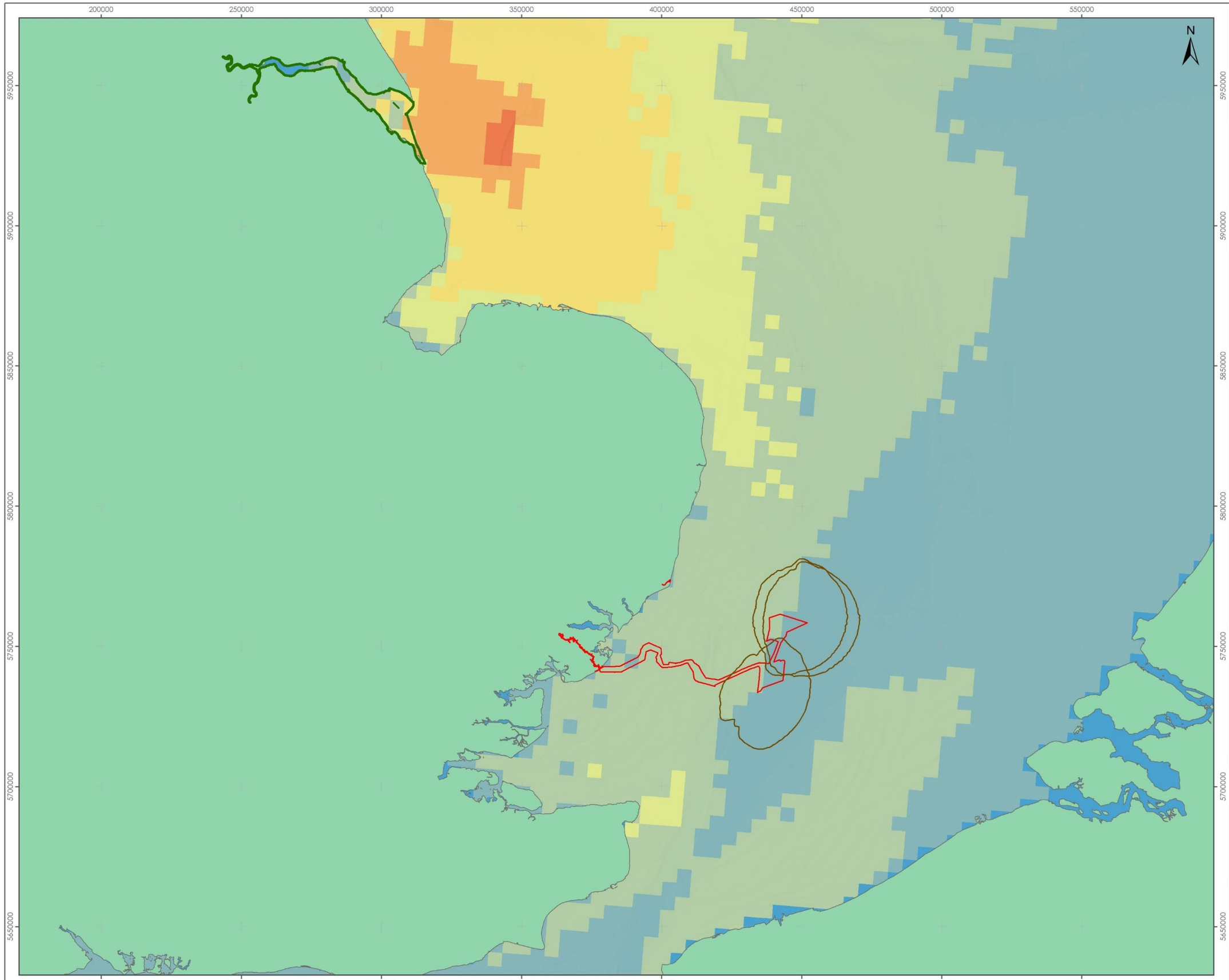
11.3.293 Using the estimated population size at the time of SAC designation is considered to be inappropriate as it is not reflective of the current level of grey seal usage within the SAC. The RIAA will therefore apply the more recent population count of 22,029 grey seals to the Humber Estuary SAC when making the assessment of effect.

11.3.294 Grey seals are a wide-ranging species and frequently travel over 100 km between haul-out sites and across Seal Management Units (e.g. Thompson . 1996). Carter ., 2022 also provides evidence that grey seals have a significant area of use outside the SAC, and therefore, it is clear that grey seals are not resident at one specific haul-out site, and as such, there is no such thing as a 'Humber Estuary SAC grey seal'. Instead, grey seals have associations with SACs (i.e. they have recorded telemetry positions within an SAC) and may associate more with one haul out site over another.

[18] https://publications.naturalengland.org.uk/publication/5009545743040512

11.3.295 The at-sea usage data (see Figure 11.9) suggest that the highest at seal densities are to the south and west of the array (as shown by the higher predicted densities in the grid cells) suggest that the highest at seal densities are to the south-west and north west of the array, as shown by the higher predicted densities in the grid cells. Given the wide-ranging behaviour of grey seals, travelling over 100 km between haul-out sites and with foraging trips lasting up to 30 days (SCOS 2017), it is highly unlikely that any temporary disturbance to grey seals would be sufficient enough to result in displacement, and individuals will be able to compensate by travelling to a different foraging area.

11.3.296 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology assesses whether the identified potential for disturbance would result in a potential effect on the population and distribution of grey seal at a population level. The effect significance of disturbance from piling to grey seal is concluded to be negligible, which is not significant in EIA terms. This is because the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), intermittent and is reversible. Given the low number of grey seals predicted to be impacted and the proportion of the population this represents, coupled with grey seal ability to store energy, and the fact that they are generalist and adaptable foragers, it is expected that they would require moderate-high levels of repeated disturbance before there was any effect on fertility rates.



LEGEND

Project Order Limits

Humber Estuary SAC

Noise Contours, Fleeing Receptors

186dB

Grey Seals (% At-Sea Population, per 25km²) (Carter *et al.* 2022)

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1

0 10 20 40

Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Grey Seal at Sea Density (based on Carter et al 2022)

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 11.9

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,250,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

11.3.298 With respect to the Humber Estuary SAC, the population for assessment is estimated to be 13,769. The maximum potential for disturbance is at most 76 individual seals, with that disturbance being a temporary and localised effect. If all disturbed individuals were attributed to the Humber Estuary SAC population, this would represent 0.55% of the Humber Estuary SAC grey seal population.

11.3.299 The test that needs to be met is the conservation objectives for the site, which is concerned about 'a potential effect on the population and distribution of grey seal'. In the context of the above, it can therefore be concluded that the proposed works would not result in an effect at population level or (other than in the localised and short-term) on the distribution of grey seal seals using this designated site.

11.3.300 Furthermore, in a site-based context, and as a worst case, approximately 0.76% of the Humber Estuary SAC grey seal population could be disturbed during the worst-case piling scenario (concurrent monopiling), on a temporary and localised basis. Any disturbance caused by piling will be short term, temporary and recoverable across a period of up to 12 months with assessments of grey seal disturbance based on a precautionary dose-response curve whereby not all of the individuals subject to the noise will show a disturbance response.

11.3.301 **There is, therefore, no AEoI from disturbance associated with piling for grey seal population and distribution with respect to the Humber Estuary SAC from VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM UXO CLEARANCE

11.3.302 The conservation objectives are the same as described above for the piling assessment and not repeated here.

11.3.303 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a minor adverse impact (which is not significant in EIA terms) certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to grey seal prey availability to be highly localised and 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 this site and VE, combined with the large overall habitat availability and the negligible changes found in the ES assessment, no potential for significant or adverse effect has been identified for grey seal habitat or prey.

11.3.304 **There is, therefore, no AEoI due to UXO clearance to the supporting habitats relevant to grey seal and their prey for the Humber Estuary SAC from VE alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term**.

11.3.305 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS) and disturbance.

11.3.306 The risk of onset of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP (See Volume 9, Report 14.2: Outline MMMP - UXO), which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during high-order UXO clearance (requiring prior approval by the regulator). **Therefore, it is concluded that VE alone does not have an AEoI on grey seal as a result of mortality or injury resulting from high-order UXO clearance.**

11.3.307 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology provides counts of individual grey seals that may be subject to disturbance and places this in the context of the overall population. As for piling related disturbance for grey seal presented above, the number of individual grey seal that may be disturbed temporarily from the clearance of an individual UXO (high-order clearance) represents a small proportion of the overall population associated with individual designated sites; therefore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect significance of disturbance from high-order UXO clearance to grey seal is negligible, which is not significant in EIA terms.

11.3.308 Table 11.9 summarises the maximum impacts for grey seal showing that the maximum number disturbed using the 26 km EDR is estimated to be 225, representing 0.34% of the combined MU populations; those at risk from onset of TTS during high-order UXO clearance is estimated to be 161 individuals which is equivalent to 0.25% of the combined MU reference population.

11.3.309 With respect to the Humber Estuary SAC, the population for assessment is estimated to be 13,769. The maximum potential for disturbance from high-order UXO clearance is at most 225 individual seals, with that disturbance being a temporary and localised effect. If all disturbed individuals were attributed to the Humber Estuary SAC population, this would represent 1.63% of the Humber Estuary SAC grey seal population.

11.3.310 **There is, therefore, no AEoI due to UXO clearance for grey seal population and distribution with respect to the Humber Estuary SAC from VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ALL SOURCES OF UNDERWATER NOISE FROM VE ALONE

11.3.311 It is clear that the proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to this site and grey seal features screened in for marine mammals.

11.3.312 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.313 The Outline SNS SAC SIP (provided in the DCO application) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that the existing RIAA conclusions of no AEoI similarly remain valid. Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.314 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions. As there are no vessel movements anticipated within the SAC itself, it is also considered that this applies equally to grey seal that may be connected to any of the sites designated for grey seal, given the localised nature of any effect.

11.3.315 **There is, therefore, no AEoI resulting from vessel collision risk on grey seal for the Humber Estuary SAC from VE alone and therefore, subject to natural change, the grey seal feature will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.316 The relevant conservation objectives for grey seal are cited in Volume 5, Report 4, Annex 4.4.

11.3.317 As regards the conservation objectives that address the natural habitats of 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a negligible impact (which is not significant in EIA terms) and that does not extend to the designated sites themselves certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to grey seal prey availability to be highly localised and negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect. Furthermore, there will be no vessel movements within the SAC boundary itself.

11.3.318 **There is, therefore, no AEoI resulting from vessel disturbance on the supporting habitats relevant for grey seal and their prey for Humber Estuary SAC from VE alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.**

11.3.319 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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. Thomsen *et al*., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.320 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.321 **There is, therefore, no AEoI resulting from vessel disturbance for Humber Estuary SAC from VE alone and therefore, subject to natural change, the grey seal will be maintained in the long-term.**

CHANGES TO PREY

11.3.322 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/ TTS/ disturbance from underwater noise and the potential for removal/ change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in ES Volume 6, Part 2, Part 2, Chapter 7: Marine Mammals, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.323 In the assessments during construction and decommissioning for this site, it was concluded that there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.

11.3.324 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6 for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout VE area or the wider area.

11.3.325 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammals concludes that due to the lack of significant effect on prey species and given the generalist/ opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on grey seal at the WNNC SAC as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.326 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/ loss of prey habitat or underwater noise impacts on prey for the Humber Estuary SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECTS

11.3.327 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/ disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/ disturbance from piling, the conclusions of the assessments of TTS/ disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.328 For grey seal, even as a worst case, only approximately 0.76% of the Humber Estuary SAC grey seal population could be disturbed during the worst-case piling scenario (concurrent monopiling), on a temporary and localised basis. As for harbour seal, the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), is intermittent and is reversible.

11.3.329 **There is, therefore, no AEoI resulting from barrier effect as a function of disturbance on the Humber Estuary SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.330 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable habitats are present and widespread. Furthermore, only a relatively small proportion of the habitats are likely to be affected in the context of wider comparable habitats that are available in the area.

11.3.331 In any case, ES Volume 6, Part 2, Chapter 7: Marine Mammals reports that grey seals are highly adaptable to a changing environment due to their generalist diet, mobility, life history and adequate fat stores. Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds.

11.3.332 Given the low numbers of seals in vicinity of VE, it is not predicted that there will be any impacts on seal features as a result of supporting habitat loss from placement of structures, scour protection, cable protection and cable crossings within the vicinity of VE.

11.3.333 **There is, therefore, no AEoI resulting from supporting habitat loss at the Humber Estuary SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK

11.3.334 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that additional traffic will be present during the O&M phase of VE when compared to the construction phase, including an increased frequency and greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). This vessel use will also take place over a longer period of time e.g., the lifetime of VE with an annual total of round trips at 1,776. Therefore, vessel traffic increase will be greater during this phase. However, in addition to no project vessels operating within the SAC boundary, it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.335 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.336 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI due to vessel collision risk to grey seal at the Humber Estuary SAC during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.**

CHANGES TO PREY

11.3.337 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.338 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be highly localised, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.339 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of grey seals' diet (i.e., grey seals are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance and distribution affecting the distribution of grey seal features.

11.3.340 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or EMF impacts on prey of grey seals from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

VESSEL DISTURBANCE AT HAUL OUT

11.3.341 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal, with a summary provided here.

11.3.342 The area surrounding VE already experiences a reasonable amount of vessel traffic throughout the year (see Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during O&M is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations.

11.3.343 Increased vessel traffic during O&M has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise and there are no anticipated within the SAC boundary or near the haul out sites. The existing vessel traffic movements within the VE area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see Volume 9, Report 10: Navigational Risk Assessment) is unlikely to occur across the entire VE array area at any one time.

11.3.344 It is therefore not expected that the level of vessel activity during the O&M of VE would cause a significant increase in the risk of disturbance by vessels at haul out locations. The adoption of a Working in Proximity to Wildlife in the Marine Environment plan (Table 8.1) 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 and 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.

11.3.345 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal found that the effect (in terms of disturbance) is of negligible significance for grey seals, which is not significant in EIA terms.

11.3.346 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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 ., 2017). Thomsen ., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.347 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with O&M is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.348 **There is, therefore, no AEoI resulting from vessel disturbance the Humber Estuary SAC from VE alone and therefore, subject to natural change, the grey seal will be maintained in the long-term.**

HUMBER ESTAURY RAMSAR – GREY SEAL

11.3.349 As Ramsar sites do not have Conservation Advice packages, the Conservation Advice packages for the overlapping European Marine Site designations are, in most cases, sufficient to support the management of the Ramsar interests (Natural England, 2023). This applies to the Humber Estuary Ramsar, which overlaps with the Humber Estuary SAC and is being considered here for the same qualifying feature (grey seal), therefore enabling the conservation objectives of the SAC to be applied to the Ramsar site.

11.3.350 Therefore, as the SAC and Ramsar sites overlap and share qualifying features (grey seal) and conservation objectives, it can be concluded that all of the assessments and conclusions for the grey seal qualifying feature of the Humber Estuary SAC above apply equally here. **Therefore, it is considered that there is no AEoI resulting from underwater noise, collision risk, changes to prey, habitat loss, or disturbance at haul out at the Humber Estuary Ramsar from VE alone and therefore, subject to natural change, the grey seal will be maintained in the long-term.**

BERWICKSHIRE AND NORTH NORTHUMBERLAND COAST SAC

CONSTRUCTION AND DECOMMISSIONING

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM PILING

11.3.351 The conservation objectives at the site 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.

11.3.352 The conservation objectives that address the natural habitats of grey seal are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect (which is not significant in EIA terms). The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish And Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to cause a minor significance of effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider area. It is worth nothing that harbour seals associated with the SAC are not restricted to this area and will move beyond the boundary area (Carter ., 2022), which results in potentially connectivity to the Project as evidenced by telemetry data (Vincent ., 2017) but also proves a wide potential foraging range which enforces the low impact of prey movements. Potential mortality or mortal injury from VE underwater noise is expected to have a minor significance of effect on spawning herring, and the spatial extent of an effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability.

11.3.353 Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology further considers the impact of piling on 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/ changes in prey availability. In every case, the impacts are concluded to be highly localised and of negligible significance. Given these conclusions, in the wider context of the scale of the available habitat and the distribution of grey seal at sea relative to VE (Carter ., 2020, 2022; Russell, 2017), all relative to the scale of VE, no potential for adverse effect has been identified.

11.3.354 **There is, therefore, no AEoI from percussive piling to the supporting habitats relevant to grey seal and their prey for the Berwickshire and North Northumberland Coast SAC, from VE alone. Therefore, subject to natural change, the supporting habitat for grey seal and their prey will be maintained in the long-term.**

11.3.355 The potential to affect the population and distribution of grey seal during construction is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS), disturbance and vessel collision risk.

11.3.356 The risk of onset of PTS in grey seals will be addressed in the MMMP, which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during percussive piling operations (with prior approval by the regulator).

11.3.357 **Therefore, it is concluded that VE alone does not have an AEoI on Berwickshire and North Northumberland Coast SAC as a result of mortality or injury resulting from percussive piling at VE alone.**

11.3.358 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers the number of grey seals potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. As the same TTS and PTS thresholds apply for both species of seal, the assessment is made using a dose-response curve calculated for harbour seals, in the absence of a dose-response curve for grey seals. The highest unmitigated disturbance levels were predicted for the concurrent monopiling where 76 individuals are expected to be affected, representing 0.12% of the combined MU populations.

11.3.359 However, grey seals are considered to be less sensitive to behavioural disturbance than harbour seals (see Section 1.5 of ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology), and recent studies of tagged grey seals have shown that there is vast individual variation is responses to pile driving, with some animals not showing any evidence of a behavioural response when within 12 km of the pile driving location (Aarts , 2018). Therefore, the adoption of the harbour seal dose response curve for grey seals is likely to over-estimate the potential for impact on grey seals.

11.3.360 The citation for the Berwickshire and North Northumberland Coast SAC[19] gives the population as 501-1,00 individuals, which has seen an increase in grey seal haul out numbers in recent years. The latest data (SCOS, 2023) shows the haul out count being 4,251 individuals, which when applying the relevant scalar results in 16,903 grey seals in the SAC population.

11.3.361 The maximum potential for disturbance is at most 76 individual seals, with that disturbance being a temporary and localised effect. If all disturbed individuals were attributed to the Berwickshire and North Northumberland SAC population, this would represent 0.45% of the Berwickshire and North Northumberland SAC grey seal population.

11.3.362 Grey seals are a wide-ranging species and frequently travel over 100 km between haul-out sites and across Seal Management Units (e.g. Thompson *et al*. 1996). Therefore, it is clear that grey seals are not resident at one specific haul-out site, and as such, there is no such thing as a "Berwickshire and North Northumberland grey seal". Instead, grey seals have associations with SACs (i.e. they have recorded telemetry positions within an SAC) and may associate more with one haul out site over another.

11.3.363 The at-sea usage data (see Figure 11.9) suggest that the highest at sea densities are to the south and west of the array, as shown by the higher predicted densities in the grid cells. Given the wide-ranging behaviour of grey seals, travelling over 100 km between haul-out sites and with foraging trips lasting up to 30 days (SCOS 2017), it is highly unlikely that any temporary disturbance to grey seals would be sufficient enough to result in displacement, and individuals will be able to compensate by travelling to a different foraging area (Carter ., 2022).

[19] http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0017072.pdf

11.3.364 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology assesses whether the identified potential for disturbance would result in a potential effect on the population and distribution of grey seal at a population level. The effect significance of disturbance from piling to grey seal is concluded to be negligible, which is not significant in EIA terms. This is because the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), intermittent and is reversible. Given the low number of grey seals predicted to be impacted and the proportion of the population this represents, coupled with grey seal ability to store energy, and the fact that they are generalist and adaptable foragers, it is expected that they would require moderate-high levels of repeated disturbance before there was any effect on fertility rates.

11.3.365 The test that needs to be met is the conservation objectives for the site which is concerned about 'a potential effect on the **population** and **distribution** of grey seal'. In the context of the above, it can therefore be concluded that the proposed works would not result in an effect at population level or (other than in the localised and short term) on the distribution of grey seal seals using this designated site.

11.3.366 Furthermore, in a site-based context, as a worst case 0.90% of the site population could be disturbed on a temporary and localised basis. Any disturbance caused by piling will be short term, temporary and recoverable across a period of up to 12 months with assessments of grey seal disturbance based on a precautionary dose-response curve whereby not all of the individuals subject to the noise will show a disturbance response.

11.3.367 **There is, therefore, no AEoI from disturbance associated with piling for grey seal population and distribution with respect to the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM UXO CLEARANCE

11.3.368 The conservation objectives are the same as described above for the piling assessment and not repeated here.

11.3.369 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a minor adverse impact (which is not significant in EIA terms) certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to grey seal prey availability to be highly localised and 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 this site and VE, combined with the large overall habitat availability and the negligible changes found in the ES assessment, no potential for significant or adverse effect has been identified for grey seal habitat or prey.

11.3.370 **There is, therefore, no AEoI due to UXO clearance on the supporting habitats relevant to grey seal and their prey for the Berwickshire and North Northumberland Coast SAC, from VE alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.**

11.3.371 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS) and disturbance.

11.3.372 The risk of onset of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP (See Volume 9, Report 14.2: Outline MMMP - UXO), which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during high-order UXO clearance (requiring prior approval by the regulator). Therefore, it is concluded that VE alone does not have an AEoI on grey seal as a result of mortality or injury resulting from high-order UXO clearance.

11.3.373 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology provides counts of individual grey seals that may be subject to disturbance and places this in the context of the overall population. As for piling related disturbance for grey seal presented above, the number of individual grey seal that may be disturbed temporarily from the clearance of an individual UXO (high-order clearance) represents a small proportion of the overall population associated with individual designated sites; therefore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect significance of disturbance from high-order UXO clearance to grey seal is negligible, which is not significant in EIA terms.

11.3.374 Table 11.9 summarises the maximum impacts for grey seal showing that the maximum number disturbed using the 26 km EDR is estimated to be 225, representing 0.34% of the combined MU populations; those at risk from onset of TTS during high-order UXO clearance is estimated to be 161 individuals which is equivalent to 0.25% of the MU reference population.

11.3.375 With respect to the Berwickshire and North Northumberland Coast SAC, the population for assessment purposes is 16,903 individual grey seals. If all disturbed individuals were attributed to the Berwickshire and North Northumberland Coast SAC population, this would represent 1.33% of the Berwickshire and North Northumberland Coast SAC grey seal population.

11.3.376 **There is, therefore, no AEoI due to UXO clearance on grey seal population and distribution with respect to the Berwickshire and North Northumberland Coast SAC, from VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ALL SOURCES OF UNDERWATER NOISE FROM VE ALONE

11.3.377 It is clear that the proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to this site and grey seal features screened in for marine mammals.

11.3.378 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.379 The Outline SNS SAC SIP (which will be provided in the DCO application) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that **the existing RIAA conclusions of no AEoI similarly remain valid.** Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.380 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions. This applies equally to grey seal that may be connected to any of the sites designated for grey seal, given the localised nature of any effect.

11.3.381 **There is, therefore, no AEoI resulting from vessel collision risk on Berwickshire and North Northumberland Coast SAC, from VE alone and therefore, subject to natural change, the grey seal will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.382 The relevant conservation objectives for grey seal are cited in Volume 5, Report 4, Annex 4.4.

11.3.383 As regards the conservation objectives that address the natural habitats of 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a negligible impact (which is not significant in EIA terms) and that does not extend to the designated sites themselves certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to seal prey availability to be highly localised and negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.

11.3.384 **There is, therefore, no AEoI resulting from vessel disturbance on the supporting habitats relevant Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.**

11.3.385 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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 ., 2017). Thomsen *et al*., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.386 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.387 **There is, therefore, no AEoI resulting from vessel disturbance on the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the grey seal feature will be maintained in the long-term**.

CHANGES TO PREY

11.3.388 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/ TTS/ disturbance from underwater noise and the potential for removal/change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.389 In the assessments during construction and decommissioning for this site, it was concluded that there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.

11.3.390 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6 for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout VE area or the wider area.

11.3.391 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that due to the lack of significant effect on prey species and given the generalist/ opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on grey seal at the Berwickshire and North Northumberland Coast SAC as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.392 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/ loss of prey habitat or underwater noise impacts on prey for the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECTS

11.3.393 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/ disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/ disturbance from piling, the conclusions of the assessments of TTS/ disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.394 The disturbance assessment for the Berwickshire and North Northumberland Coast SAC found as a worst case 1.33% of the site population could be disturbed on a temporary and localised basis, with the potential for disturbance of seals associated with transboundary sites is even less. As for harbour seal, the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), is intermittent and is reversible.

11.3.395 **There is, therefore, no AEoI resulting from barrier effect as a function of disturbance on the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.396 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m2 within the array area, alternative and comparable habitats are present and widespread. Furthermore, only a relatively small proportion of the habitats are likely to be affected in the context of wider comparable habitats that are available in the area.

11.3.397 In any case, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that grey seals are highly adaptable to a changing environment due to their generalist diet, mobility, life history and adequate fat stores. Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds.

11.3.398 Given the low numbers of seals in vicinity of VE, it is not predicted that there will be any impacts on seal features as a result of supporting habitat loss from placement of structures, scour protection, cable protection and cable crossings within the vicinity of VE.

11.3.399 **There is, therefore, no AEoI resulting from supporting habitat loss at the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK

11.3.400 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that additional traffic will be present during the O&M phase of VE when compared to the construction phase, including an increased frequency and greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). This vessel use will also take place over a longer period of time e.g., the lifetime of VE with an annual total of round trips at 1,776. Therefore, vessel traffic increase will be greater during this phase. However, it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.401 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.402 Given that the assessment applies equally to all marine mammals there is, therefore, no AEoI to grey seals at the Berwickshire and North Northumberland SAC in relation to vessel collision risk during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.

CHANGES TO PREY

11.3.403 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.404 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be highly localised, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.405 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of grey seals' diet (i.e., grey seals are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance and distribution affecting the distribution of grey seal features.

11.3.406 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or EMF impacts on prey of grey seals from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

VESSEL DISTURBANCE AT HAUL OUT

11.3.407 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with a summary provided here.

11.3.408 The area surrounding VE already experiences a high amount of vessel traffic throughout the year (see Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during O&M is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations.

11.3.409 Increased vessel traffic during O&M has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. The existing vessel traffic movements within the VE area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see Volume 7, Report 6: Navigational Risk Assessment) is unlikely to occur across the entire VE array area at any one time.

11.3.410 It is therefore not expected that the level of vessel activity during the O&M of VE would cause a significant increase in the risk of disturbance by vessels at haul out locations. The adoption of the Working in Proximity to Wildlife in the Marine Environment (Table 8.1) 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 and 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.

11.3.411 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect (in terms of disturbance) is of negligible significance for grey seals, which is not significant in EIA terms.

11.3.412 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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 ., 2017). Thomsen ., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.413 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with O&M is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.414 **There is, therefore, no AEoI resulting from vessel disturbance the Berwickshire and North Northumberland Coast SAC from VE alone and therefore, subject to natural change, the grey seal will be maintained in the long-term.**

TRANSBOUNDARY SITES (DOGGERSBANKS [NETHERLANDS] SAC, KLAVERBANK SCI, BANCS DES FLANDRES SCI, VLAAMSE BANKEN SAC, SBZ 1 SCI, SBZ 2 SCI AND SBZ 3 SCI, VLAKTE VAN DE RAAN SCI, WESTERSCHELDE & SAEFTINGHE SCI, VOORDEL TA SCI, NOORDZEEKUSTZONE SCI AND WADDENZEE SCI)

CONSTRUCTION AND DECOMMISSIONING

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM PILING

11.3.415 Variable information exists on the conservation objectives for individual transboundary sites. Therefore, the sites following relevant conservation objectives for UK sites are used as a starting point:

- 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.

11.3.416 The additional objectives for transboundary sites (where available) are:

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

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

- Conservation of intertidal areas for resting grey seal.
- Together with the following additional objective for the Noordseekustzone SCI (the second point also for the Waddenzee SCI):
- Improving the quality of habitat for marine mammals; and
- Maintain undisturbed resting places and optimal breeding habitat for grey seal.

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

11.3.419 The conservation objectives that address the natural habitats of grey seal (the first four bullet points for UK site conservation objectives) are concerned with the physical habitat and the species contained within. The potential for impact on the physical habitat is considered within ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded at most a minor adverse effect (which is not significant in EIA terms). The potential for project alone impacts (including habitat loss, habitat change and effects of underwater noise) on sandeel and herring are addressed in full in Section 6.12 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this assessment, some underwater noise impact pathways (TTS and recoverable injury) are considered to cause a minor significance effect on spawning herring. Additionally, these effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability throughout the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a minor significance effect on spawning herring, and the spatial extent of an effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability.

11.3.420 Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology further considers the impact of piling on 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/changes in prey availability. In every case, the impacts are concluded to be highly localised and of negligible significance. Given these conclusions, in the wider context of the scale of the available habitat and the distribution of grey seal at sea relative to VE (Carter., 2020, 2022; Russell, 2017), all relative to the scale of VE, no potential for adverse effect has been identified.

11.3.421 **There is, therefore, no AEoI to the supporting habitats relevant to grey seal and their prey for the Doggersbank (Netherlands) SAC, Klaverbank (Netherlands) SCI , Bancs des Flandres (France) SCI, Vlaamse Banken (Belgium) SCI, SBZ 1 (Belgium) SCI, SBZ 2 (Belgium) SCI, SBZ 3 (Belgium) SCI, Vlakte van de Raan (Netherlands) SCI, Westerschelde & Saeftinghe (Netherlands) SCI, Voordelta (Netherlands) SCI, Noordzeekustzone (Netherlands) SCI or Waddenzee (Netherlands) SCI from VE alone. Therefore, subject to natural change, the supporting habitat for grey seal and their prey will be maintained in the long-term.**

11.3.422 The potential to affect the population and distribution of grey seal during construction is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS), disturbance and vessel collision risk.

11.3.423 The risk of onset of PTS in grey seal will be addressed in the MMMP, which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during percussive piling operations (with prior approval by the regulator).

11.3.424 **Therefore, it is concluded that VE alone does not have an AEoI on grey seal at the transboundary sites as a result of mortality or injury resulting from percussive piling at VE alone.**

11.3.425 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers the number of grey seals potentially disturbed by unmitigated pile driving at each modelled location for both monopiles and pin piles. As the same TTS and PTS thresholds apply for both species of seal, the assessment is made using a dose-response curve calculated for harbour seals, in the absence of a dose-response curve for grey seals. The highest unmitigated disturbance levels were predicted for the concurrent monopiling where 76 individuals are expected to be affected, representing 0.12% of the combined MU populations.

11.3.426 However, grey seals are considered to be less sensitive to behavioural disturbance than harbour seals (see Section 1.5 of ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology), and recent studies of tagged grey seals have shown that there is vast individual variation is responses to pile driving, with some animals not showing any evidence of a behavioural response when within 12 km of the pile driving location (Aarts , 2018). Therefore, the adoption of the harbour seal dose response curve for grey seals is likely to over-estimate the potential for impact on grey seals.

11.3.427 For the transboundary grey seal sites, population estimates have been sourced where available from the standard data forms[20]. For sites in Dutch waters several population estimates are given:

- Doggersbank (Netherlands) SAC population estimate: information unavailable
- Klaverbank SCI population estimate: information unavailable;
- Westerschelde & Saeftinghe SCI population estimate: 1-20;
- Voordelta SCI population estimate: 50-200;
- Noordzeekustzone SCI population estimate: 2,040; and
- Waddenzee SCI population estimate: 1,800.
- For the sites in French and Belgium waters several population estimates are given:
- Bancs des Flandres SCI population estimate: not given;
- Vlaamse Banken SCI population estimate: information unavailable;
- SBZ 1 SCI population estimate: information unavailable;
- SBZ 2 SCI population estimate: information unavailable;
- SBZ 3 SCI population estimate: information unavailable; and
- Vlakte van de Raan SCI population estimate: 0-400.

11.3.428 Many transboundary sites do not have a population given in the standard data forms and those that do have population levels that vary between 1 and >2,000 individuals. Therefore, the assessment for these sites draws on the conclusions for the closest site (Humber Estuary SAC and Ramsar, see above) in the context of the transboundary site location (further offshore and/ or at greater distance) which have with less connectivity to VE than adjacent UK sites.

[20] http://natura2000.eea.europa.eu/

11.3.429 Grey seals are a wide-ranging species and frequently travel over 100 km between haul-out sites and across Seal Management Units (e.g. Thompson . 1996). Carter ., 2022 also provides evidence that grey seals have a significant area of use outside the SAC, and therefore, it is clear that grey seals are not resident at one specific haul-out site, and as such, there is no such thing as a 'Klaverbank SCI grey seal' (for example). Instead, grey seals have associations with SACs (i.e. they have recorded telemetry positions within an SAC) and may associate more with one haul out site over another.

11.3.430 The at-sea usage data (see Figure 11.9) suggest that the highest at seal densities are to the south and west of the array, as shown by the higher predicted densities in the grid cells. Given the wide-ranging behaviour of grey seals, travelling over 100 km between haul-out sites and with foraging trips lasting up to 30 days (SCOS, 2017), it is highly unlikely that any temporary disturbance to grey seals would be sufficient enough to result in displacement, and individuals will be able to compensate by travelling to a different foraging area.

11.3.431 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology assesses whether the identified potential for disturbance would result in a potential effect on the population and distribution of grey seal at a population level. The effect significance of disturbance from piling to grey seal is concluded to be negligible, which is not significant in EIA terms. This is because the impact is predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), intermittent and is reversible. Given the low number of grey seals predicted to be impacted and the proportion of the population this represents, coupled with grey seal ability to store energy, and the fact that they are generalist and adaptable foragers, it is expected that they would require moderate-high levels of repeated disturbance before there was any effect on fertility rates.

11.3.432 For the 12 transboundary sites, a variable level of information is provided in citation literature as regards the site level population, with several not giving a population number at all. However, for assessment purposes, if it is assumed that transboundary site locations (further offshore and/ or at greater distances from VE) will have less connectivity to VE than adjacent UK sites, it can be reasonably assumed that the majority of the grey seals that may be disturbed originate from the two closest sites (Humber Estuary SAC and Ramsar and Berwickshire and North Northumberland Coast SAC). Therefore, very few individuals that are disturbed are likely to be associated with the transboundary sites. Taking this into consideration and that the number of grey seals estimated to be disturbed is very small (see above), the total number of seals affected from transboundary sites is inconsequential.

11.3.433 The test that needs to be applied here relates to the conservation objectives for the SAC or Ramsar site, which are concerned about 'a potential effect on the **population** and **distribution** of grey seal'. In the context of the above, it can therefore be concluded that the proposed works would not result in an effect at population level or (other than in the localised and short term) on the distribution of grey seals using these designated sites.

11.3.434 Furthermore, in a site-based context, and as a worst case, < 0.12% of the transboundary site populations could be disturbed on a temporary and localised basis. Any disturbance caused by piling will be short term, temporary and recoverable across a period of up to 12 months with assessments of grey seal disturbance based on a precautionary dose-response curve whereby not all of the individuals subject to the noise will show a disturbance response.

11.3.435 **There is, therefore, no AEoI from disturbance associated with piling for grey seal population and distribution with respect to the 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 VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ASSESSMENT OF PTS, TTS AND DISTURBANCE FROM UXO CLEARANCE

11.3.436 The sites for which grey seal are screened in for potential LSE with respect to underwater noise are highlighted under the assessment for piling above, including confirmation that the conservation objectives as applied to UK sites encompass the relevant measures for transboundary sites. Therefore, the assessment that follows is presented following the UK conservation objective requirements to minimise repetition.

11.3.437 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a minor adverse impact (which is not significant in EIA terms) certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to grey seal prey availability to be highly localised and 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 VE, combined with the large overall habitat availability and the negligible changes found in the ES assessment, 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.

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

11.3.439 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for injury (risk of onset of PTS) and disturbance.

11.3.440 The risk of onset of PTS in all marine mammal species will be addressed by the anticipated requirement for a UXO-MMMP (See Volume 9, Report 14.2: Outline MMMP - UXO), which will provide for appropriate mitigation to minimise the risk of injury or mortality in grey seal during high-order UXO clearance (requiring prior approval by the regulator). **Therefore, it is concluded that VE alone does not have an AEoI on grey seal as a result of mortality or injury resulting from high-order UXO clearance.**

11.3.441 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology provides counts of individual grey seals that may be subject to disturbance and places this in the context of the overall population. As for piling related disturbance for grey seal presented above, the number of individual grey seal that may be disturbed temporarily from the clearance of an individual UXO (high-order clearance) represents a small proportion of the overall population associated with individual designated sites; therefore, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect significance of disturbance from high-order UXO clearance to grey seal is negligible, which is not significant in EIA terms.

11.3.442 Table 11.9 summarises the maximum impacts for grey seal showing that the maximum number disturbed using the 26 km EDR is estimated to be 225, representing 0.35% of the combined MU populations; those at risk from onset of TTS during high-order UXO clearance is estimated to be 161 individuals which is equivalent to 0.25% of the MU reference population.

11.3.443 If it is assumed that transboundary site locations (further offshore and/ or at greater distances from VE than the UK sites) will have with less connectivity to VE than adjacent UK sites, it can be reasonably assumed that the majority of the grey seals that may be disturbed originate from the two closest sites (Humber Estuary SAC and Ramsar and Berwickshire and North Northumberland Coast SAC) (Carter ., 2022). Therefore, very few individuals that are disturbed are likely to be associated with the transboundary sites. Taking this into consideration and that the number of grey seals estimated to be disturbed is very small, the total number of seals affected from transboundary sites is inconsequential.

11.3.444 **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 VE alone and therefore, subject to natural change, the population of grey seal will be maintained in the long-term.**

ALL SOURCES OF UNDERWATER NOISE FROM VE ALONE

11.3.445 It is clear that the proposed works resulting in underwater noise would, independently of each other, not result in an AEoI with respect to this site and grey seal features screened in for marine mammals.

11.3.446 For clarity, it can be confirmed that such activity (in terms of percussive piling and UXO activity) will be managed through the SIP process in such a manner as to preclude threshold exceedance temporally and will therefore not lead to a 'project alone in-combination effect'. Such an effect could occur, if for example high-order UXO clearance occurs in the same timeframe as percussive piling or two high-order UXO clearances in a single day (with the values calculated demonstrating potential for threshold exceedance).

11.3.447 The Outline SNS SAC SIP (which will be provided in the DCO application) includes as part of its purpose the need to confirm that the project parameters applied for the RIAA assessment alone remain valid and, if these parameters change, that the existing RIAA conclusions of no AEoI similarly remain valid. Therefore, the Outline SNS SAC SIP includes provision to confirm these conclusions.

ASSESSMENT OF VESSEL COLLISION RISK

11.3.448 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that (in the context of existing and increased shipping levels and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions. This applies equally to grey seal that may be connected to any of the sites designated for grey seal, given the localised nature of any effect.

11.3.449 **There is, therefore, no AEoI resulting from vessel collision risk for the 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 VE alone and therefore, subject to natural change, the grey seal feature will be maintained in the long-term.**

ASSESSMENT OF VESSEL DISTURBANCE

11.3.450 As regards the conservation objectives that address the natural habitats of 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 ES, Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes which concluded a negligible impact (which is not significant in EIA terms) and that does not extend to the designated sites themselves certainly insufficient to reach any habitat designated for grey seal. Similarly, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found the potential for effect in relation to grey seal prey availability to be highly localised and negligible at most, with the effect therefore not taken forward further in the assessment, as it will not lead to a significant effect.

11.3.451 **There is, therefore, no AEoI resulting from vessel disturbance on the supporting habitats relevant to grey seal and their prey for 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 VE alone and therefore, subject to natural change, the supporting habitat for grey seal prey will be maintained in the long-term.**

11.3.452 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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 ., 2017). Thomsen ., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.453 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with construction (and decommissioning) is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.454 **There is, therefore, no AEoI resulting from vessel disturbance on 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 VE alone and therefore, subject to natural change, the grey seal feature will be maintained in the long-term.**

CHANGES TO PREY

11.3.455 The potential for changes to prey during construction and decommissioning is a function of direct impacts on fish through PTS/ TTS/ disturbance from underwater noise and the potential for removal/change of fish supporting habitat. The extent of these effects on marine mammals during construction has broadly been assessed above in the underwater noise assessment (by default via consideration of the conservation objectives of the relevant sites). The assessment presented above draws on conclusions presented in the assessments in ES Volume 6, Part 2, Chapter 7: Marine Mammals, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and Volume 6, Part 2, Chapter 2: Marine Geology, Oceanography and Physical Processes and are relevant here.

11.3.456 In the assessments during construction and decommissioning for this site, it was concluded that there is no AEoI on marine mammals as a result of impacts on supporting habitats and processes relevant to features and their prey.

11.3.457 This is because although sandeels and herring are known prey items and there is the potential for project alone impacts on these fish species from underwater noise impact pathways (TTS and recoverable injury), the effects are localised and of a short duration, which is not considered to have the potential to have a long-term negative effect on prey availability within the VE area or the wider area. Potential mortality or mortal injury from VE underwater noise is expected to have a moderate significance effect on spawning herring in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; however, as a result of this VE will be implementing mitigation measures to reduce the impact on herring (see section 6.9 of Volume 6, Part 2, Chapter 6 for additional details). Even if unmitigated, the spatial extent of a PTS effect is even smaller than that of TTS or recoverable injury therefore it is considered to also be too localised and of a short duration to cause a long-term negative effect on prey availability throughout VE area or the wider area.

11.3.458 Furthermore, ES Volume 6, Part 2, Chapter 7: Marine Mammals concludes that due to the lack of significant effect on prey species and given the generalist/ opportunist nature of the features in question (with the ability to switch prey species, SCOS, 2022), it is not predicted that there will be any impacts on grey seal at these sites as a result of changes to the populations or general distributions of fish species within the vicinity of VE. No impact on survival and reproduction is predicted and therefore the sensitivity of the receptor is considered to be low.

11.3.459 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or underwater noise impacts on prey for the Doggersbank [Netherlands] SAC, Klaverbank SCI, Bancs Des Flandres SCI, Vlaamse Banken SAC, SBZ 1 SCI, SBZ 2 SCI and SBZ 3 SCI, Vlakte Van De Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, and Waddenzee SCI from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

BARRIER EFFECT

11.3.460 The potential for barrier effects to affect marine mammals has only been identified as a function of TTS/ disturbance from underwater noise generated specifically by piling, and this has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Given that the risk of barrier effects relates specifically to the impact of TTS/ disturbance from piling, the conclusions of the assessments of TTS/ disturbance caused by underwater noise generated by piling presented for all features above is relevant.

11.3.461 For grey seal at transboundary sites, even as a worst case, < 0.57% could be disturbed on a temporary and localised basis, with the impact being predicted to be of local spatial extent, short term duration (up to 81 piling days (It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate) within a one-year construction window), is intermittent and is reversible.

11.3.462 **Therefore, therefore, no AEoI resulting from barrier effect as a function of disturbance on grey seal at Doggersbank [Netherlands] SAC, Klaverbank SCI, Bancs Des Flandres SCI, Vlaamse Banken SAC, SBZ 1 SCI, SBZ 2 SCI and SBZ 3 SCI, Vlakte Van De Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, and Waddenzee SCI from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

HABITAT LOSS

11.3.463 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m2 within the array area, alternative and comparable habitats are present and widespread. Furthermore, only a relatively small proportion of the habitats are likely to be affected in the context of wider comparable habitats that are available in the area.

11.3.464 In any case, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that grey seals are 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 ., 2003; Sparling ., 2006). Grey seals are also very wide ranging and are capable of moving large distances between different haul out and foraging regions (Carter ., 2020, 2022; Russell ., 2013). Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds.

11.3.465 Given the low numbers of grey seals in vicinity of VE, it is not predicted that there will be any impacts on seal features as a result of supporting habitat loss from placement of structures, scour protection, cable protection and cable crossings within the vicinity of VE.

11.3.466 **There is, therefore, no AEoI resulting from supporting habitat loss on the Doggersbank [Netherlands] SAC, Klaverbank SCI, Bancs Des Flandres SCI, Vlaamse Banken SAC, SBZ 1 SCI, SBZ 2 SCI and SBZ 3 SCI, Vlakte Van De Raan SCI, Westerschelde & Saeftinghe SCI, Voordelta SCI, Noordzeekustzone SCI, and Waddenzee SCI from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

OPERATION AND MAINTENANCE

VESSEL COLLISION RISK (O&M)

11.3.467 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology reports that additional traffic will be present during the O&M phase of VE when compared to the construction phase, including an increased frequency and greater variety of vessel types used (e.g. jack-up vessels, SOV, small O&M vessels, lift vessels, cable maintenance vessels and auxiliary vehicles). This vessel use will also take place over a longer period of time e.g., the lifetime of VE with an annual total of round trips at 1,776. Therefore, vessel traffic increase will be greater during this phase. However, it is still highly likely that a proportion of vessels will be stationary or slow moving throughout operations at VE for significant periods of time.

11.3.468 Nevertheless, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology concludes that in the context of the relevant project mitigation, the increased vessel traffic associated with O&M is insufficient (insignificant in terms of the EIA regulations) to result in an increase in the risk of mortality or injury in marine mammals through vessel collisions.

11.3.469 Given that the assessment applies equally to all marine mammals **there is, therefore, no AEoI to grey seals at the transboundary sites in relation to vessel collision risk during O&M from VE alone and therefore, subject to natural change, features will be maintained in the long-term.**

CHANGES TO PREY

11.3.470 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; states that although the total extent of seabed habitat change expected from placement of structures, scour protection, cable protection and cable crossings, is 3,611,128 m^2 within the array area, alternative and comparable fish habitats are present and widespread. The significance of seabed habitat losses to receptors is determined by their spawning behaviours, whereby those that are substrate dependent (e.g., herring and sandeel) are deemed to be of medium sensitivity to seabed substrate loss, and those that are not dependent on substrate for spawning are deemed to be of negligible sensitivity. However, only a relatively small proportion of the fish habitats are likely to be affected in the context of wider habitats in the area in any case, and most fish species are predicted to have some tolerance to this impact. The significance of the residual long term habitat loss effect is therefore concluded to be minor adverse, which is not significant in EIA terms.

11.3.471 It is also possible that during operation, the electromagnetic fields (EMF) that are produced as a result of the electricity passing through the cables (particularly B fields and iE fields) may interrupt navigation and consequently migration of fish species. Although the impact is predicted to be highly localised, it is long-term, continuous and irreversible (within the lifetime of the project). Nevertheless, it is predicted that the impact will affect fish though the impact is considered to only be of a low magnitude. The significance of the residual effect is concluded to be minor adverse in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is not significant in EIA terms.

11.3.472 It is not predicted that there will be any impacts on marine mammals as a result of changes to the populations or general distributions of fish species within the vicinity of VE as a result of EMF or habitat loss. This, coupled with the fact that there may be certain fish species that comprise the main part of grey seals' diet (i.e., grey seals are considered to be generalist feeders and are thus not reliant on a single prey species) means that there is low risk of changes in prey abundance and distribution affecting the distribution of grey seal features.

11.3.473 **There is, therefore, no AEoI resulting from changes to prey as a function of changes/loss of prey habitat or EMF impacts on prey of grey seals from VE alone and therefore, subject to natural change, the feature distributions will be maintained in the long-term.**

VESSEL DISTURBANCE AT HAUL OUT

11.3.474 The potential for vessel related disturbance (movements and noise) on marine mammals alone has been assessed in ES Volume 6, Part 2, Chapter 7: Marine Mammal ecology, with a summary provided here.

11.3.475 The area surrounding VE already experiences a reasonable amount of vessel traffic throughout the year (see Volume 6, Part 2, Chapter 9: Shipping and Navigation). Therefore, the introduction of vessels during O&M is not a novel impact for marine mammals present in the area, whether that is at sea or at haul out locations.

11.3.476 Increased vessel traffic during O&M has the potential to result in disturbance of marine mammals, through physical presence and movement of vessels. However, disturbance from vessel noise is only likely where noise from vessel movements is greater than the background ambient noise. The existing vessel traffic movements within the VE area (a maximum of 21 vessels per day passing through) combined with an indicative peak number of vessels on site simultaneously as 35 during construction of VE (see Volume 7, Report 6: Navigational Risk Assessment) is unlikely to occur across the entire VE array area at any one time.

11.3.477 It is therefore not expected that the level of vessel activity during the O&M of VE would cause a significant increase in the risk of disturbance by vessels at haul out locations. The adoption of the Working in Proximity to Wildlife in the Marine Environment (Table 8.1) 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 and 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.

11.3.478 Overall, ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology found that the effect (in terms of disturbance) is of negligible significance for seals, which is not significant in EIA terms.

11.3.479 The potential to affect the population and distribution of grey seal is considered within ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology with respect to potential for disturbance from construction vessels. No indication was found that disturbance from shipping can result in decreased numbers of seals. The assessment also reports that Jones ., (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 co-occurrence, 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., 2017). Thomse ., (2006) estimated that grey seals will respond to both small (~2 kHz) and large (~0.25 kHz) vessels at approximately 400 m. The sensitivity of grey seals for vessel disturbance has, therefore, been assessed as negligible.

11.3.480 With regards to the risk of disturbance, it is clear from the summary presented above that (in the context of existing shipping levels, the increase in those levels proposed during construction at VE, the lack of evidence that increased vessel activity causes decreases in seal numbers and the relevant project mitigation) the increased vessel traffic associated with O&M is insufficient to result in significant disturbance in marine mammals either at sea or at haul out locations. Therefore, even if all such disturbance were attributed to a single SAC population, no significant effect would result.

11.3.481 **There is, therefore, no AEoI resulting from vessel disturbance on 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 VE alone and therefore, subject to natural change, the grey seal feature will be maintained in the long-term.**

11.4 OFFSHORE AND INTERTIDAL ORNITHOLOGY

ASSESSMENT SUMMARY

11.4.1 This section presents the site and the associated impacts identified in the HRA screening process through which the construction, operation, maintenance and decommissioning of VE has the potential to cause LSE on several ornithological receptors.

11.4.2 Firstly, information is presented for each phase (C&D, then O&M). This is because the majority of impacts on ornithological features occur during O&M. Within each phase, impacts are presented by SPA and species to avoid unnecessary repetition of site information because there are often multiple designated features within a single SPA.

11.4.3 The potential for an AEoI applies in relation to the following designated sites and features (i.e., the feature screened in for potential LSE):

- OTE SPA
  - Red-throated diver - disturbance and displacement in the ECC (C&D only)
- Flamborough and Filey Coast SPA
  - Gannet - disturbance and displacement from the array area and risk of collision
  - Guillemot - disturbance and displacement from the array area
  - Razorbill - disturbance and displacement from the array area
  - Kittiwake - risk of collision
- Alde Ore Estuary SPA
  - Lesser black-backed gull - risk of collision
- Farne Islands
  - Guillemot - disturbance and displacement from the array area

11.4.4 Migratory collision risk was assessed for waterbird features of the following sites.

- Alde-Ore Estuary SPA and Ramsar
- Minsmere-Walberswick SPA and Ramsar
- Deben Estuary SPA and Ramsar
- OTE SPA

11.4.5 This assessment for AEoI is presented as follows:

- Assessment Criteria (a summary of the approach to the assessment);
- Description of Significance (a detailed description of the potential effects and their relevance to the ornithological features, including);
  - An introduction to all the identified impacts relevant to the assessment; and
  - The relevant MDS.
- The full assessment considered for the OTE SPA;
- The full assessment considered for the Flamborough and Filey Coast SPA;
- The full assessment considered for the Alde-Ore Estuary SPA;
- The full assessment considered for the Farne Islands SPA.

ASSESSMENT CRITERIA

11.4.6 The offshore ornithological assessment was based on relevant guidance for conducting HRA and assessing offshore wind farms (e.g. Dierschke . 2016; European Commission 2011; Maclean . 2009; Natural England, 2022; Parker ., 2022; PINS Advice Note Ten; Wade . 2016) and applied the criteria contained in that guidance where relevant to the interest features under consideration.

11.4.7 Criteria used for screening in species are detailed within the VE OWF HRA Screening report. Key guidance and literature used to identify species sensitive to disturbance and/ or displacement and collision risk were Bradbury . (2014); Dierschke . (2016); Furness and Wade (2012); Furness . (2013); Parker . (2022); SNCBs (2017) and Wade . (2016), Woodward . (2019). Determination of breeding and non-breeding bio-season connectivity is presented in detail within the Chapter 6, Part 5, Annex 4.15: Apportioning Note. Decisions to screen species in for barrier effects and/ or changes to prey availability were also derived from those sources and stakeholder advice. Site-specific aerial digital surveys, which provided information about when species were present in the array area and associated 4 km buffer, were used to determine species susceptibility to impacts during the different bio-seasons. Season-specific proportion of adults in a population was derived from the tables in the appendix of Furness (2015).

11.4.8 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 qualifying 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.

11.4.9 An AEoI cannot be ruled out where predicted impacts (either in project alone or in-combination scenarios) equate to an increase of greater than 1% of baseline mortality of the relevant population. In this case, a further consideration is required e.g. through population modelling (Population Viability Analysis (PVA)), to determine the significance of the mortality for the population in question. This approach is recommended by Natural England (Parker ., 2022) and can incorporate known population trends and density dependence, where it is considered appropriate, to assess the impacts on a population more accurately. Although there is considerable evidence that density dependence acts on seabird populations (Horswill ., 2017), there remains substantial uncertainties about how density dependence should be applied within population models. For instance, a fuller understanding of how many non-breeding birds, which would choose to breed if appropriate sites become available, are available within the wider population would provide some certainty in how density dependence may act on specific colonies. Therefore, a precautionary approach was adopted by focusing primarily on the outputs from density independent models. The consequence of this is that any reduction in growth rates presented throughout this assessment can be treated as worst case.

11.4.10 The recent outbreak of Highly Pathogenic Avian Influenza (HPAI) among seabirds is likely to influence the short, medium and long-term productivity and survival of seabird populations. Impacts are expected to be present within UK populations from approximately June 2022. DAS surveys were completed before this time and Natural England guidance dictates that the scale of impact is likely to remain in proportion to the size of the colony. Throughout this report the impacts calculated from abundances and densities estimates prior to the HPAI outbreak have been assessed against the latest counts, which may have been impacted by HPAI. Therefore, this is considered appropriate and precautionary. If population counts used are from prior to June 2022, then the population is considered un-impacted by HPAI, and therefore DAS data from un-impacted birds is assessed against un-impacted populations which is considered appropriate. For population counts after June 2022, the population counts are considered to be under additional pressure and are expected to be smaller than they would be in the absence of HPAI impacts. In this scenario, DAS data from un-impacted birds is assessed against impacted (and therefore potentially smaller) populations and therefore this approach is considered precautionary. The most recent impact of HPAI on seabird colonies can be found in Tremlett , 2024.

Table 11.13 Definitions of the Conservation Value Levels for an Ornithological Feature.

Value	Definition
High	A species population for which individuals at risk can be clearly connected to a particular SPA, Ramsar site, SSSI or which would otherwise qualify under selection guidelines. Species present in internationally important numbers (>1% biogeographic population).
Medium	A species for which individuals at risk are probably drawn from particular SPA, SSSI or Ramsar site populations, although other populations may also contribute to individuals at risk. Species present in nationally important numbers (>1% breeding or non-breeding population).
Low	A species for which individuals at risk have no known connectivity to SPAs, Ramsar sites or SSSIs, or for which no sites are designated. Species not present in nationally important numbers.

DESCRIPTION OF SIGNIFICANCE

11.4.11 A description of the significance of project level effects upon the receptors grouped under 'offshore ornithology', as relevant to the designated sites and their associated features screened in for the assessment are provided throughout Section 11.4.9 for the project alone.

CONSTRUCTION AND DECOMMISSIONING

DISTURBANCE AND DISPLACEMENT

11.4.12 Disturbance and displacement are considered together when determining LSE although in the assessment for AEoI they will be treated as separate pathways.

11.4.13 Birds in the marine environment have the potential to be affected by C&D through disturbance caused by the installation of foundations, towers, blades, export cables and other infrastructure, as well as being disturbed by the movement of the vessels and helicopters associated with the works. This disturbance has the potential to cause the displacement of birds from the access routes used by vessels, the C&D site, and a wider area around any such activities. This displacement could effectively result in temporary habitat loss through a reduction in the area available to birds for behaviours such as feeding, resting and moulting.

11.4.14 The effects of disturbance and displacement on birds during the C&D phases are considered to be short-term, temporary and reversible, lasting only for the duration of activities, as birds would return to the area once activities have ceased. Disturbance and displacement during the C&D phase are most likely to affect birds foraging in and around the construction area. The level of disturbance at each work location would differ depending on the nature of the activities and time of day or night over which they occur.

11.4.15 Although there may be up to 12 vessels associated with cable-laying for VE, these would tend to be aggregated around fewer, larger cable laying vessels, which pose the greatest potential for the displacement of seabirds. It should be noted that cable laying vessels are very slow moving and remain static for long periods during construction. Offshore cable installation activity is also a relatively low noise emitting operation, particularly when compared to activities such as piling. Therefore, it is realistic to determine any impacts from no more than three cable-laying vessels (or vessel aggregations) present within the ECC at any time.

11.4.16 During C&D it is likely that disturbance and displacement will only impact seabirds using the areas of the marine environment where the activities are occurring.

11.4.17 The screening process and consultation with Natural England during the EPP concluded that the following features and sites have the potential for disturbance and displacement during the C&D phases (LSE cannot be ruled out):

- Red-throated diver during the non-breeding bio-season (disturbance and displacement due to work activity and vessel movements within the ECC only): OTE SPA;
- Gannet: Flamborough and Filey Coast SPA during all bio-seasons (array only);
- Common guillemot (hereafter referred to as 'guillemot') during the non-breeding bio-season (array only): Flamborough and Filey Coast SPA, Farne Islands SPA; and
- Razorbill during the non-breeding bio-season (array only): Flamborough and Filey Coast SPA, Farne Islands SPA.

11.4.18 The conservation objectives for the above sites are detailed within Volume 5, Report 4, Annex 4.4: Summary of Designated Sites.

11.4.19 The level of disturbance and displacement is variable between different species, with some species being more susceptible to disturbance from construction activities, which may lead to subsequent displacement. This variability in disturbance and displacement has been outlined by Dierschke . (2016), who noted the varying degrees by which some seabird species avoided or were attracted to wind farms. Most notably, gannet and auk species (in this instance, guillemot and razorbill) have been noted to respond to OWF construction activities and be displaced as a consequence, and so are considered below due to the potential impact of displacement from the array area and surrounding buffer during the C&D phase of VE. Divers (in this instance, red-throated divers) have also been noted to avoid shipping, with one study identifying red-throated diver flushing at a median value of 400 m and a maximum value of 2 km (Bellebaum . 2006). Consequently, this species is considered further below for the potential impact of displacement from cable laying vessels within the ECC during the C&D phase of VE.

11.4.20 For the assessment of displacement during the C&D phase of VE, it is recognised that activities will be restricted both temporally and spatially based on the following:

- Export cable laying activities being undertaken by three cable-laying vessels across the entire ECC;
- Any potential displacement is likely to occur only within the array area, where vessels and construction activities are;

- Construction activities are restricted both temporally, with an offshore construction period over a five-year period; and
- Not all of the array area or ECC being influenced by construction activities at the same time.

11.4.21 A lack of evidence is currently available to provide definitive empirical displacement rates for the C&D phase of OWFs. However, studies have noted that displacement rates for auks are either comparable to the O&M phase or significantly lower (Royal Haskoning, 2013; Vallejo ., 2017). Similarly, Krijgsveld . (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 C&D phase in comparison to the O&M phase, it is considered that the level of displacement used for assessment for auks and gannet would be half of that of the O&M phase. This is a suitably precautionary approach, which has been adopted as a standard methodology by the industry. For red-throated diver, a precautionary approach was taken with a displacement rate of 100%.

11.4.22 The level of mortality from C&D displacement was set at a precautionary 1% during all bio-seasons, with a range of 1 - 10% presented for auk species and divers as advocated by SNCBs (SNCBs, 2017; Parker . 2022).

11.4.23 A summary of the level of displacement used with the assessment for disturbance and displacement during the C&D phase are as presented in Table 11.14. Reference should be made to the O&M phase for a full description and justification for the displacement and mortality rates used.

Table 11.14 Displacement rates used for assessment in the construction and decommissioning phase based on half that in the O&M 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%)

11.4.24 It is also noted that the assessment undertaken for the RIAA as outlined above is considered suitably precautionary based on a number of assumptions made, including:

- The population assessed within each bio-season being the mean of the peak monthly survey abundances within the specific bio-season from each survey year. This makes the assumption that the identified peak 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 1% mortality rate of displaced birds is highly unlikely in reality, as the species assessed in this RIAA are not solely dependent upon the area within the VE array area and buffer for all their foraging needs either within the breeding or non-breeding bio-seasons; and

- Adult birds that are actively breeding will often respond to displacement by ceasing to breed (i.e. abandoning eggs or young) and surviving to breed in a later year as opposed to putting themselves to further stress to the extent of dying.

11.4.25 It is considered that there is a potential the impacts above may result in LSE in relation to the SPA breeding populations of lesser black-backed gull, kittiwake, gannet, guillemot and razorbill for FFC SPA, AOE SPA and Farne Islands SPA (including seabird assemblages) and for the non-breeding population of red-throated diver of the OTE SPA (ECC only).

DIRECT HABITAT LOSS

11.4.26 Direct habitat loss may occur during the construction phase due to infrastructure in the area. It is unlikely that this short-term effect during construction will have an any significant effect on the marine ornithological features found within the array area. However, there is potential for effects to occur in relation to the ECC passing through the OTE SPA. Therefore, there is potential for LSE to the qualifying features (red-throated diver) of the OTE SPA.

CHANGES IN PREY AVAILABILITY

11.4.27 Construction works may lead to changes in availability or abundance in prey resulting in displacement from foraging areas or a reduced energy intake, resulting in impacts on survival rates and productivity in the short-term. The ECC passes through the OTE SPA so there is potential for LSE for that site.

OPERATION AND MAINTENANCE

DISTURBANCE AND DISPLACEMENT

11.4.28 Birds in the marine environment have the potential to be disturbed and displaced by the presence of offshore wind farms. Therefore, the presence of VE could in effect represent habitat loss by potentially reducing the area available to those seabirds to for example forage, loaf and/ or moult. Disturbance and displacement may be caused by the physical presence of turbines, as well as the movement of vessels during the O&M phase (e.g. maintenance vessels). Displacement could have fitness consequences for birds, which at an extreme level could result in mortality of individuals.

11.4.29 The screening process concluded that the following features and sites have the potential for disturbance and displacement during the O&M phase (LSE cannot be ruled out):

- Gannet: Flamborough and Filey Coast SPA;
- Guillemot (non-breeding): Flamborough and Filey Coast SPA, Farne Islands SPA; and
- Razorbill (non-breeding): Flamborough and Filey Coast SPA.

11.4.30 The following section collates the evidence base to inform the displacement and mortality rates presented within VE's approach to the assessment. As advocated by SNCB guidance, the full range of displacement and mortality rates are provided within the displacement matrices (SNCBs, 2022).

GANNET

11.4.31 Available evidence suggests that gannets show a low-level sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004 and Furness and Wade, 2012). Radar and visual observations from post-construction monitoring of the Offshore Windpark Egmond aan Zee (OWEZ) revealed that 64% of gannets avoided entering the wind-farm (Krijgsveld ., 2011). Similarly, post-consent monitoring for the Thanet OWF found reduced densities of gannet within the site during the third year, though notably this was not quantified in the report (Royal HaskoningDHV, 2013). More recently, a study by APEM (APEM, 2014) evidenced that high levels of macro avoidance by gannets during their migration, with 95% of individuals avoiding flying into areas with operational WTGs. A recent desk-based study (Pavat , 2023) calculated an overall macro-avoidance rate of 83.3% (weighted mean) for gannet (85.6% using an unweighted mean approach). For the purpose of this assessment, a displacement rate of 70% was used as deemed appropriate by Natural England (SNCBs, 2017; Parker ., 2022). A range of between 60% to 80% is also presented in Table 11.32.

11.4.32 A mortality rate of 1% was selected for gannet based on available evidence and expert judgement. Gannets have a large mean max (315 km) and maximum (709 km) foraging range (Woodward ., 2019), and also show a high degree of habitat flexibility, allowing them to feed on a variety of different prey items that provide sufficient alternative foraging opportunities (Furness and Wade, 2013). Additionally, no evidence of displacement-induced mortality of gannet has been identified from available evidence which suggests that there is no justification for setting predicted mortality rates at a higher level than 1%. Therefore, based on the evidence presented above, a displacement rate of 70% and mortality rate of 1% were used as VE's approach, with the range advocated by Natural England (60% - 80%) also presented.

11.4.33 Following discussions with Natural England it was agreed that 74% of birds found in the array area were to be apportioned to FFC and the apportioning of adults would follow Furness (2015) with 55% of the birds assumed to be adults.

AUK SPECIES

11.4.34 More recently, APEM (APEM, 2021) undertook a review of all post-construction monitoring studies to date within the North Sea and UK Western Waters. The review found displacement effects ranging from +112% to -75%, though the majority of sites reported weak or no displacement effects. It was noted in the review that sites reporting high displacement rates appeared to be related to low auk abundance and may be artefacts of the analysis method being incapable of incorporating low abundances and/or high inflation within the dataset. It is therefore concluded that a displacement rate of up to 50% is considered most applicable and also suitably precautionary, based on OWFs presented in the above report with moderate to high auk abundance reporting non-significant or weak displacement. This rate is further supported by a review of OWF data in the German North Sea, undertaken by Peschko . (2020). The review indicated that guillemot displacement rates are reduced during the breeding bio-season by ~20% compared with the non-breeding bio-season, which is of important considering the mean displacement rates derived from the Dierschke . (2016) review was predominantly from data collected in the non-breeding bio-season.

11.4.35 Additionally, studies have indicated a habituation response of auks to OWFs. For example, at the Thanet OWF, year one displacement rates were 75% to 85%, but this fell to a low of 31% to 41% in year two and three (Royal Haskoning, 2013). There is further emerging evidence as additional post-construction OWF monitoring continues, with reports of auk numbers increasing and observations of foraging behaviour within the wind farm itself (Leopold & Verdaat, 2018). Post-construction monitoring of the Beatrice OWF found guillemot numbers using the array area had increased during the post-construction surveys compared with the pre-construction survey results (MacArthur Green, 2019a). This would suggest that displacement rates are expected to diminish over the operational life of OWFs.

11.4.36 Considering the evidence presented above, an auk displacement rate of 50% within the OWF array area and out to a 2 km buffer is therefore considered as strongly evidenced and is also sufficiently precautionary. Throughout the report the impacts from the full range of displacement advocated by Natural England (30% and 70%) have been presented within the tabulated results.

11.4.37 Current guidance advises a range of potential mortality is displayed from 1-10% for guillemots and other auk species (Natural England, 2014). However, it has been advised by environmental consultants working on behalf of a range of developers that 1% mortality is more appropriate (Norfolk Boreas Limited, 2019; SPR, 2019; Orsted, 2018). In support of this, anecdotal evidence has implied low additional auk mortality as a result of the Helgoland OWF cluster and Butendiek (Peschk ., 2020).

11.4.38 A study by van Kooten . (2019), provided further support of a lower mortality rates, demonstrating that a 1% mortality for displaced auks is more appropriate than the 10% rate. They also note that 1% is considered precautionary in itself, considering the study reported a modelled additional non-breeding bio-season mortality rate of 0.1% for a 50% displacement rate and 0.4% for a 100% displacement rate. Based on the evidence presented above, a displacement rate of 50% and a mortality rate of 1% is considered appropriate for the assessment, with the range advocated by Natural England also presented.

Table 11.15 Displacement rates used for assessment in the O&M phase.

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

11.4.39 Significant numbers of guillemots will be dispersing and migrating south from North Sea east coast colonies during the post-breeding period. It is recognised that some of these birds will use the Five Estuaries array area but the abundance within the array area is low in comparison with other projects and there is no evidence or clear reason why guillemots would favour foraging within the Five Estuaries array area compared with the wider region. Therefore, the Applicant considers that this area is not an important foraging habitat for guillemot and that the majority of birds in the post-breeding dispersal season will be transiting through the site and any potential LSE for migratory birds has been ruled out.

11.4.40 The ECC is considered to have no potential LSE during the operational phase due to it being an immobile structure in the seabed that requires minimal maintenance resulting in low impacts of disturbance or displacement.

COLLISION RISK

11.4.41 When birds fly through the VE array area (e.g. while foraging, commuting or on migration), there is potential risk of collision with turbine rotor blades and other infrastructure, resulting in injury or fatality.

11.4.42 The screening process concluded that the following features from a number of designated sites have the potential for collision risk during the O&M phase (LSE cannot be ruled out):

- Gannet: Flamborough and Filey Coast SPA;
- Kittiwake (non-breeding): Flamborough and Filey Coast SPA; and
- Lesser black-backed gull: Alde-Ore Estuary SPA, Alde-Ore Estuary Ramsar;
- Migratory waterbirds:
  - Alde-Ore Estuary SPA: avocet, marsh harrier, redshank, ruff;
  - Minsmere-Walberswick SPA: avocet, bittern, gadwall, white-fronted goose, hen harrier, marsh harrier, nightjar, shoveler, teal;
  - Deben Estuary SPA: avocet, dark-bellied brent goose; and
  - Deben Estuary Ramsar: dark-bellied brent goose.
  - OTE SPA: red-throated diver

11.4.43 Throughout the O&M phase of VE, seabirds flying through the array area may be at risk of collision, with any collision assumed to be fatal. It is assumed that this risk is present for the entire array area and throughout the entire period of operation of VE. The level of effect is defined by the MDS used for assessment found in Volume 6, Part 2, Chapter 4: Offshore Ornithology. To assess the risk of collision to birds from VE, CRM has been carried out as described in Volume 6, Part 5, Annex 4.1: Offshore Ornithology Technical Report and Volume 6, Part 5, Annex 4.5: Seabird Densities by Survey.

11.4.44 CRM results for assessed species are based on Band Option 2 (B02), which applies a uniform distribution of bird flight heights between the lowest and highest levels of the rotors. Following the publication of updated flight height distributions by Johnston . (2014), the revised numbers were used to determine the 'generic' percentage of flights at collision risk height for each species based on the proposed project's WTG parameters.

11.4.45 The CRM assessment used the latest advocated nocturnal activity factors and avoidance rates provided in the Natural England interim guidance (Natural England, 2022). The latest Natural England guidance on avoidance rates, nocturnal activity factors and bird biometric data formed the basis of this assessment, as outlined in (Natural England, 2022). It is noted that these avoidance rates are still considered precautionary and likely to overestimate the risk of collision to assessed species (APEM, 2014). Parameters used are presented in Table 11.16 below.

Table 11.16 Parameters used for the CRM assessments.

Species	Body length (m)	Wingspan (m)	Flight speed (ms-1)	Nocturnal activity factor (1 to 5 / %)	Flight type	Avoidance rate (%)
Gannet	0.94	1.72	14.9	1.3 / 8%	Flapping	99.7
				2 / 25%		99.9
Kittiwake	0.39	1.08	13.1	3 / 50%	Flapping	99.2
				2 / 50%		
Lesser black-backed gull	0.58	1.42	13.1	3 / 50%	Flapping	99.4
				2 / 25%		

DIRECT HABITAT LOSS

11.4.46 Although direct habitat loss may occur during the O&M phase it is unlikely to have effects on the breeding populations of the SPAs due to the species large foraging ranges and the options for roosting in adjacent marine habitats. Migratory birds are also unlikely to be impacted by habitat loss as they pass through or over the array area and don't use it for foraging or roosting.

BARRIERS TO MOVEMENT

11.4.47 Offshore windfarms may act as a barrier to seabirds and migratory bird movements. Seabird species that commute regularly through the array area while foraging may be impacted by incurring greater energy costs flying around the array, however species likely to be significantly impacted by barrier effects do not breed near to the VE site so commutes through the site are unlikely to be regular. Likewise, migratory birds are unlikely to be affected by barrier effects as they will make one-off movements through array area during migration periods.

CHANGES IN PREY AVAILABILITY

11.4.48 The presence of an offshore windfarm may lead to changes in availability or abundance in prey resulting in displacement from foraging areas or a reduced energy intake, resulting in impacts on survival rates and productivity in the short-term. The ECC passes through the OTE SPA so there is potential for LSE for that site.

MAXIMUM DESIGN SCENARIO

11.4.49 The assessment undertaken for Offshore and Intertidal Ornithology is based on the MDS within Volume 6, Part 2, Chapter 4: Offshore Ornithology, which is repeated in Table 11.17 for clarity.

Table 11.17 The Maximum Design Scenario considered for offshore and intertidal ornithology as established within Volume 6, Part 2, Chapter 4: Offshore Ornithology.

Potential effect	MDS assessed	Justification
Construction		
Direct disturbance and displacement	**Array Areas:** > Small WTGs: > > 79 monopile WTGs with foundation of 13 m x 15 m, Rotor Diameter (RD) of 260 m, minimum blade tip height of 28 m above MHWS and maximum blade tip height of 320 m above MHWS. > Large WTGs: > > 41 monopile WTGs with foundation of 15 m x 15 m, RD of 360 m, minimum blade tip height of 28 m above MHWS and maximum blade tip height of 395 m above MHWS. > 2 monopile OSPs 125 m x 100 m > Total length of array cables = 200 km > Minimum spacing of WTGs = 830 m > Aviation lighting = up to 2000 cd on WTGs **Offshore ECC:** > > Number of export cable circuits = 2, with minimum 5 m and nominal 200 m spacing; > > Total length of export cables = 196 km; > > Indicative width of seabed affected by installation per cable = 18 m;	With more WTGs to be constructed under the Small WTGs scenario, the area subject to construction disturbance, and the overall duration of disturbance is likely to be greater.

Potential effect	MDS assessed	Justification
	> Total area of seabed disturbed by cable installation = 3.52 km^2. **<u>Vessels:</u>** > Indicative peak numbers of construction vessels: ▪ Foundations = 38; ▪ WTGs = 10; ▪ Inter-array cables = 12; ▪ Offshore ECC = 12; ▪ Other installation vessels = 24; > Max total vessels offshore (combination of peaks) = 96; > Indicative peak total vessels offshore = 35; > Indicative max number of vessel round trips: ▪ Array areas (WTGs, foundations, substations) = 69 peak, 1,734 round trips; ▪ Offshore ECC = 12 peak, 278 round trips; ▪ Other vessels = 15 peak, 2,300 round trips; ▪ Total = 96 peak, 4,311 round trips. > Up to 530 round trips, by up to two helicopters. **<u>Construction Programme:</u>** > Programme to occur over a five-year period; > Onshore preliminary works anticipated to commence 2027. Main offshore construction works are anticipated to	

Potential effect	MDS assessed	Justification
	commence in 2029, with some preliminary survey and clearance works potentially taking place in 2028 and 2027. The windfarm is anticipated to be operational in 2030. > Indicative duration of works: ▪ Offshore preconstruction works (survey/clearance etc) = 27 months from Year 1; ▪ Offshore substation installation and commissioning = 12 months from Year 3; ▪ Offshore ECC installation = 9 months from Year 3; ▪ Foundation installation = 12 months from Year 3; ▪ Array cable installation = 9 months from Year 3; ▪ WTG installation = 12 months from Year 4; ▪ WTG and foundation commissioning/ snagging = 30 months from Year 3. > 24-hour offshore working will be required, with illumination required on construction vessels during night-time and low light conditions. **Piling:** > Number of monopiles = 81; > Maximum duration of piling per day = 15 hrs monopile, 24 hrs per pin pile; > Total duration per monopile = 7.5 hrs max, 3 hrs average; > Number of simultaneous monopile piling events = 2;	

Potential effect	MDS assessed	Justification
	> Number of monopiles to be installed in 1 day (assuming 2 piling vessels) = 1 indicative, 4 worst case highest value.	
Indirect impacts through effects on habitats and prey species	**Temporary subtidal habitat disturbance** The total temporary subtidal habitat disturbance for the array areas and the offshore ECC is fully described in Table 11.46.	See justification within Table 6.10, Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.
Operation		
Direct disturbance and displacement	**Array Areas and Offshore ECC specifications** Project lifespan = 24 to 40 years Indicative max lifetime number of major component replacement events for WTG's and platforms (jacking-up activities) = 284 Indicative number of offshore export cable subsea repairs – actual whole project lifetime = 9 Indicative peak vessels on-site simultaneously = 27, with 1,776 round trips annually Up to 125 helicopter return trips per year.	A larger number of WTGs under the Small WTG scenario is likely to result in a larger area of habitat to be effectively lost as a result of displacement responses. More WTGs will require more vessel and helicopter activity for maintenance reasons.
Indirect impacts through effects on habitats and prey species	**Total Habitat change** > Max footprint for all WTG foundations = 13,960 m^2 > Max footprint of all OSPs = 353 m^2 > Max scour protection volume for project (rock) including WTG, OSP and Met mast = 2,257,300 m^3	A larger number of WTGs under Small WTG scenario is likely to affect a larger extent of habitat, as well as increased displacement of prey species. A larger number of WTGs is also likely to increase the possibility of a pollution incident.

Potential effect	MDS assessed	Justification
	> Maximum area of seabed disturbed by up to 200 km of array cable installation = 3,600,000 m^2 > Maximum area of seabed disturbed by up to 196 km Offshore ECC installation = 3,520,000 m^2 **Operational disturbance to seabed** > Indicative max seabed disturbance per year from jacking-up activities = 12,496 m^2 > Total seabed area disturbed by array cable replacement through life = 276,656 m^2 > Total seabed area disturbed by export cable repairs through life = 145,842 m^2	
Collision risk	> <u>Small WTGs:</u> > 79 monopile WTGs with foundation of 13 m x 15 m, RD of 260 m, minimum blade tip height of 28 m above MHWS and maximum blade tip height of 324 m above MHWS. > <u>Large WTGs:</u> > 41 monopile WTGs with foundation of 15 m x 15 m, RD of 360 m, minimum blade tip height of 28 m above MHWS and maximum blade tip height of 395 m above MHWS.	The MDS in relation to collision risk is species-specific and dependent on the behaviour and ecology of individual IOFs. As the number of WTGs is the factor likely to have the greatest influence on collision rates under the deterministic and stochastic CRMs, the Small WTGs has been taken forward for assessment, with the higher annual collision rates predicted for all species.
Combined operational collision risk and displacement	As per direct disturbance and displacement, and collision risk.	A larger number of WTGs under the Small WTG scenario is likely to result in increased displacement. A

Potential effect	MDS assessed	Justification
		larger number of WTGs is also likely to increase the possibility of collisions.
Decommissioning		
Direct disturbance and displacement	See the construction phase impacts. The decommissioning sequence will generally be in the reverse of construction (reverse lay) and is expected to involve similar types and numbers of vessels and equipment and take place over a three-year period.	With more WTGs to be decommissioned, the area subject to disturbance, and the overall duration of disturbance is likely to be greater under the Small WTG scenario.
Indirect impacts through effects on habitats and prey species	See construction phase impacts for guidance on extent of areas affected.	A larger number of WTGs to be removed under the Small WTG scenario is likely to affect a larger extent of habitat, as well as increased displacement of prey species. A larger number of WTGs is also likely to increase the possibility of a pollution incident.

ASSESSMENT OF ADVERSE EFFECT ON INTEGRITY ALONE

CONSTRUCTION AND DECOMMISSIONING

OUTER THAMES ESTUARY SPA

11.4.50 The Outer Thames Estuary (OTE) SPA was designated in August 2010 and covers over 379,268 ha of marine habitat, partly in English territorial waters and partly in UK offshore waters. The red-throated diver is an Annex 1 species and the sole feature of the SPA (Natural England and JNCC 2010).

11.4.51 An extension to the SPA was proposed in 2015 to include coastal and estuarine areas used by foraging terns breeding nearby however as terns were not identified as at risk of LSE it is only the original feature, red-throated diver, that is considered here.

11.4.52 The conservation objectives of the site include:

- 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.

RED-THROATED DIVER (NON-BREEDING)

STATUS AND ECOLOGY

11.4.53 The red-throated divers wintering habitats in the UK and Europe are generally shallow inshore waters up to 20m in depth (Natural England, 2010). The bulk of the UK distribution is found in coastal areas of east England with 38% of the UK wintering population found in the OTE SPA at the time of designation (JNCC and Natural England 2013). The distribution and abundance of red-throated divers is primarily determined by the presence and availability of their food source (Poot , 2009), in particular sprats and young herring.

POTENTIAL EFFECTS OF THE PROPOSED FIVE ESTUARIES OWF ON THE SPA FEATURE

11.4.54 Red-throated divers were screened in for the C&D phase to assess the potential for an AEoI from displacement within the ECC from VE alone in relation to the following conservation objectives for this species, as a feature of the OTE SPA:

- '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.

11.4.55 Based on the above the conservation objective for the OTE SPA the specific target for the red-throated diver feature is as follows based on JNCC and Natural England's case-specific advice (JNCC and Natural England, 2013):

11.4.56 To maintain the size of the wintering population at a level which is above 6,466 individuals whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest mean count is 22,280 adults based on the 2019 count provided by Irwin . (2019).

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The distribution of the qualifying features within the site.

11.4.57 Red-throated divers have shown sensitivity and strong avoidance behaviour to shipping activity and other anthropogenic activities associated with the development of OWFs through both noise and visual cues (Schwemmer ., 2011). They show a preference for shallow shelf areas and for sandy substrates, which coincides with ideal areas for the development of OWFs (Kleinschmidt ., 2019). The literature indicates that the majority of red-throated divers present will flush from approaching vessels at a distance of 1 km or less (Bellebaum ., 2006; Jarrett ., 2018; Topping and Petersen, 2011) which makes them susceptible to impacts during the C&D of the windfarm and in the O&M phase due to vessel presence (Garthe and Hüppop, 2004; Schwemmer ., 2011; Furness ., 2013; Bradbury ., 2014; Dierschke ., 2017, Mendel ., 2019).

11.4.58 They rank highly for displacement impact sensitivity in different indexes including one developed by Furness and Wade (2012) and the SeaMaST (Seabird Mapping and Sensitivity Tool) (Bradbury *et al*., 2014) but have a moderately low collision risk due to their lower flight altitude. Collision is also less of a concern because red-throated diver showed a very low abundances within the VE array area and 4 km buffer.

11.4.59 There is no evidence that birds displaced from wind farms or by vessels suffer any mortality as a consequence of displacement (Dierschke . 2017). MacArthur Green (2019) undertook a review of available evidence for red-throated diver displacement as part of the Norfolk Vanguard OWF assessment submission, concluding little or no effect of displacement on red-throated diver survival. Additionally, displacement impacts throughout the cable construction are temporary, and so mortality rates of red-throated diver are expected to be less than mortality rates of individuals displaced from the array area plus buffer zone as individuals displaced from the cable corridor can return intermittently.

11.4.60 Based on available evidence regarding red-throated diver displacement by operational OWFs, it is suggested that there will be little or no impact on adult survival as a result of displacement, and that any impact would probably be undetectable at the population level. No evidence has been identified which supports the upper range of mortality effects for displaced birds currently advised by Natural England (i.e. up to 10%), and a review of the available evidence indicates that a mortality rate of 1% is considered appropriately precautionary (MacArthur Green, 2019). Given that vessel disturbance occurs over a reduced range compared with disturbance from operational windfarms, it is assumed that these conclusions can also be applied to birds displaced by the cable laying vessel in the ECC.

11.4.61 The proposed ECC route will overlap with the OTE SPA and therefore has been identified as having a potential impact on red-throated divers. Preparatory works for cable installation (including geophysical and geotechnical surveys, and route clearance) and cable laying and burial will take place over a five year period. However, each element of works in the SPA, which is crossed by the ECC for approximately 16 km, will be limited in duration with each activity (e.g. route surveys, route clearance, cable laying and cable burial) taking around 5 to 15 days to complete. The laying of the export cables will involve cable laying vessels being *in situ* for the offshore construction period of a maximum of five years. As a worst-case scenario there will be one cable-laying vessel or vessel cluster (one cable laying vessel and several auxiliary vessels working in proximity to each other) working on the ECC at any one time. During the winter season, there were 102 unique vessels recorded over a 14-day period, along with 116 in the summer season (ES Volume 6, Part 2, Chapter 9: Shipping and Navigation), and it is therefore considered that the additional one vessel for cable-laying at VE will not cause a significant change from the baseline.

11.4.62 Displacement of red-throated diver was estimated within the ECC during the migration-free winter bio-season, defined as December to January by Furness (2015), presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note. Both the mean and maximum density of red-throated diver within the ECC corridor was estimated using data from Irwin *et al*. (2019). This was achieved by clipping the RTD Irwin density data to the relevant area (ECC, ECC with buffer) and calculating an average density. The displacement of both species was scaled up to a 2 km buffer surrounding the cable laying vessel to provide a range from the average to the maximum abundance of birds that are displaced at any moment in time during the migration-free winter bio-season.

11.4.63 The average density of red-throated divers within the ECC area that overlaps the OTE SPA during the non-breeding season was estimated as 3.31 birds per km2. Applying this density of birds within a 2 km buffer of the cable laying vessel equates to an average of 125 (124.94) red-throated diver susceptible to displacement at any one time. Using a maximum density of red-throated divers estimated to be within the ECC of 8.75 birds per km2 equated to a maximum displacement of 110 (110.00) birds within a 2 km buffer of cable-laying vessels (Table 11.18).

11.4.64 Using the rate of 100% displacement within the area around the cable laying vessel and a precautionary 2 km buffer then between 42 and 110 red-throated divers would be displaced. This is a highly precautionary approach, because only 20.8% of the ECC overlaps with OTE SPA. Based on 1% mortality, this would result in between 0.37 and 1.1 mortalities per annum (Table 11.20), representing between a 0.036% and 0.106% increase in baseline mortality based on a citation population of 6,466 individuals (and a baseline mortality of 1,035 individuals per annum. Based on the more recent 2019 count of 22,280 individuals (and a baseline mortality of 3,565 individuals per annum), this would represent between a 0.012% and 0.031% increase in baseline mortality. Results based on the full displacement (90% to 100%) and mortality (1% to 10%) mortalities as per Natural England guidance are presented in Table 11.18 below.

11.4.65 **There is, therefore, no potential for an AEoI to the conservation objective to maintain the population levels of the red-throated diver feature of OTE SPA in relation to disturbance and displacement effects in the C&D phase from VE alone.**

11.4.66 If it is assumed that displaced birds all remain within the OTE SPA, then this displacement would result in an increase of between 0.9% and 1.5% in diver density in the remaining areas of the SPA. For the purposes of estimating displacement, the vessels can be considered as effectively stationary from the perspective of the birds affected. This is because tidal flows (3.6 km per hour) are considerably faster than the maximum speed of vessel movements during cable laying activities (max. 0.3-0.4 km per hour). Consequently, it can be assumed that the estimated number of birds displaced represents the total number displaced over the course of a single winter, since the zone of exclusion can be treated as fixed.

11.4.67 In their Section 42 comments, regarding the impacts on red-throated divers, Natural England recommended assessing the impacts of habitat loss to the red-throated diver OTE SPA population. Table 11.19 provides the densities of red-throated divers for three areas, the area of overlap between the ECC and the OTE SPA, the ECC plus 2 km buffer and the entirety of the southern part of the OTE SPA. Mean densities are very similar in each area however the lowest mean density was predicted within the area of overlap between the ECC and the OTE SPA. Due to the higher mean densities found in the adjacent areas, and the availability of similar habitat throughout the OTE SPA and beyond, it is believed that any habitat loss would have no significant long-term impact on the red-throated diver population of OTE SPA.

11.4.68 Red-throated diver are opportunistic feeders, their diet is composed primarily of fish and to a less extent crustaceans, polychaetes molluscs and aquatic insects (Madsen, 1957; Palmer, 1962; Kleinschmidt *et al*., 2019). As such this species is considered to have a reasonably varied diet. Moreover, based on tracking data, red-throated diver has a small foraging range (mean max +1SD of 9 km) (Woodward., 2019). This species tends to forage close to the shore during rough and windy conditions however red-throated diver can travel further offshore to forage under calm conditions (Furness, 1983).

11.4.69 Following the evidence presented regarding the adaptability of red-throated diver foraging behaviours, changes to prey species and abundance and availability is likely to cause minimal impact to foraging habitat use.

11.4.70 Furthermore, potential effects on prey species namely, sandeels, herring and sprat, that are key prey species for various seabirds, and the habitats that support these species have been covered within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology and Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology respectively, of the ES. Impacts were found to be non-significant therefore, it is reasonable to assume, regardless of the sensitivity of the receptor, any potential indirect effects on red-throated diver are extremely low.

11.4.71 Following guidance from Natural England a best practice protocol to minimise disturbance on the red-throated divers will be adopted and will form part of the Working in Proximity to Wildlife in the Marine Environment (Volume 9, Report 18.1). Some of the following best practice examples have been included in the Working in Proximity to Wildlife in the Marine Environment:

- Export cable installation will not be carried out within the OTE SPA between 1st November to 31st March inclusive to mitigate disturbance impacts on red throated diver;
- Selecting routes that avoid known aggregations of birds;
- Restricting vessel movements to existing navigation routes where possible;
- Maintaining direct transit routes to minimise distances through areas used by red-throated divers;
- Considering the potential for crew transfer vessels (CTV) to travel in convoy en route to the wind farm sites;
- Avoiding rafting birds either in-route to the array and within the array, where possible, and avoiding disturbance to areas with consistently high diver density; and
- Maintenance vessel operators being made aware of the importance of this species and the associated mitigation measure through toolbox talks.

11.4.72 With these mitigation measures in place, which aim to avoid disturbance during peak months of red-throated diver presence, the impacts presented above are highly unlikely to occur. The displacement impacts on red-throated diver that will occur due to the installation of the VE OWF export cable within the Outer Thames SPA are low in magnitude, temporary and reversible.

11.4.73 **Predicted red-throated diver mortality and changes to distribution due to vessel traffic in the C&D phase from VE alone will not adversely effect the integrity of OTE SPA. 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 including changes to their supporting habitats.**

Table 11.18 Displacement matrix for red-throated diver within the ECC attributed to the OTE across all bio-seasons. Assessment based on the maximum density of red-throated diver within the ECC inferred from Irwin . (2019), with values in light green representing the range-based values and dark green representing VE's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	1	2	3	4	6	7	8	9	10	11
20	0	0	1	2	4	7	9	11	13	15	18	20	22
30	0	1	2	3	7	10	13	17	20	23	26	30	33
40	0	1	2	4	9	13	18	22	26	31	35	40	44
50	1	1	3	6	11	17	22	28	33	39	44	50	55
60	1	1	3	7	13	20	26	33	40	46	53	59	66
70	1	2	4	8	15	23	31	39	46	54	62	69	77
80	1	2	4	9	18	26	35	44	53	62	70	79	88
90	1	2	5	10	20	30	40	50	59	69	79	89	99
100	1	2	6	11	22	33	44	55	66	77	88	99	110

Table 11.19 Red-throated diver densities for the ECC overlap of the OTE SPA, the whole ECC plus a 2 km buffer and the southern part of the OTE SPA.

	Mean Density	Min density	Max density	SD	Area (km2)
ECC Overlap with the OTE SPA	3.314	0.565	8.754	2.097	34.6
ECC+ 2 km buffer	3.715	0.001	15.945	2.818	115.4
Southern part of OTE SPA	3.837	0.0001	102.134	8.174	2,322.0

Table 11.20 Red-throated diver predicted mortalities based on the full range of potential displacement impacts at the OTE SPA.

Season	100% displacement, 1% mortality			90% to 100% displacement, 1% to 10% mortality		
	Estimated mortalities	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated mortalities	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Non-breeding season (mean density	0.42	0.040	0.012	0.37– 4.16	0.036– 0.402	0.011 – 0.117
Non-breeding season (max density	1.10	0.106	0.031	0.99 – 11.00	0.096 – 1.063	0.028 – 0.309

FLAMBOROUGH AND FILEY COAST SPA

11.4.74 The FFC SPA was formally designated in July 2018, representing a geographical extension of the existing Flamborough Head and Bempton Cliffs SPA and adds several species to the citation list. Table 11.21 lists the relevant ornithological qualifying features and their population status at time of the SPA citation and the most recent colony counts.

11.4.75 The extension consists of a landward extension to the north west of the existing SPA to incorporate important breeding colonies of seabirds and marine extensions out to 2 km in order to protect the areas of the sea adjacent to the breeding colonies that are important to the breeding seabirds. The addition of migratory features to the SPA citation for gannet, guillemot and razorbill are additional modifications to the existing SPA.

11.4.76 The conservation objectives of the site include:

- Ensuring the integrity of the site is maintained and the site makes a full contribution to achieving the aims of the Birds Directive;
- Subject to natural change, to maintain or restore, for each qualifying feature:
  - 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 populations of the qualifying features; and
  - The distribution of the qualifying features within the site.

Table 11.21 Qualifying features and condition for the FFC SPA.

Qualifying features	Citation populations (individuals)	Recent populations (individuals) (Clarkson , 2022; Butcher , 2023)	Broader conservation status
Kittiwake	89,040	89,148	Red
Gannet	16,938	30,466	Amber
Guillemot	83,214	149,980	Amber
Razorbill	21,140	61,346	Amber

GANNET

STATUS AND ECOLOGY

11.4.77 The gannet is the largest breeding seabird in the British Isles, it feeds on a wide range of fish and is an opportunistic feeder, scavenging on discards from fishing vessels (Garthe *et al*, 1996). The foraging behaviour of gannets generally involves diving, often from a considerable height, resulting in potential for collision risk with wind turbines while foraging. Gannets rely on sight when foraging and therefore don't forage during hours of darkness (Hamer *et al*, 2007, Garthe *et al*, 2012).

11.4.78 The gannet can travel vast distances while foraging, although breeding adults normally remain within a foraging area that is unique to the individual colony, rarely overlapping with the foraging distributions of other colonies (Wakefield *et al*, 2013). Gannets migrate south and many of the British breeders winter off the west of Africa and southern Europe (Furness *et al*, 2018). A considerable proportion of the gannets that winter in British waters originate from colonies in Norway or Iceland (Fort *et al*, 2012, Garthe *et al*, 2017b).

11.4.79 There are a relatively small number of gannet colonies in the British Isles, however the colonies that are present are generally very large and often in relatively remote locations away from disturbance and predation dangers. The gannet population has been increasing since 1900 peaking at the recent count in 2023 with 15,233 pairs (Butcher *et al*, 2023), although the rate of increase has slowed in recent years (Murray *et al*, 2015). Approximately 60% of the global population breeds in the British Isles, with over 90% of the British population breeding within SPAs (Furness, 2015).

POTENTIAL EFFECTS OF THE PROPOSED FIVE ESTUARIES OWF ON THE SPA FEATURE

11.4.80 There is strong evidence that gannets display macro-avoidance of offshore windfarms (Garthe *et al*, 2017a & b, Skov *et al*, 2018, Pavat , 2023) and the avoidance rates (meso and micro) used in collision risk assessments are an underestimation, inflating of collision mortalities (Garthe , 2017b). An increase in avoidance rates could increase the effects from displacement and barrier effects. However, due to the large distances gannets travel to forage, small additions to flight distances (through avoidance or barrier effects) are highly unlikely to significantly increase energetic expenditure or reduce survival of gannets unless the OWF is located close to the breeding colony and avoidance is continually repeated (Masden , 2009 & 2010). For example, Searle *et al*, (2014) modelled displacement and barrier effects of commuting breeding gannets off the east coast of Scotland and the results indicated that the effects would be negligible at a population level, even when windfarms were situated close to a colony.

11.4.81 Gannets were screened into the impact assessment for the C&D phase to assess the potential for an AEoI through displacement from VE array and 2 km buffer alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

11.4.82 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 mean count is 24,594 adults based on the mean of the 2012, 2015 and 2017 counts (Aitken *et al*. 2017).

11.4.83 The project array area is located at 275.50 km distance from the FFC SPA, which is within the mean max plus 1 SD foraging distance of 509.4 km (Woodward *et al*. 2019) and has therefore been screened in for the full-breeding bio-season of March to September. It is also considered during the return migration bio-season (December to March) and the post breeding bio-season (September to November) as defined by Furness (2015), when gannets migrate through the southern North. Notably, despite VE being within mean max plus 1SD foraging distance from the FFC SPA, tracking data from Langstone *et al*. (2013) indicates that gannets from the FFC SPA predominantly forage due east, with no tagged birds heading as far south as the VE array area. Apportioning of gannet impacts to FFC SPA during the breeding season is therefore considered a precautionary approach. Table 11.22 presents the agreed approach with Natural England for adult apportioning and the apportioning to FFC SPA.

Table 11.22 Breeding season apportioning values for gannet.

Approach	Adult apportioning (%)	FFC apportioning (%)
Agreed approach with NE	82.0	74.0

BREEDING

11.4.84 The number of gannets estimated to occur in the array area during the breeding bio-season is 141 (141.4) individuals. The estimated number of individuals predicted to be displaced is less than one (0.49) (Table 11.23) when applying a displacement rate of 35% and a mortality rate of 1% of birds within the array and 2 km buffer are adult birds (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note.).

Table 11.23 Abundance of gannets in the VE OWF survey area per season apportioned to FFC SPA.

Season	North	South	North and South combined	Estimated mortalities (35% & 1%)	Estimated mortalities (30% to 40% & 1%)
Full Breeding (Mar-Sep)	68.4	73.0	141.4	0.49	0.42 – 0.56
Autumn (Oct – Nov)	21.4	13.4	34.8	0.12	0.11 – 0.14
Spring (Dec – Feb)	1.9	2.9	4.8	0.02	0.01 – 0.02

11.4.85 Following consultation with Natural England there was an initial disagreement with the apportioning methods to SPA colonies with Natural England preferring 100% apportionment to FFC SPA based on a lack of connectivity to the Alderney West Coast. Following the tagging project from Alderney (Warwick-Evans *et al*, 2017) it was found that gannets were tracked foraging from the Alderney colony into the VE OWF proposed array area and therefore it was agreed to include the Alderney West Coast and Burhour Islands Ramsar site in the apportioning and an apportioning figure of 74% for FFC was agreed with Natural England.

11.4.86 Based on a citation population of 16,938 breeding adults and a background mortality of 1,490 breeding adults per annum, the addition of less than one (0.49) breeding adult suffering displacement consequent mortality would represent a 0.033% increase in baseline mortality.

11.4.87 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 population count undertaken in 2023, consisting of 30,466 breeding adults and an annual background mortality of 2,681 breeding adults per annum (Butcher *et al*. 2023). On this basis, when considering the potential impact of this loss to the FFC SPA then the prediction of one breeding adult (0.49) suffering displacement consequent mortality would represent a 0.019% increase in baseline mortality in the full breeding bio-season.

NON-BREEDING

11.4.88 Outside of the full breeding bio-season the number of gannets estimated to occur in the array area and a 2 km buffer in the return migration bio-season is 5 (4.8) individuals and in the post-breeding migration bio-season is 35 (34.8) individuals.

11.4.89 The total predicted consequent mortality from being displaced is estimated at less than one (0.02) breeding adult during the return migration bio-season and less than one (0.12) breeding adults during the post-breeding migration bio-season.

11.4.90 On the basis that 7.19% of the gannets are deemed to be breeding adults from FFC SPA during the return migration (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent mortality from being displaced is estimated at <0.1 (0.02) breeding adult per annum.

11.4.91 During the post-breeding migration bio-season it is considered that 5.44% of all gannets within the array are breeding adults from FFC SPA (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). Therefore, the consequent mortality of adult birds from FFC SPA from being displaced is estimated at less than one (0.1) breeding adult per annum.

11.4.92 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.14) breeding adult per annum. This represents an increase of 0.009% in baseline mortality to the citation population or 0.005% of the 2023 population of FFC SPA.

ANNUAL TOTAL

11.4.93 Across all bio-seasons, the number of gannet estimated to occur in the array area and a 2 km buffer is 181 (181.0) individuals. The total predicted consequent mortality from being displaced is fewer than two (1.5) individuals annually. Displacement consequent mortalities based on the range advocated by Natural England (30% displacement to 40% displacement, 1% mortality). Table 11.25 presents the full matrices for the impacts on gannets.

11.4.94 The impact of displacement from the array area and 2 km buffer attributed to FFC SPA throughout the C&D phase of VE is less than one (0.64) breeding adult birds per annum across all bio-seasons.

11.4.95 This predicted total consequential additional mortality represents an increase in baseline mortality of 0.042% to the citation population or 0.023% to the 2022 population of FFC SPA per annum. **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature of FFC SPA in relation to potential adverse disturbance and displacement effects from the C&D phase of VE alone can be ruled out and therefore, subject to natural change, gannet would be maintained as a feature in the long term.**

Table 11.24 Range-based displacement mortalities during the construction and decommissioning phases for gannet based on the values advocated by Natural England for both citation population and counts and more recent Clarkson . (2022) Seabird Monitoring Programme (SMP) population counts.

FFC SPA		Abundance of adults apportioned to SPA (array area plus 2 km buffer)	30% Displacement, 1% Mortality			35% Displacement, 1% Mortality			40% Displacement, 1% Mortality		
			Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Breeding	North	68.4	0.21	0.011	0.007	0.24	0.016	0.008	0.28	0.018	0.010
	South	73.0	0.22	0.012	0.009	0.25	0.017	0.009	0.29	0.020	0.011
Post-breeding migration	North	21.4	0.06	0.004	0.002	0.07	0.005	0.003	0.08	0.006	0.003
	South	13.4	0.04	0.003	0.002	0.05	0.003	0.002	0.05	0.003	0.002
Return migration	North	1.9	0.01	0.000	0.000	0.01	0.000	0.000	0.01	0.000	0.000
	South	2.9	0.01	0.001	0.000	0.02	0.001	0.000	0.01	0.001	0.000
Total		**181.0**	**0.55**	**0.036**	**0.020**	**0.64**	**0.42**	**0.23**	**0.72**	**0.048**	**0.027**

Table 11.25 Project alone displacement matrix for adult gannet attributed to the FFC SPA across all bio-seasons, with values in light green representing the range-based values dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
5	0.1	0.2	0.5	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.1
10	0.2	0.4	0.9	1.8	3.6	5.4	7.2	9.1	10.9	12.7	14.5	16.3	18.1
15	0.3	0.5	1.4	2.7	5.4	8.1	10.9	13.6	16.3	19.0	21.7	24.4	27.2
20	0.4	0.7	1.8	3.6	7.2	10.9	14.5	18.1	21.7	25.3	29.0	32.6	36.2
25	0.5	0.9	2.3	4.5	9.1	13.6	18.1	22.6	27.2	31.7	36.2	40.7	45.3
30	0.5	1.1	2.7	5.4	10.9	16.3	21.7	27.2	32.6	38.0	43.4	48.9	54.3
35	0.6	1.3	3.2	6.3	12.7	19.0	25.3	31.7	38.0	44.3	50.7	57.0	63.4
40	0.7	1.4	3.6	7.2	14.5	21.7	29.0	36.2	43.4	50.7	57.9	65.2	72.4
45	0.8	1.6	4.1	8.1	16.3	24.4	32.6	40.7	48.9	57.0	65.2	73.3	81.5
50	0.9	1.8	4.5	9.1	18.1	27.2	36.2	45.3	54.3	63.4	72.4	81.5	90.5

GUILLEMOT (NON-BREEDING)

STATUS AND ECOLOGY

11.4.96 The guillemot breeding colony is a designated feature of the FFC SPA. The FFC SPA colony of guillemots is the largest in the southern North Sea with a population of 83,214 breeding adults (2008-2011) at the time of citation with the population increasing since the citation count with the most recent population estimate of 149,980 breeding adults in 2022 (Clarkson *et al*, 2022).

11.4.97 The guillemot is one of the largest auks in the world and a consummate diver having been recorded diving to depths up to 100m. Their diet mainly consists of small fish and invertebrates (e.g. euphausiids and cephalopods) (Ainley *et al*, 2021). The guillemot is specially adapted for diving underwater with relatively short wings, an adapted compromise for underwater diving and aerial flight, requiring rapid wing beats for flight. This highly intensive flight and feeding style, plus feeding in cool waters, contributes to an energetically costly lifestyle (Ainsley *et al*, 2021).

POTENTIAL EFFECTS VE ON THE SPA FEATURE

11.4.98 Guillemot has been screened in for C&D phase to assess the potential for an AEoI from displacement from VE alone within the array area and 2 km buffer. Any impact is assessed in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each qualifying feature.

11.4.99 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 149,980 breeding adults based on the most recent 2022 colony count.

11.4.100 The VE array area is located at 275.50 km distance from the FFC SPA, which is beyond the mean-max plus 1 SD foraging distance of 153.7 km (Woodward *et al*. 2019) and therefore there is no breeding season connectivity for this species at this site. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, guillemot was screened in for disturbance and displacement due to work activity and vessel movements within the array area during the non-breeding bio-season defined as August to February by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

11.4.101 The number of guillemots estimated to occur in the array area during the non-breeding bio-season is 3,698 (3697.9) breeding adults. The estimated number of breeding adults per annum predicted to be displaced is less than ten (9.25) when applying a displacement rate of 25% and a mortality rate of 1%.

11.4.102 Following the approach to apportionment presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note, 4.4% of predicted guillemots within the project array area plus 2 km buffer are predicted to be from the FFC SPA in the non-breeding season. The consequent displacement mortality is, therefore, less than one (0.4) breeding adult during the non-breeding bio-season. Displacement consequent mortalities based on the range advocated by Natural England (15% to 35% displacement, 1% to 10% mortality) are presented in Table 11.27.

11.4.103 Based on a citation population of 83,214 breeding adults and an annual background mortality of 5,076 breeding adults, the additional mortality of under one breeding adult (0.41) as a consequence of displacement would represent an increase in baseline mortality of 0.008%.

11.4.104 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 2022, consisting of 149,980 breeding adults with an annual background mortality of 9,149 breeding adults. On this basis, the additional mortality of under one breeding adult (0.41) as a consequence of displacement would represent and an increase of 0.004% in baseline mortality in the nonbreeding bio-season. The full range of displacement is presented in the displacement matrices in Table 11.28.

11.4.105 The potential loss of under one breeding adult is deemed so low as to be considered no material contribution to the natural baseline mortality rates of the FFC SPA, especially considering that construction activities are both temporally and spatially limited. **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 C&D phase from VE alone can be ruled out and therefore, subject to natural change, guillemot will be maintained as a feature in the long-term with respect to the potential for adverse effects from disturbance and displacement.**

RAZORBILL (NON-BREEDING)

STATUS AND ECOLOGY

11.4.106 The razorbill breeding colony is a designated feature of the FFC SPA. The FFC SPA colony of razorbills has increased significantly in recent years with the population of 21,140 breeding adults (2008-2011) at the time of citation and the most recent population estimate climbing to 61,346 breeding adults in 2022 (Clarkson *et al*, 2022).

11.4.107 The razorbill is a large, stocky alcid with similar foraging behaviours to guillemots, although they tend to be more selective in choice of feeding habitat compared to other alcids (Ainsley *et al*, 2021). Their diet mainly consists of small fish and invertebrates with the latter especially important part of the diet in winter (Ainsley *et al*, 2021).

POTENTIAL EFFECTS OF VE OWF ON THE SPA FEATURE

11.4.108 Razorbill has been screened into the impact assessment of the C&D phase to assess the impacts from displacement from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each qualifying feature.

11.4.109 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 61,346 breeding adults based on the most recent 2022 colony count.

11.4.110 The VE array area is out with the mean max plus 1 SD foraging distance of 164.6 km to the FFC SPA at 275.50 km distance (Woodward *et al*. 2019) and therefore there is no breeding season connectivity for this species at this site. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, razorbill was screened in for disturbance and displacement due to work activity and vessel movements within the array area during the return-migration bio-season from January to March, the post-breeding migration from August to October and the migration-free winter bio-season from November to December, as defined by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

11.4.111 The number of razorbill estimated to occur in the array area during the return-migration bio-season is 757 (756.5) individuals, post-breeding migration is 284 (283.6) and 1046 (1046.0) in the migration free winter bio-season. The estimated number of individuals predicted to be displaced is less than two (1.89) individuals in the return migration bio-season, less than one (0.71) individuals during the post-breeding migration bio-season and less than three (2.62) individuals during the migration-free winter bio-season when applying a displacement rate of 25% and a mortality rate of 1%.

11.4.112 Following the approach to apportionment presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note, the proportion of adult razorbill from the BDMPS populations from FFC SPA is estimated to be 3.38% during the return migration and post-breeding migration bio-seasons, and 0.91% during the migration-free winter bio-season. The consequent displacement mortality is, therefore, 0.06 breeding adult in the return-migration bio-season, 0.02 during the post-breeding migration and 0.02 in the migration-free winter bio-season.

11.4.113 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.11) breeding adult per annum. Displacement consequent mortalities based on the range advocated by Natural England (15% to 35% displacement, 1% to 10% mortality) are presented in Table 11.27.

11.4.114 Based on the citation count of 21,140 breeding adults and a baseline mortality of 2,220 breeding adults per annum, this would represent an increase in baseline mortality of 0.005% during the non-breeding bio-season.

11.4.115 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 2022, consisting of 61,346 breeding adults and a baseline mortality of 4,807 breeding adults per annum. On this basis, this would represent a 0.002% increase in baseline mortality during the non-breeding bio-season. The full range of displacement is presented in the displacement matrices in Table 11.29.

11.4.116 The potential loss of under one (0.11) breeding adult is deemed so low as to be considered no material contribution to the natural baseline mortality rates of the FFC SPA (Table 11.21), especially considering that construction activities are both temporally and spatially limited. **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 C&D phase from VE alone can be ruled out and therefore, subject to natural change, razorbill will be maintained as a feature in the long-term with respect to the potential for adverse effects from disturbance and displacement.**

FARNE ISLANDS SPA

11.4.117 The Farne Islands SPA was formally designated in July 1985, covering the group of low lying islands two to six km off the Northumberland coast.

11.4.118 The islands are important breeding grounds for a number of seabirds, supporting more than 1% of the British populations of four Annex 1 species, common tern, Arctic tern, roseate tern and Sandwich tern and regularly supporting more than 1% of the biogeographical population of guillemot as a regularly occurring migratory species not listed as an Annex 1 species (Table 11.26).

11.4.119 The SPA also qualifies as a seabird assemblage feature, supporting over 163,000 individual seabirds during the breeding season including Atlantic puffin, cormorant, shag, kittiwake and razorbill as well as the species mentioned above.

11.4.120 The conservation objectives of the site include:

- Ensuring the integrity of the site is maintained or restored, as appropriate and the site makes a full contribution to achieving the aims of the 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 populations of the qualifying features; and
  - The distribution of the qualifying features within the site.

Table 11.26 Qualifying features and condition for Farne Islands SPA.

Qualifying feature	Citation population count (individuals)	Recent population count (individuals) (Farne Islands, 2019)	Broader conservation status (BoCC 5)
Guillemot	65,751	64,042	Amber
Common tern	366	130	Amber
Arctic tern	2,003	2,832	Amber
Roseate tern	26	0	Red
Sandwich tern	1,724	934	Amber

GUILLEMOT (NON-BREEDING)

POTENTIAL EFFECTS OF THE PROPOSED FIVE ESTUARIES OWF ON THE SPA FEATURE

11.4.121 Guillemot has been screened into the impact assessment of the C&D phase to assess the impacts from displacement from VE alone in relation to the following conservation objectives for this species, as a feature of the Farne Islands SPA:

- Maintain the population of each qualifying feature.

11.4.122 The other site-specific conservation objectives are not relevant to the assessment because there is no functional linkage between activities from VE impacting the habitat of the SPA. Therefore, conservation objectives relating to the structure and function of the habitats, supporting processes and distribution of qualifying features within the site were not assessed for this SPA.

11.4.123 Based on the above the conservation objective for the Farne Islands 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 2017 colony count.

11.4.124 The VE array area is beyond the mean max plus 1 SD foraging distance of 153.7 km to the Farne Islands SPA at 472.54 km distance (Woodward *et al*., 2019) and therefore there is no breeding season connectivity for this species at this site. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, guillemot was screened in for disturbance and displacement due to work activity and vessel movements within the array area during the non-breeding bio-season defined as August to February by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

11.4.125 The number of guillemots estimated to occur in the array area during the non-breeding bio-season is 3,698 (3698.0) breeding adults. The estimated number of individuals predicted to be displaced is less than ten (9.25) when applying a displacement rate of 25% and a mortality rate of 1%.

11.4.126 Following the approach to apportionment presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note, the proportion of adult guillemot from the BDMPS populations from the Farne Islands SPA during the non-breeding bio-season was estimated to be 3.73%. The consequent displacement mortality is, therefore, less than one (0.435) breeding adult during the non-breeding bio-season. Displacement consequent mortalities based on the range advocated by Natural England (15% to 35% displacement, 1% to 10% mortality) are presented in Table 11.27.

11.4.127 Based on the citation population of 65,750 breeding adults and a baseline mortality of 4,011 breeding adults per annum, the addition of less than one mortality would represent a 0.009% increase in baseline mortality in the non-breeding bio-season.

11.4.128 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 2017, consisting of 64,042 breeding adults and an annual background mortality of 3,907 breeding adults per annum. On this basis, this would represent a 0.009% increase in baseline mortality in the non-breeding bio-season (Table 11.26). The full range of displacement is presented in the displacement matrices in Table 11.30.

11.4.129 The potential loss of one (0.35) breeding adult is deemed so low as to be considered no material contribution to the natural baseline mortality rates of the Farne Islands SPA, especially considering that construction activities are both temporally and spatially limited. **Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of the Farne Islands SPA in relation to disturbance and displacement effects in the C&D phase from VE alone can be ruled out and therefore, subject to natural change, guillemot will be maintained as a feature in the long-term with respect to the potential for adverse effects from disturbance and displacement.**

Table 11.27 Range-based displacement mortalities during the construction and decommissioning phases for guillemot based on the values advocated by Natural England for both citation population and counts and more recent (FFC SPA, 2022; Farne Islands SPA, 2019) SMP population counts.

Non-breeding		Abundance of adults apportioned to SPA (array area plus 2 km buffer)	15% Displacement, 1% Mortality			25% Displacement, 1% Mortality			35% Displacement, 10% Mortality		
			Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Guillemot FFC SPA	North	17.8	0.05	0.001	0.001	0.09	0.002	0.001	1.24	0.025	0.018
	South	63.8	0.19	0.004	0.003	0.32	0.006	0.004	4.46	0.088	0.065
	Total	**81.6**	**0.24**	**0.005**	**0.004**	**0.41**	**0.008**	**0.005**	**5.70**	**0.113**	**0.083**
Guillemot Farne Islands SPA	North	15.5	0.04	0.001	0.001	0.08	0.002	0.001	1.05	0.026	0.027
	South	54.0	0.16	0.004	0.005	0.27	0.005	0.003	3.75	0.094	0.097
	Total	**69.5**	**0.20**	**0.005**	**0.006**	**0.35**	**0.007**	**0.004**	**4.80**	**0.121**	**0.124**
Razorbill FFC SPA	North	14	0.04	0.002	0.001	0.07	0.003	0.001	0.98	0.044	0.156
	South	8.4	0.03	0.001	0.001	0.04	0.002	0.001	0.59	0.027	0.094
	Total	**22.4**	**0.07**	**0.003**	**0.002**	**0.11**	**0.005**	**0.002**	**1.57**	**0.071**	**0.250**

Table 11.28 Project alone displacement matrix for adult guillemot attributed to the FFC SPA across the non-breeding season, with values in light green representing the range-based values dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
5	0.1	0.2	0.4	0.8	1.6	2.4	3.3	4.1	4.9	5.7	6.5	7.3	8.2
10	0.2	0.3	0.8	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.3
15	0.2	0.5	1.2	2.4	4.9	7.3	9.8	12.2	14.7	17.1	19.6	22.0	24.5
20	0.3	0.7	1.6	3.3	6.5	9.8	13.1	16.3	19.6	22.8	26.1	29.4	32.6
25	0.4	0.8	2.0	4.1	8.2	12.2	16.3	20.4	24.5	28.6	32.6	36.7	40.8
30	0.5	1.0	2.4	4.9	9.8	14.7	19.6	24.5	29.4	34.3	39.2	44.1	48.9
35	0.6	1.1	2.9	5.7	11.4	17.1	22.8	28.6	34.3	40.0	45.7	51.4	57.1
40	0.7	1.3	3.3	6.5	13.1	19.6	26.1	32.6	39.2	45.7	52.2	58.7	65.3
45	0.7	1.5	3.7	7.3	14.7	22.0	29.4	36.7	44.1	51.4	58.7	66.1	73.4
50	0.8	1.6	4.1	8.2	16.3	24.5	32.6	40.8	48.9	57.1	65.3	73.4	81.6

Table 11.29 Project alone displacement matrix for adult razorbill attributed to the FFC SPA across the non-breeding seasons, with values in light green representing the range-based values dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
5	0.0	0.0	0.1	0.2	0.4	0.7	0.9	1.1	1.3	1.6	1.8	2.0	2.2
10	0.0	0.1	0.2	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.6	4.0	4.5
15	0.1	0.1	0.3	0.7	1.3	2.0	2.7	3.4	4.0	4.7	5.4	6.0	6.7
20	0.1	0.2	0.4	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.1	8.0	8.9
25	0.1	0.2	0.6	1.1	2.2	3.4	4.5	5.6	6.7	7.8	8.9	10.1	11.2
30	0.1	0.3	0.7	1.3	2.7	4.0	5.4	6.7	8.0	9.4	10.7	12.1	13.4
35	0.2	0.3	0.8	1.6	3.1	4.7	6.3	7.8	9.4	10.9	12.5	14.1	15.6
40	0.2	0.4	0.9	1.8	3.6	5.4	7.1	8.9	10.7	12.5	14.3	16.1	17.9
45	0.2	0.4	1.0	2.0	4.0	6.0	8.0	10.1	12.1	14.1	16.1	18.1	20.1
50	0.2	0.4	1.1	2.2	4.5	6.7	8.9	11.2	13.4	15.6	17.9	20.1	22.3

Table 11.30 Project alone displacement matrix for adult guillemot attributed to the Farne Islands SPA across the non-breeding season, with values in light green representing the range-based values dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
5	0.1	0.1	0.3	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5	6.2	6.9
10	0.1	0.3	0.7	1.4	2.8	4.1	5.5	6.9	8.3	9.7	11.0	12.4	13.8
15	0.2	0.4	1.0	2.1	4.1	6.2	8.3	10.4	12.4	14.5	16.6	18.6	20.7
20	0.3	0.6	1.4	2.8	5.5	8.3	11.0	13.8	16.6	19.3	22.1	24.8	27.6
25	0.3	0.7	1.7	3.5	6.9	10.4	13.8	17.3	20.7	24.2	27.6	31.1	34.5
30	0.4	0.8	2.1	4.1	8.3	12.4	16.6	20.7	24.8	29.0	33.1	37.3	41.4
35	0.5	1.0	2.4	4.8	9.7	14.5	19.3	24.2	29.0	33.8	38.6	43.5	48.3
40	0.6	1.1	2.8	5.5	11.0	16.6	22.1	27.6	33.1	38.6	44.2	49.7	55.2
45	0.6	1.2	3.1	6.2	12.4	18.6	24.8	31.1	37.3	43.5	49.7	55.9	62.1
50	0.7	1.4	3.5	6.9	13.8	20.7	27.6	34.5	41.4	48.3	55.2	62.1	69.0

OPERATION AND MAINTENANCE

FLAMBOROUGH AND FILEY COAST SPA - DISPLACEMENT

GANNET (BREEDING AND NON-BREEDING)

11.4.130 Gannets were screened in for the O&M phase to assess the potential for an AEoI through displacement from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

11.4.131 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 30,466 adults based on the 2023 survey (Butcher *et al*., 2023).

11.4.132 The project array area is located 275.50 km from the FFC SPA, which is within the mean max plus 1 SD foraging distance of 509.4 km (Woodward *et al*., 2019) and has therefore been screened in for the breeding bio-season. Notably, despite VE being within mean max plus 1SD foraging distance from the FFC SPA, tracking data from Langstone *et al*. (2013) indicates that gannets from the FFC SPA predominantly forage due east, with no tagged birds heading as far south as the VE array area. The screening in of gannets is therefore considered a precautionary approach.

11.4.133 In the non-breeding bio-season, 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 bio-season, and therefore gannet has also been screened in for the non-breeding bio-season. Gannets recorded during digital aerial surveys are therefore considered to come from a range of breeding colonies in the UK and further afield.

11.4.134 The different bio-seasons for consideration of assessing potential risk from displacement on birds from FFC SPA includes the full breeding bio-season (March to September), the post-breeding migration bio-season (September to November) and the return migration bio-season (December to March), as defined by Furness (2015). Where there is overlap in months within the bio-seasons (e.g. March in full breeding and return migration seasons and September in the full breeding and post-breeding migration seasons) the months were assigned to the full-breeding season. There is no migration free winter bio-season.

BREEDING

11.4.135 In the full breeding bio-season the number of gannets estimated to occur in the array area and 2 km buffer is 233 (233.0) individuals. During the full breeding bio-season, the predicted consequent mortality of birds within the array from displacement (based on 70% displacement, 1% mortality) is estimated at less than two (1.63) individuals within the array area and 2 km buffer are breeding adult birds (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

11.4.136 Following the methodology set out in the Chapter 6, Part 5, Annex 4.15: Apportioning Note, 74.0% of adult gannet within the array are predicted to be breeding birds from FFC SPA, then the consequent displacement mortality is estimated at one (0.99) breeding adult during the full breeding bio-season.

11.4.137 Based on a citation population of 16,938 breeding adults and annual background mortality of 1,372 breeding adults per annum, the addition of one predicted breeding adult mortality would represent a 0.066% increase in baseline mortality during the full breeding bio-season.

11.4.138 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 2023, consisting of 30,466 individuals and an annual background mortality of 2,681 individuals. On this basis, this would represent a 0.037% increase in baseline mortality during the full breeding bio-season.

NON-BREEDING

11.4.139 Outside of the full breeding bio-season the number of gannets estimated to occur in the array area and a 2 km buffer in the return migration bio-season is 67 (67.1) individuals and in the post-breeding migration bio-season is 640 (639.8) individuals.

11.4.140 The total predicted consequent mortality from being displaced is estimated at less than one (0.47) individuals during the return migration bio-season and less than five (4.48) individuals during the post-breeding migration bio-season.

11.4.141 On the basis that 7.19% of the gannets are deemed to be breeding adults from FFC SPA during the return migration (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note) then the consequent mortality from being displaced is estimated at <0.1 (0.03) breeding adult per annum.

11.4.142 During the post-breeding migration bio-season it is considered that 5.44% of all gannets within the array are breeding adults from FFC SPA (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). Therefore, the consequent mortality of adult birds from FFC SPA from being displaced is estimated at less than one (0.24) breeding adult per annum.

11.4.143 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.27) breeding adult per annum. This represents an increase of 0.018% in baseline mortality of the citation population and <0.001% increase using the most recent count.

ANNUAL TOTAL

11.4.144 Across all bio-seasons, the number of gannets estimated to occur in the array area and a 2 km buffer is 940 (939.8) individuals. The total predicted displacement consequent mortality from these birds is estimated at 7 (6.58) individuals per annum. The impact attributed to FFC SPA throughout the operational life of VE is under two (1.51) breeding adult from FFC SPA per annum across all bio-seasons (Table 11.31) Displacement consequent mortalities based on the range advocated by Natural England (60% to 80% displacement, 1% mortality) and the apportioning rate of 74.0% are presented in Table 11.31. Table 11.32 presents the full displacement matrix from 1% mortality and 10% displacement to 100% mortality and 100% displacement.

11.4.145 This prediction of this total consequential additional mortality represents an increase of 0.085% when considering the citation population or an increase of 0.047% when considering the recent colony count across all bio-seasons per annum. This level of impact would be indistinguishable from natural fluctuations in the population. **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 VE alone can be ruled out, subject to natural change, gannet will be maintained as a feature.**

Table 11.31 Range-based displacement mortalities for gannet based on the values advocated by Natural England for both citation population and counts and more recent Carkson *et al*. (2022) SMP population counts.

FFC SPA		Abundance of adults apportioned to SPA (array area plus 2 km buffer)	60% Displacement, 1% Mortality			70% Displacement, 1% Mortality			80% Displacement, 1% Mortality		
			Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Breeding	**North**	68.4	0.42	0.028	0.015	0.49	0.032	0.018	0.56	0.037	0.020
	South	73.0	0.43	0.029	0.017	0.50	0.034	0.019	0.57	0.039	0.022
Post-breeding migration	**North**	21.4	0.12	0.008	0.005	0.14	0.011	0.006	0.17	0.012	0.006
	South	13.4	0.09	0.006	0.003	0.10	0.007	0.003	0.11	0.007	0.004
Return migration	**North**	1.9	0.01	0.001	0.000	0.01	0.001	0.000	0.01	0.001	0.001
	South	2.9	0.01	0.001	0.001	0.02	0.001	0.001	0.02	0.001	0.001
Total		**180.0**	**1.09**	**0.073**	**0.041**	**1.27**	**0.085**	**0.047**	**1.45**	**0.097**	**0.054**

Table 11.32 Displacement matrix for adult gannets attributed to the FFC SPA across all bio-seasons, with values in light green representing the range-based values and dark green representing VE's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0.2	0.4	0.9	1.8	3.6	5.4	7.2	9.1	10.9	12.7	14.5	16.3	18.1
20	0.4	0.7	1.8	3.6	7.2	10.9	14.5	18.1	21.7	25.3	29.0	32.6	36.2
30	0.5	1.1	2.7	5.4	10.9	16.3	21.7	27.2	32.6	38.0	43.4	48.9	54.3
40	0.7	1.4	3.6	7.2	14.5	21.7	29.0	36.2	43.4	50.7	57.9	65.2	72.4
50	0.9	1.8	4.5	9.1	18.1	27.2	36.2	45.3	54.3	63.4	72.4	81.5	90.5
60	1.1	2.2	5.4	10.9	21.7	32.6	43.4	54.3	65.2	76.0	86.9	97.7	108.6
70	1.3	2.5	6.3	12.7	25.3	38.0	50.7	63.4	76.0	88.7	101.4	114.0	126.7
80	1.4	2.9	7.2	14.5	29.0	43.4	57.9	72.4	86.9	101.4	115.8	130.3	144.8
90	1.6	3.3	8.1	16.3	32.6	48.9	65.2	81.5	97.7	114.0	130.3	146.6	162.9
100	1.8	3.6	9.1	18.1	36.2	54.3	72.4	90.5	108.6	126.7	144.8	162.9	181.0

GUILLEMOT (NON-BREEDING)

11.4.146 Guillemot has been screened in for the O&M phase to assess the potential for an AEoI through displacement from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

> Maintain the population of each qualifying feature.

11.4.147 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 149,980 breeding adults based on the most recent 2022 colony count (Clarkson *et al*, 2022).

11.4.148 The VE array area is located 275.50 km from the FFC SPA which is beyond the mean max plus 1 SD foraging distance of 153.7 km (Woodward *et al*., 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, guillemot was screened in for disturbance and displacement within the array area during the non-breeding bio-season defined as August to February by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

NON-BREEDING

11.4.149 In the non-breeding bio-season the number of guillemots estimated to occur in the array area and 2 km buffer is 3,698 (3,698.0) individuals. The total predicted consequent mortality of birds within the array from displacement (based on 50% displacement, 1% mortality) is estimated at less than 19 (18.49) individuals.

11.4.150 On the assumption that 4.41% of these guillemots are deemed to be breeding adults from the FFC during the non-breeding bio-season (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent mortality from being displaced is estimated at less than one (0.82) breeding adult. Displacement consequent mortalities are based on the range advocated by Natural England (30% to 70% displacement, 1% to 10% mortality) (Table 11.36).

11.4.151 Based on a citation population of 83,214 breeding adults and an annual background mortality of 5,076 breeding adults per annum, the addition of less than one predicted breeding adult mortality would represent an increase in baseline mortality of 0.016%.

11.4.152 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 2022, consisting of 149,980 individuals and an annual background mortality of 9,149 individuals. On this basis, this would represent a 0.009% increase in baseline mortality in the nonbreeding bio-season.

11.4.153 **This level of impact would be indistinguishable from natural fluctuations in the population. 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 VE alone can be ruled out, subject to natural change, guillemot will be maintained as a feature in the long term.**

Table 11.33 Displacement matrix for adult guillemot attributed to the FFC SPA across the nonbreeding bio-season, with values in light green representing the range-based values and dark green representing VE's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	2	3	5	7	8	10	11	13	15	16
20	0	1	2	3	7	10	13	16	20	23	26	29	33
30	0	1	2	5	10	15	20	24	29	34	39	44	49
40	1	1	3	7	13	20	26	33	39	46	52	59	65
50	1	2	4	8	16	24	33	41	49	57	65	73	82
60	1	2	5	10	20	29	39	49	59	69	78	88	98
70	1	2	6	11	23	34	46	57	69	80	91	103	114
80	1	3	7	13	26	39	52	65	78	91	104	118	131
90	1	3	7	15	29	44	59	73	88	103	118	132	147
100	2	3	8	16	33	49	65	82	98	114	131	147	163

RAZORBILL (NON-BREEDING)

11.4.154 Razorbill has been screened into the impact assessment of the O&M phase to assess the impacts through displacement from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each qualifying feature.

11.4.155 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 61,346 breeding adults based on the most recent 2022 colony count (Table 11.21).

11.4.156 The VE array area is located 275.50 km from the FFC SPA which is beyond the mean max plus 1 SD foraging distance of 164.6 km (Woodward *et al*., 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, razorbill was screened in for displacement within the array area during the non-breeding bio-season defined by Furness (2015) as August to March including the return-migration from January to March, post-breeding migration from August to October and the migration-free winter from November to December (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

NON-BREEDING

11.4.157 In the non-breeding bio-seasons, the number of razorbills estimated to occur in the array area and 2 km buffer is 757 (756.5) individuals during the return migration, 284 (283.6) during the post-breeding migration, and 1,046 (1046.0) in the migration free winter bio-season. The total predicted consequent mortality of birds within the array area and 2 km buffer from displacement is four (3.8) individuals in the return-migration bio-season, less than two (1.4) individuals in the post-breeding migration bio-season and five (5.2) individuals in the migration-free winter bio-season (based on 50% displacement, 1% mortality).

11.4.158 On the assumption that 3.38% of the razorbills are deemed to be breeding adults from the FFC SPA during the return migration bio-season (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent mortality from being displaced is estimated at less than one (0.13) breeding adult per annum.

11.4.159 During the post-breeding migration bio-season, it is considered that 3.38% of the razorbills are breeding adults from the FFC SPA (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). Therefore, the consequent mortality of adult birds from FFC SPA from being displaced is estimated at <0.1 (0.05) breeding adult per annum.

11.4.160 During the migration-free winter bio-season, it is considered that 0.91% of the razorbills are breeding adults from the FFC SPA (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). Therefore, the consequent mortality of adult birds from FFC SPA from being displaced is estimated at <0.1 (0.05) breeding adult per annum.

11.4.161 This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.22) breeding adults per annum. Displacement consequent mortalities based on the range advocated by Natural England (30% to 70%) are presented in Table 11.27 and Table 11.34.

11.4.162 Based on the citation count of 21,140 breeding adults and a baseline mortality of 2,220 breeding adults per annum, the addition of less than one predicted breeding adult mortality would represent a 0.010% increase in baseline mortality during the non-breeding bio-season.

11.4.163 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 2022, consisting of 61,346 breeding adults and an annual background mortality of 6,441 breeding adults per annum. On this basis, this would represent a 0.004% increase in baseline mortality during the non-breeding bio-season.

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

Table 11.34 Range-based displacement mortalities for razorbill based on the values advocated by Natural England for both citation population and counts and more recent Clarkson *et al*. (2022) SMP population counts.

FFC SPA		Abundance of adults apportioned to SPA (array area plus 2 km buffer)	30% Displacement, 1% Mortality			70% Displacement, 10% Mortality		
			Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Post-breeding	North	4.1	0.01	0.000	0.000	0.29	0.013	0.004
	South	5.5	0.02	0.001	0.000	0.38	0.017	0.006
Migration-free winter	North	6.9	0.02	0.001	0.001	0.48	0.021	0.006
	South	2.7	0.01	0.000	0.000	0.19	0.009	0.003
Return-migration	North	17.0	0.05	0.001	0.001	1.19	0.054	0.018
	South	8.6	0.03	0.001	0.000	0.60	0.027	0.009
Total Non-breeding		**44.7**	**0.13**	**0.006**	**0.002**	**3.13**	**0.141**	**0.049**

Table 11.35 Displacement matrix for adult razorbill attributed to the FFC SPA across the non-breeding bio-season, with values in light green representing the range-based values and dark green representing VE's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	1	1	2	2	3	3	4	4	4
20	0	0	0	1	2	3	4	4	5	6	7	8	9
30	0	0	1	1	3	4	5	7	8	9	11	12	13
40	0	0	1	2	4	5	7	9	11	13	14	16	18
50	0	0	1	2	4	7	9	11	13	16	18	20	22
60	0	1	1	3	5	8	11	13	16	19	21	24	27
70	0	1	2	3	6	9	13	16	19	22	25	28	31
80	0	1	2	4	7	11	14	18	21	25	29	32	36
90	0	1	2	4	8	12	16	20	24	28	32	36	40
100	0	1	2	4	9	13	18	22	27	31	36	40	45

FARNE ISLANDS SPA - DISPLACEMENT

GUILLEMOT (NON-BREEDING)

11.4.165 Guillemot has been screened in for the O&M phase to assess the impacts through displacement from alone in relation to the following conservation objectives for this species, as a feature of the Farne Islands SPA:

> Maintain the population of each qualifying feature.

11.4.166 Based on the above the conservation objective for the Farne Islands 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.

11.4.167 The VE array area is located 275.50 km from the FFC SPA which is beyond the mean max plus 1 SD foraging distance of 153.7 km (Woodward *et al*., 2019) and has therefore been screened out for the breeding bio-season. However, there is non-breeding bio-season connectivity, defined as August to March by Furness (2015). Therefore, guillemot was screened in for disturbance and displacement within the array area during the non-breeding bio-season defined as August to February by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

NON-BREEDING

11.4.168 The displacement matrix in Table 11.37 provides a displacement matrix for the non-breeding bio-season total of guillemots apportioned to the Farne Islands SPA predicted to be at risk of displacement from the VE array area plus 2 km buffer when applying any value of displacement or mortality.

11.4.169 In the non-breeding bio-season the number of guillemots estimated to occur in the array area and 2 km buffer is 3,698 (3,697.98) individuals. The total predicted consequent mortality of birds within the array from displacement (based on 50% displacement, 1% mortality) is estimated at less than 19 (18.49) individuals.

11.4.170 On the assumption that 3.73% of the guillemots are deemed to be breeding adults from the Farne Islands SPA during the non-breeding bio-season (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent mortality from being displaced is estimated at less than one (0.69) breeding adult (Table 11.36).

11.4.171 Displacement consequent mortalities based on the range advocated by Natural England (30% to 70% displacement, 1% to 10% mortality) are presented in Table 11.37. Based on the citation population of 65,750 breeding adults and a baseline mortality of 4,011 breeding adults per annum, the addition of less than one mortality would represent a 0.017% increase in baseline mortality.

11.4.172 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 2017, consisting of 64,042 breeding adults and an annual background mortality of 3,907 breeding adults per annum. On this basis, this would represent a 0.018% increase in baseline mortality in the nonbreeding bio-season.

11.4.173 **This level of impact would be indistinguishable from natural fluctuations in the population. Therefore, the potential for an AEoI to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to disturbance and displacement effects in the O&M phase from VE alone can be ruled out, subject to natural change, guillemot will be maintained as a feature in the long-term.**

Table 11.36 Range-based displacement mortalities for guillemot based on the values advocated by Natural England for both citation population and counts and more recent (Clarkson, 2022; Farne Islands SPA, 2019) SMP population counts.

Site	Abundance of adults apportioned to SPA (array area plus 2 km buffer)	30% Displacement, 1% Mortality			50% Displacement, 1% Mortality			70% Displacement, 10% Mortality		
		Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
FFC SPA	163.2	0.49	0.010	0.005	0.82	0.016	0.009	11.42	0.225	0.125
Farne Islands SPA	138.0	0.41	0.010	0.011	0.69	0.014	0.008	9.66	0.241	0.247

Table 11.37 Displacement matrix for adult guillemots attributed to the Farne Islands SPA across the non-breeding bio-season, with values in light green representing the range-based values and dark green representing VE's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	1	3	4	6	7	8	10	11	12	14
20	0	1	1	3	6	8	11	14	17	19	22	25	28
30	0	1	2	4	8	12	17	21	25	29	33	37	41
40	1	1	3	6	11	17	22	28	33	39	44	50	55
50	1	1	3	7	14	21	28	35	41	48	55	62	69
60	1	2	4	8	17	25	33	41	50	58	66	75	83
70	1	2	5	10	19	29	39	48	58	68	77	87	97
80	1	2	6	11	22	33	44	55	66	77	88	99	110
90	1	2	6	12	25	37	50	62	75	87	99	112	124
100	1	3	7	14	28	41	55	69	83	97	110	124	138

FLAMBOROUGH AND FILEY COAST - COLLISION

GANNET (BREEDING AND NON-BREEDING)

11.4.174 Gannets were screened into the impact assessment for the O&M phase to assess the impacts through collision from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

11.4.175 The specific target for the gannet feature at FFC SPA 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 30,466 adults based on the 2023 survey (Butcher *et al*., 2023).

11.4.176 The VE array area is located at 275.50 km distance from the FFC SPA, which is within mean max plus 1 SD foraging distance of 509.4 km (Woodward *et al*., 2019). Consequently, gannet has been screened in for the breeding bio-season. Notably, despite VE being within mean max plus 1SD foraging distance from the FFC SPA, tracking data from Langstone *et al*. (2013) indicates that gannets from the FFC SPA predominantly forage due east, with no tagged birds heading as far south as the VE array area. The screening in of gannets is therefore considered a precautionary approach.

11.4.177 In the non-breeding bio-season, 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 bio-season, and therefore gannet has also been screened in for the non-breeding bio-season. Gannets recorded during digital aerial surveys are therefore considered to come from a range of breeding colonies in the UK and further afield.

11.4.178 The different bio-seasons for consideration of assessing potential risk from collision on birds from FFC SPA includes the full breeding bio-season (March to September), 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).

BREEDING

11.4.179 The predicted collision mortality from the operation of VE during the breeding bio-season is two (2.0) individuals. Of these two individuals, the proportion considered to represent adult breeding birds is 82%, which equates to a prediction of 1.4 breeding adult mortalities.

11.4.180 Using the agreed approach the assumption is that 74% of these breeding adults are attributed to FFC SPA (as justified above and presented in the Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent collision mortality during the full breeding bio-season is estimated at less than one (0.99) breeding adult.

11.4.181 Based on a citation population of 16,938 breeding adults and a background mortality of 1,372 breeding adults per annum, the addition of less than one breeding adult mortality would represent a 0.066% increase in baseline mortality.

11.4.182 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 2023, which was 30,466 breeding adults and a baseline mortality of 2,681 breeding adults per annum. On this basis, when considering the potential impact of this loss to the FFC SPA, there would be a 0.037% increase in baseline mortality.

11.4.183 All results can be found in Table 11.46.

NON-BREEDING

11.4.184 The predicted collision resultant mortality as a result of the operation of VE in the return migration bio-season is less than one (0.24) individual and in the post-breeding migration bio-season is less than three (2.26) individuals (there is no migration free winter bio-season). Outside of the breeding bio-season, proportion of gannet from the BDMPS populations from FFC SPA during return migration and post-breeding migration bio-seasons were estimated to be 7.19% and 5.44%, respectively (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). The consequent collision mortality attributed to FFC SPA is estimated at less than 0.1 (0.02) breeding adult in the return migration bio-season and less than one (0.12) breeding adult during the post-migration bio-season and therefore less than one (0.14) breeding adult during the entire non-breeding bio-season.

11.4.185 Using this prediction less than one (0.14) breeding adult suffering collision mortality would represent a 0.009% increase in baseline mortality relative to the citation count. Considering the level of impact attributed to the most recent counts, then there would be an increase in 0.006% in baseline mortality.

ANNUAL TOTAL

11.4.186 The potential impact of collision related mortality, that would occur throughout the operational life of VE is predicted at less than two (1.37) breeding adults in the breeding bio-season and less than one (0.14) breeding adult in the non-breeding bio-seasons, this equates to less than two (1.51) breeding adults in total per annum across all bio-seasons. This represents an increase of 0.10% to existing mortality when considering the citation population or an increase of 0.06% when considering the recent colony count across all bio-seasons per annum.

11.4.187 The addition of less than one possible additional breeding adult mortalities per annum equates to less than a 1% increase in baseline mortality, when considering either the citation or the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the baseline mortality rate of breeding adults from this population per annum. **Therefore, the potential for an AEoI to the conservation objectives of the gannet feature of the FFC SPA in relation to collision mortality effects in the O&M phase from VE alone can be ruled out, subject to natural change, gannet will be maintained as a feature in the long term.**

Table 11.38 Collision Risk Impacts for gannet.

FFC SPA		Collision Risk - Project Approach & Natural England Approach		
		Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Breeding	North	0.46	0.031	0.017
	South	0.90	0.061	0.033
Post-breeding migration	North	0.05	0.003	0.002
	South	0.07	0.004	0.002
Return migration	North	<0.01	<0.001	<0.001
	South	0.01	<0.001	<0.001
Total		1.51	0.10	0.06

KITTIWAKE (NON-BREEDING)

11.4.188 Kittiwakes were screened into the impact assessment for the O&M phase to assess the impacts through collision from VE alone in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

> Maintain or restore the population of each of the qualifying features.

11.4.189 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 or retore the size of the breeding population at a level which is above 44,520 breeding pairs (89,040 breeding adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest mean count is 89,148 adults (Clarkson *et al*., 2022).

11.4.190 The VE array area is located 275.50 km from the FFC SPA, which is considerably beyond the mean foraging range for this species but within the mean max plus 1 SD foraging distance of 300.6 km (Woodward *et al*., 2019). Although the VE array is within the mean-maximum foraging range of kittiwake from FFC SPA, low numbers of kittiwake were detected within the array. In addition, there is clear evidence from two datasets presented in Cleasby *et al*. (2020) that breeding kittiwake do not make foraging trips as far south as the VE array, with birds instead utilising foraging grounds within closer proximity to the FFC SPA. It is therefore considered that those kittiwakes detected within the array during the breeding bio-season are highly unlikely to be breeding birds from FFC SPA. Consequently, kittiwake has been screened in for the non-breeding bio-season only as agreed with Natural England during the evidence plan, including the post-breeding migration of August and December and the return migration bio-season of January to April (Furness, 2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

NON-BREEDING

11.4.191 The predicted collision resultant mortality as a result of the O&M of VE in the return migration bio-season is six (5.51) individuals and in the post-breeding migration bio-season is eight (7.88) individuals. Outside of the breeding bio-season, the proportions of kittiwake from the BDMPS population from the FFC SPA in the return migration and post-breeding migration bio-seasons were estimated to be 7.19% and 5.44% respectively (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). The consequent collision mortality is estimated at less than one (0.40) adult in the return migration bio-season, and less than one (0.43) bird during the post-breeding bio-season, equating to 1 (0.82) adult throughout the entire non-breeding bio-season.

11.4.192 Based on a citation population of 89,040 breeding adults, and a background mortality of 13,000 breeding adults per annum, the addition of 1 (0.82) mortality during the non-breeding bio-season attributed to the SPA represents an increase 0.006% in baseline mortality based on the citation population.

11.4.193 As the population of kittiwakes 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, which was 89,148 breeding adults and a baseline mortality of 13,015 breeding adults per annum. On this basis, when considering the potential impact of this loss to the FFC SPA, there would be a 0.006% increase in baseline mortality.

11.4.194 The addition of one additional adult mortality in the non-breeding equates to less than 1% (0.006%) increase in baseline mortality, when considering either the citation or the latest colony count. Considering the level of impact is <0.01% increase in baseline mortality it would be indistinguishable from natural fluctuations in the baseline mortality rate of breeding adults from this population per annum and is considered to be no material contribution to the natural baseline mortality rates of the colony.

11.4.195 **Therefore, the potential for an AEoI to the conservation objectives of the kittiwake feature of the Flamborough and Filey Coast SPA in relation to collision mortality effects in the O&M phase from VE alone can be ruled out, subject to natural change, the kittiwake population at the FFC SPA will continue to be restored and be maintained as a feature in the long-term.**

ALDE ORE ESTUARY SPA AND RAMSAR - COLLISION

11.4.196 The Alde-Ore Estuary (AOE) was listed as a Ramsar site in October 1996 and the site was classified as an SPA in August 1998. Both the SPA and Ramsar site share the same boundary as the AOE SSSI which was notified in 1952.

11.4.197 The AOE SPA has several important habitats within the site which attracts notable assemblages of wetland birds including seabirds, wildfowl and waders. The AOE qualifies as a SPA under Article 4.1 of the Birds Directive (79/409/EEC) by regularly supporting populations of Annex 1 species of European importance: breeding populations of little tern, marsh harrier, Sandwich tern and avocet. It also qualifies under Article 4.2 of the Birds Directive by supporting two Annex II species, a wintering population of redshank and a breeding population of lesser black-backed gull. Further Article 4.2 qualifying features were added in 2001 following a review: breeding seabird assemblage of international importance (at least 20,000 seabirds) and a wintering waterbird assemblage of international importance (at least 20,000 waterbirds.

11.4.198 The designation of lesser black-backed gull was based on a breeding population of 14,074 pairs.

- The conservation objectives of the site include:
- Avoid the deterioration of the habitats of the qualifying features,
  - Subject to natural change, to maintain or restore, for each qualifying feature:
  - 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 populations of the qualifying features;
  - The distribution of the qualifying features within the site.

LESSER BLACK-BACKED GULL (BREEDING)

STATUS AND ECOLOGY

11.4.199 The lesser black-backed gull is mainly a coastal breeder in England, breeding in large numbers and can be found breeding in urban sites and some inland sites also (Mitchell *et al*, 2004). Historically it was a summer visitor, with most birds wintering in southern Europe or north and northwest Africa (Wernham , 2002). In recent decades an increasing number of lesser black-backed gulls have started overwintering in the southern North Sea (Wernham , 2002).

11.4.200 Lesser black-backed gulls forage both inland and at sea with the habitat use varying throughout the year with greater use of inland foraging at the beginning and end of the breeding season and peak foraging at sea during chick rearing (Thaxter *et al*, 2015). Lesser black-backed gulls are prone to flying at heights that make them vulnerable to collision with turbine blades (Ross-Smith *et al*, 2016). Thaxter *et al* (2018) found through tracking data that they have high levels of meso-avoidance of turbines but show little in the way of macro-avoidance of the windfarms themselves.

11.4.201 The AOE SPA lesser black-backed gull colony has suffered a major decline since the designation of the site. The peak was 23,000 pairs in 2000 at Orfordness with a further 400 pairs at Havergate Island (BTO, 2023) with the most recent counts from the SMP database reporting 1,524 pairs at Havergate Island in 2023 (peak of 2,399 pairs in 2015) and 225 pairs at Orfordness in 2022 based on recent monitoring (Galloper, 2022).

11.4.202 Lesser black-backed gulls were screened into the impact assessment for the O&M phase to assess the impacts through collision from VE alone in relation to the following conservation objectives for this species, as a feature of the Alde-Ore Estuary SPA:

- Maintain or restore the population of each of the qualifying features.

11.4.203 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):

- Restore the size of the breeding population to a level which is above 14,070 pairs whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

11.4.204 The VE array area is located at 37.44 km distance from Alde-Ore Estuary SPA and Ramsar, which is within the mean max plus 1 SD foraging distance of 236 km (Woodward *et al*., 2019). Consequently, lesser black-backed gull has been screened in for the breeding and non-breeding bio-seasons. The different bio-seasons for consideration of assessing potential risk from displacement on birds from the sites includes the full breeding bio-season from April to August, migration-free winter bio-season from November to February, post-breeding migration from August to October and the return migration bio-season, defined as March to April by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note).

11.4.205 With regards to potential impacts on the Alde-Ore Estuary SPA, it is likely that breeding lesser black-backed gulls will mix with both breeding and non-breeding birds from a variety of sources (e.g. non-SPA colonies in East Anglia), and so proposed impacts will in reality relate to a mixture of breeding birds from Alde-Ore Estuary SPA, breeding birds from non-SPA colonies and immatures/nonbreeders from many different sources.

11.4.206 The apportioning considers several large local colonies from non-SPA sites, in line with the approach used by East Anglia One North and East Anglia TWO (MacArthur Green *et al*, 2020). Rock (2021) found that the Felixstowe port and town population was estimated at 1,572 pairs, while MacArthur Green *et al* (2020) used further local urban colony numbers, 250 pairs at Ipswich, 2,000 pairs at Lowestoft and 1,200 pairs at Great Yarmouth and Southtown. Other colonies within nearby SPAs at Hamford Water (600 pairs) and Outer Trial Bank (1,300 pairs) were also used. The 1,767 pairs found at AOE SPA equates to just 20% of the East Anglian population based on these figures.

11.4.207 Thaxter *et al*. (2012, 2015) tracking data of breeding adult lesser black-backed gulls at the Alde-Ore Estuary SPA found that the feeding habitat used by the birds differed both between and within seasons. During chick rearing stage of breeding the birds mainly foraged out to sea suggesting that this stage of the breeding season is the most likely time there would be connectivity with VE OWF. Other times during the breeding season foraging occurred in more terrestrial and coastal locations.

11.4.208 Recent tracking data (Green *et al*, 2023) found that there was connectivity with the tagged birds from AOE SPA and the VE array although the connectivity was generally low and the most recent years data (2020) found that 63% (N=12) of the tagged birds had no interaction with VE and the other 37% (N=7) had a low interaction with VE.

11.4.209 Colonies in the Netherlands were considered in regard to connectivity to the Project as they were within the mean max plus 1 SD foraging distance however colour ringing and tracking projects from several colonies in the Netherlands showed there was little or no connectivity between birds in the breeding season in Dutch colonies and the UK, and during migration and winter there was also very little connectivity (Camphuysen, 2013). Tracking data between 2008 and 2011 found that 95% of foraging trips from Dutch colonies were within 60.5 km of the colony (Camphuysen, 2015). Following discussions with Natural England and using the data from the Dutch colonies it was agreed that the birds from Dutch colonies would be very unlikely to reach VE OWF and not included in the apportioning.

11.4.210 During the breeding season it is likely that the adult lesser black-backed gull at the VE site will breed at AOE SPA and other non-SPA urban colonies in East Anglia highlighted above. These birds are likely to be mixed with non-breeding adults and immature birds from various locations.

11.4.211 The approach to apportioning impacts to SPAs has been detailed in a separate document, Chapter 6, Part 5, Annex 4.15: Apportioning Note. Following discussions from Natural England all Dutch colonies were omitted from any apportioning.

BREEDING

11.4.212 Apportioning of adults will be represented in two different ways in Chapter 6, Part 5, Annex 4.15: Apportioning Note:

- The Project's approach used adult proportions found in Furness (2015) with a sabbatical rate of 0.35 applied, which equates to a breeding adult proportion of 0.39.
- The Natural England preferred approach using site specific adult proportions supplied from the DAS data, giving an adult proportion of 0.79.

11.4.213 The predicted collision mortality from the operation of VE in the full breeding bio-season is 36 (35.10) individuals. Of these 36 individuals, the proportion considered to represent adult breeding birds is 39%, which equates to a prediction of 14 (13.69) breeding adult mortalities when sabbaticals are excluded using the Project's preferred approach.

11.4.214 On the assumption that 40.0% of all breeding adults are predicted to be attributed to Alde-Ore Estuary SPA (as justified above and presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note), then the consequent collision mortality during the full-breeding bio-season is estimated at six (5.48) breeding adult mortalities when sabbaticals are excluded using the Project's preferred approach.

11.4.215 Based on a citation population of 28,140 breeding adults, and a baseline mortality of 3,236 breeding adults per annum, the addition of six (5.48) breeding adult collision mortalities would represent a 0.169% increase in baseline mortality.

11.4.216 Table 11.39 presents the mortality rates for both approaches discussed above.

11.4.217 As the population of lesser black-backed gulls has changed since the citation population count the potential impact on the population is more reasonably assessed against the latest population count undertaken in 2022/23, which was 3,498 breeding adults and a baseline mortality of 402 (402.3) breeding adults. On this basis, when considering the potential impact of this loss to the Alde-Ore Estuary SPA and Ramsar there would be a 1.231% increase in baseline mortality when using the Project's preferred approach (Table 11.39).

Table 11.39 Adult mortality rates and increases in baseline mortality for the AOE SPA during the breeding season for both the Project's and Natural England's preferred approaches.

	Project approach			Natural England preferred approach		
Alde-Ore Estuary Breeding	Adult mortality apportioned to SPA (Furness excluding sabbaticals)	Increase in baseline mortality Citation (%)	Increase in baseline mortality SMP (%)	Site Specific adult proportions (NE)	Increase in baseline mortality Citation (%)	Increase in baseline mortality SMP (%)
North	3.69	0.114	0.844	7.48	0.231	1.860
South	1.78	0.055	0.387	3.61	0.112	0.897
Total	5.48	0.169	1.231	11.09	0.343	2.757

NON-BREEDING

11.4.218 The predicted collision resultant mortality from the operation of VE in the migration-free winter bio-season is less than three (2.49) individuals, post-breeding migration is less than three (2.16) individuals, and the return migration bio-season is less than one (0.82) individual. Outside of the breeding bio-season, the proportion of lesser black-backed gull breeding adults within the BDMPS population from the Alde-Ore Estuary SPA and Ramsar during the return migration, post-breeding migration, and migration-free winter were estimated to be 3.33%, 3.33%, and 4.92% respectively (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). The consequent collision mortality is estimated at less <0.1 (0.12) adult in the migration-free winter bio-season, post-breeding migration is <0.1 (0.07) and the return migration bio-season is <0.1 (0.03) individual, equating to less than one (0.2) adult during the non-breeding bio-season. (Table 11.48).

11.4.219 Using this prediction of less than one (0.22) breeding adults suffering collision mortality would represent a 0.007% increase in baseline mortality relative the citation count. Considering the level of impact attributed to the most recent counts then there would be an increase in 0.055% in baseline mortality.

Table 11.40 Adult mortality rates and increases in baseline mortality for the Ale-Ore Estuary SPA during the non-breeding seasons.

Alde-Ore non-breeding		SPA adult breeding population as a percentage of the relevant BDMPS region (using Furness)	Adult mortality attributed to SPA	Citation Count (breeding adults)	Adult background mortality	Increase in baseline mortality CITATION (%)	SMP Count (breeding adults)	Adult background mortality	Increase in baseline mortality SMP (%)
Autumn	North	0.01	0.02	28,140	3236.1	0.000	3,534	406.41	0.004
	South	0.03	0.06			0.002			0.014
Winter	North	0.01	0.02	28,140	3236.1	0.001	3,534	406.41	0.005
	South	0.04	0.11			0.003			0.028
Spring	North	0.00	0.00	28,140	3236.1	0.000	3,534	406.41	0.000
	South	0.03	0.03			0.001			0.007

ANNUAL TOTAL

11.4.220 The potential impact of collision related mortality that would occur per annum throughout the operational life of VE is estimated at six to twelve (5.48 to 11.09) breeding adults in the breeding bio-season and less than one (0.22) breeding adults in the non-breeding bio-season, equating to a range of six to twelve (5.70 to 11.31) breeding adult birds in total per annum across all bio-seasons. This represents a range in the increase in baseline mortality of 0.176% to 0.350% when considering the citation population or an increase of 1.417% to 2.813% when considering the recent colony count across all bio-seasons per annum.

11.4.221 As the predicted impacts exceed a 1% increase in baseline mortality for the most recent population count, further analysis in the form of PVA has been undertaken.

11.4.222 PVA was undertaken on a range of scenarios for both the VE alone and in-combination with other projects (as presented in Table 11.34). For each scenario, counterfactual of population growth (CGR) and counterfactual of population size (CPS) have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period of 40 years relative to a baseline scenario. The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2022/23 Alde-Ore Estuary SPA count).

Table 11.41 Outputs from PVA analysis for Project Alone annual impacts on lesser black-backed gulls from AOE SPA.

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Project alone (VE approach)	5.70	0.002	0.998	0.925
Project alone (NE approach)	11.31	0.003	0.996	0.859

11.4.223 The population of lesser black-backed gulls at the Ale-Ore Estuary SPA, has experienced substantial declines in the last 25 years, with the population declining from a peak-mean population of 14,070 pairs between 1994-1997 to approximately 1,750 pairs at the recent 2022 count, largely driven by fox predation, flooding and poor habitat quality.

11.4.224 Considering the PVA results, the worst case scenario of 11 mortalities (Natural England approach to apportioning) would represent only a 0.4% reduction in annual population growth rate, and 0.2% based on the VE approach to apportioning. Annual variations in the colony population already exceed 0.2% so the reduction in annual population growth rate based on the VE approach, the impacts resulting from VE are therefore expected to be indistinguishable from natural fluctuations in the population regardless of recent population declines. This also applies to the 0.4% reduction when using the Natural England approach to apportioning.

11.4.225 **Based on these conclusions, the project alone impact of six lesser black-backed gull will not have an adverse effect from VE alone on the integrity of the Alde-Ore SPA in terms of the conservation objectives for lesser black-backed gull.**

MIGRATORY WATERBIRDS

11.4.226 During the O&M phase of VE, the presence of turbines has the potential to create a barrier to the movement of waterbirds migrating down the North Sea. Notably, the project may impact birds migrating north to the SPA during spring migrations, and the following southward migration during autumn. Unlike seabirds, most waterbirds are unable to rest or forage at sea during migrations and are therefore required to undertake the migration in a single flight. The presence of VE has the potential to cause migrating birds to divert their flight path around the OWF, increasing the energy demand.

11.4.227 Migratory birds may pass windfarms during their migrations; however, the impact is vastly different to species that may come into contact with windfarms daily (e.g., central place foragers during the breeding season). Migratory species are consequently less at risk from adverse impacts caused by the "barrier effect". The costs of one-off avoidances during migration are trivial, accounting for less than 2% of available fat reserves (Masden *et al*., 2009).

11.4.228 It is noted that most migratory non-seabirds fly at heights well above the maximum turbine blade height (Alerstam, 1990), and therefore the risk is considered minimal since birds are likely to fly over the site instead of diverting their path around it. However, mCRM has been undertaken on the above species as a precautionary approach (ES, Volume 6, Part 5, Annex 4.14: Migratory Collision Risk Modelling).

11.4.229 Migratory waterbird and tern species have been screened in for the assessment of O&M phase to assess the potential impact from collision during migration. The site-specific DAS conducted in the VE array area plus buffer provide a robust abundance and density for seabirds however there are limitations when it comes to birds in the area during migration. There are various reasons for this, the birds may move through in poor weather, at night or in short time periods outwith the DAS. Due to the potential for underestimating the number of migratory birds passing the array area a migratory bird collision assessment was undertaken using APEMs bespoke MigroPath tool, which is supported by Natural England (Parker *et al*., 2022c). The tool models the likelihood of bird passage through a given area using the positions of relevant SPA's, staging grounds and species populations.

11.4.230 All species that have <1% proportion of the UK population at risk of collision within the VE array area were screened out, as presented in the annex: Chapter 6, Part 5, Annex 14.4: Migratory Bird Collision Risk Modelling.

11.4.231 MigroPath calculates the predicted impacts based on the UK populations which are then assigned to one or a few specific SPAs. To be more reflective of the true numbers the predicted impacts have been apportioned to each SPA based on the UK wide populations at SPAs. The apportioned impact to each SPA is then used to calculate the increase in baseline mortality for each species at the impacted SPA (Table 11.42).

11.4.232 Table 11.42 presents the results, when apportioning predicted impacts to the population protected by the UK SPA suite, impacts are reduced substantially, and to a level below 1% of baseline mortality.

11.4.233 MigroPath also assumes that all individuals within the population migrate, which in some cases (wintering geese and other wildfowl) is correct however, in many cases the species are sedentary or partial migrants.

11.4.234 Bittern should be treated similarly, as male bitterns are largely sedentary and females are only partial migrants. As such, the number of collisions predicted for this species by MigroPath will also be an overestimate.

11.4.235 Another note of caution regarding the results from MigroPath is that the tool assumes that the majority of species fly at the rotor height 100% of the time. Of the species assessed only dark-bellied brent goose (50%) was assessed at a rate lower than 100% flying at rotor height. Wildfowl and waders especially often fly at low levels when migrating, more often a few metres above the sea, therefore the predicted impacts for dark-bellied brent goose, white-fronted goose, gadwall, teal, shoveler, redshank, avocet, black-tailed godwit, dunlin, grey plover, knot, pochard, pintail, ringed plover, shelduck and ruff are likely to be vastly over estimated.

11.4.236 **Considering the highly precautionary nature of the outputs of the MigroPath analyses, impacts to migrating birds at the four scoped in SPA's can be considered to be minimal and make no material contribution to any changes in population or baseline mortality.**

Table 11.42 Predicted Impacts (MigroPath) and Increase in baseline mortality comparisons: selected SPA citations apportioned to UK SPA populations.

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Alde-Ore Estuary	Avocet	766	2.89	6,369	0.35	0.21
Alde-Ore Estuary	Redshank (*Robustica*)	1,919	8.35	46,548	0.34	0.07
Alde-Ore Estuary	Redshank (*Totanus*)	1,919	8.35	46,548	0.34	0.07
Alde-Ore Estuary	Ruff	3	0.05	242	<0.01	0.04
Deben Estuary	Avocet	95	2.89	6,369	0.04	0.21
Deben Estuary	Dark-bellied brent goose	2,516	14.78	73,532	0.50	0.20
Minsmere - Walberswick	Avocet	47	2.89	6,369	0.02	0.21
Minsmere - Walberswick	Bittern	14	0.09	90	0.01	0.33
Minsmere - Walberswick	Gadwall (breeding)	48	0.45	296	0.07	0.54

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Minsmere - Walberswick	Gadwall (wintering)	93	2.18	5,076	0.04	0.15
Minsmere - Walberswick	Hen harrier	15	0.10	249	0.01	0.21
Minsmere - Walberswick	Nightjar	48	0.49	2,124	0.01	0.08
Minsmere - Walberswick	Shoveler (wintering)	98	2.18	4,659	0.04	0.11
Minsmere - Walberswick	Teal (breeding)	146	0.52	N/A	N/A	N/A
Minsmere - Walberswick	White-fronted goose	67	0.36	1,547	0.02	0.08
OTE	Red-throated diver	6,466	0.19	7,475	0.16	0.02
Hamford Water	Avocet	317	2.89	6,369	0.14	0.20
Hamford Water	Black-tailed godwit	1,121	4.56	28,999	0.18	0.26
Hamford Water	Dark-bellied brent goose	6,892	14.78	73,532	1.38	0.20

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Hamford Water	Grey plover	3,251	2.14	35,931	0.19	0.04
Hamford Water	Redshank	1,461	8.35	46,548	0.26	0.07
Hamford Water	Ringed plover	520	2.45	4,206	0.30	0.25
Hamford Water	Shelduck	1,629	3.55	42,926	0.13	0.07
Hamford Water	Teal	3,631	23.96	73,809	1.18	0.07
Stour and Orwell Estuaries	Black-tailed godwit	2,559	4.56	28,999	0.40	0.26
Stour and Orwell Estuaries	Dark-bellied brent goose	2,627	14.78	73,532	0.53	0.09
Stour and Orwell Estuaries	Dunlin	19,114	19.93	297,892	1.28	0.03
Stour and Orwell Estuaries	Grey plover	3,261	2.14	35,931	0.19	0.04

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Stour and Orwell Estuaries	Knot	5,970	14.77	282,859	0.31	0.03
Stour and Orwell Estuaries	Pintail	741	0.80	16,883	0.04	0.01
Stour and Orwell Estuaries	Redshank	3,687	8.35	46,548	0.66	0.07
Colne Estuary (Mid-Essex Coast Phase 2)	Dark-bellied brent goose	4,907	14.78	73,532	0.99	0.09
Colne Estuary (Mid-Essex Coast Phase 2)	Pochard (breeding)	30	2.14	4,284	0.01	0.14
Colne Estuary (Mid-Essex Coast Phase 2)	Redshank	2,077	8.35	46,548	0.37	0.07
Colne Estuary (Mid-Essex Coast Phase 2)	Ringed plover (breeding)	270	2.45	4,206	0.16	0.25

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Blackwater Estuary (Mid-Essex Coast Phase 4	Black-tailed godwit	1,280	4.56	28,999	0.20	0.26
Blackwater Estuary (Mid-Essex Coast Phase 4	Dark-bellied brent goose	15,392	14.78	73,532	3.09	0.09
Blackwater Estuary (Mid-Essex Coast Phase 4	Dunlin	33,267	19.93	297,892	2.22	0.26
Blackwater Estuary (Mid-Essex Coast Phase 4	Grey plover	5,090	2.14	35,931	0.30	0.04
Dengie (Mid-Essex Coast Phase 1)	Dark-bellied brent goose	2,308	14.78	73,532	0.46	0.09
Dengie (Mid-Essex Coast Phase 1)	Grey plover	2,411	2.14	35,931	0.14	0.04

SPA	Feature	SPA citation count	Predicted Impact (MigroPath) (98%)	UK SPA population	Apportioned impacts to SPA	% increase in baseline mortality
Dengie (Mid-Essex Coast Phase 1)	Knot	8,393	14.77	282,859	0.44	0.03

MIGRATORY SEABIRDS

11.4.237 The use of Migropath is not suitable for all species, in particular species which do not follow a point-to-point migration pattern (Alerstam, 1990). Many seabirds fall into this category (Wernham, 2002), with some seabirds known to take longer routes, for example following the coastline in preference to a more direct route over land. For such species, a 'broad front' pathway might better describe the movements that these birds are making within the North Sea. The risk to the population caused by the presence of the VE development, relates to the proportion of the 'broad front' pathway crossing the VE array area.

11.4.238 This method is based on a basic calculation utilising species-specific information on population estimates and migration behaviour derived from desk-based study, with the key findings summarised in Section 11.4.179. The method used to calculate 'broad front' migration follows a stepwise methodology outlined below:

- Identify the population of birds undertaking the 'broad front' migration;
- Identify the width of the 'broad front' based on the migratory pathway or corridor that is being used;
- Calculate the proportion of the 'broad front' occupied by the VE array area perpendicular to the direction of flight;
- Where possible, identify if there is any skewed distribution of birds within the 'broad front' such as a preference to fly along the coast; and
- Calculate the numbers of birds flying across the array area based on the proportion of the 'broad front' occupied by the array area factoring in any skewed migratory distribution.

11.4.239 To ensure the estimates are precautionary, the 'broad front' corridor is assumed to extend from the UK coast to the edge of the UK waters boundary, where populations have been based on the same assumed corridor. This represents the width intersecting the array area perpendicular to birds migrating in a North/South flight pattern and was measured as being 183 km. The width of the array area within that corridor is calculated to be 17.7 km based on the maximum design scenario. This is the widest point across the array area and when presuming an even distribution of birds migrating within the 'broad front' represents the worst-case scenario for collision risk.

11.4.240 The total number of bird species determined to be required to be screened in for 'broad front' modelling was two seabirds. These were: common tern and little tern (Table 11.43).

Table 11.43 Predicted annual collision rate for migratory terns using Broadfront method.

SPA	Species	Avoidance Rate (%)	Annual Collision Rate (MigroPath) (98%)	Apportioned Collision Rate (98%)	% of citation count (98%)
Alde-Ore Estuary	Little tern	98.0	0.02	0.00	0.00
OTE	Little tern	98.0	0.02	0.04	0.00
Minsmere-Walberswick	Little tern	98.0	0.02	0.00	0.00
Hamford Water	Little tern	98.0	0.02	0.01	0.00
Thanet Coast and Sandwich Bay	Little tern	98.0	0.02	0.00	0.00
OTE	Common tern	98.0	0.69	4.28	0.80

11.4.241 Only one common tern was recorded during the 12 months of DAS data collected. Common tern migration undertaken by WWT and MacArthur Green (2013) concluded that the majority of UK common terns migrate within 10 km of the UK coastline based on observations from coastal watches and offshore surveys. The estimated impact is less than 1% of the citation count for the OTE SPA (Table 11.43), **therefore any AOEI can be ruled out.**

11.4.242 No little terns were recorded on the 12 months of DAS. A study carried out by WWT and MacArthur Green (2014) found that the majority of little tern migration tracks are between 0 to 10 km from the coastlines. The estimated impact is less than 1% of the citation count for all SPAs assessed (Table 11.43), **therefore any AOEI can be ruled out.**

11.5 MIGRATORY FISH

ASSESSMENT SUMMARY

11.5.1 Table 9.1 presents the site and the associated impacts with the potential to cause LSE on migratory fish features as identified in the HRA screening process.

11.5.2 The potential for an AEoI was only identified for migratory fish in relation to underwater noise during construction, with no impacts during operation or maintenance. Impacts as a result of an increase in underwater noise on migratory fish during construction is the only potential impact screened in, and it relates to the following designated site and the relevant feature (i.e., the feature screened in for potential LSE):

- Vlaamse Banken SAC (twaite shad).

11.5.3 This assessment of AEoI is presented as follows:

- Assessment Criteria (a summary of the approach to the assessment);
- Description of Significance (a detailed description of the potential effects and their relevance to the migratory fish receptor group, including);
  - An introduction to underwater noise sources relevant to this assessment;
  - The relevant MDS;
  - Details on the specific impacts of underwater noise on migratory fish receptors; and
  - The mitigation of relevance.
  - The full assessment considered for the Vlaamse Banken SAC.

ASSESSMENT CRIERIA

11.5.4 A range of effects were identified for migratory fish, as described within Table 9.1. Of the effects to be considered, underwater noise is the most complex and additional information is provided below for context. For full detail see ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.

11.5.5 Underwater noise can potentially have a negative impact on migratory fish species ranging from behavioural effects to physical injury/ mortality. Biological damage as a result of sound energy 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., high-order UXO clearance or a single strike of a piling hammer). However, when considering injury due to the energy of an exposure, the time of the exposure also becomes important.

11.5.6 To inform the assessment of impacts associated with underwater noise that are considered to have the potential to cause LSE (i.e., as a result of piling, sheet piling and high-order UXO clearance), predictive underwater noise modelling has been undertaken for the relevant piling MDS. Full details of the predictive underwater noise modelling are presented in ES Volume 4, Annex 6.2 Underwater Noise Technical Report and it forms the basis for the assessments in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which this assessment draws upon.

11.5.7 The assessment of the potential underwater noise impacts associated with high-order UXO clearance presented here is based on the high-level consideration is provided in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. That assessment is limited due to the fact that high-order UXO clearance will be consented under a separate Marine License (post-consent) and will therefore not be consented under the DCO.

11.5.8 Predictive underwater noise modelling for the piling of cofferdams is based on the modelling outputs and assessment presented within the ES.

11.5.9 In ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; Valued Ecological Receptors (VERs) have been grouped into the Popper *et al*. (2014) categories based on their hearing system. The only migratory fish feature assessed in this RIAA is twaite shad which is considered to be in Group 3 (the most sensitive hearing category). Hearing in fish in Group 3 involves a swim bladder or other gas volume which makes them primarily sensitive to sound pressure (Popper, 2014).

11.5.10 Table 11.44 presents the impact threshold criteria from Popper *et al*. (2014) which is used in the assessment of the risk of mortality and potential injury, recoverable injury and TTS for twaite shad (Group 3 receptor).

Table 11.44 Impact Threshold Criteria for Group 3 species from Popper *et al*. (2014).

Fish hearing category (and relevant feature)	Impact Threshold Noise Level (dB re 1 µPA Sound Exposure Level (SEL)/dB re 1 µPA^2 Sound Exposure Level (SEL))		
	Mortality and Potential Injury	Recoverable Injury	TTS
Group 3 (twaite shad)	207 dB SEL_{cum} 207 dB SPL_{peak}	203 dB SEL_{cum} 207 dB SPL_{peak}	186 dB SEL_{cum}

11.5.11 With regard to assessments of noise-induced behavioural changes, there are no quantitative thresholds advised to be used; 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.

11.5.12 Using this information, the assessment for twaite shad contained in this RIAA draws on the conclusions presented in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; which determines the significance of the underwater noise effect via a two-stage process that involves defining the sensitivity of the feature and the magnitude of the impact.

11.5.13 For clarity, the sensitivity of the feature assessed in both ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; and here is defined by:

- Its potential vulnerability to an impact which is based on its ability to accommodate a temporary or permanent change, and its mobility. Mobility in the sense of having the ability to flee from an impact.

- Its recoverability which is defined as the extent and rate at which it will recover following an impact, i.e., its ability to return/recolonise an area after an impact, or for normal behaviours to resume.

11.5.14 Further, the approach taken in the assessment of migratory fish in the RIAA is strongly linked to the following points:

- The distance between the array boundary / ECC and the relevant designated sites;
- The effects screened in for LSE; and
- Relevant mitigation, as identified below.

11.5.15 For the RIAA, not only does the assessment of potential for adverse effect draw on the conclusions of the ES but specifically assesses against the relevant conservation objectives (as adopted from Severn Estuary SAC in the absence of specific conservation objectives for Vlaamse Banken) in the context of the designated feature. Where possible, parameters are quantified, and predicted changes presented. The final assessment for each effect is based upon expert judgement.

DESCRIPTION OF SIGNIFICANCE

11.5.16 A description of the significance of the project level effect upon the only receptor grouped under 'migratory fish', as relevant to the designated site and its associated feature screened in for potential LSE, is provided below.

CONSTRUCTION AND DECOMMISSIONING

UNDERWATER NOISE

11.5.17 The following assessment is in relation to the potential for effects of underwater noise during construction only. The Screening Report determined that the potential for LSE in relation to underwater noise during decommissioning would be similar to and potentially less than those outlined in the construction phase. Therefore, potential for effect during decommissioning would fall within, and be no worse than, the degree of effect during construction, with any such decommissioning being subject to the relevant licensing requirements at that time.

11.5.18 As detailed in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, there are several sources of underwater noise associated with the project alone during construction. These can be broadly characterised as:

- Underwater noise from foundation installation (e.g., piling);
- Underwater noise from general seabed clearance, cable installation (including HDD and cofferdam installation) and vessel operations; and
- Underwater noise from UXO specific seabed clearance.

11.5.19 The extent to which unmitigated intense underwater sound might cause an adverse environmental impact in a particular fish species is dependent upon the level of sound pressure, 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.

11.5.20 The potential for mortality or mortal injury is likely to only occur in close proximity to the sound source (within <100 m), 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. 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.

11.5.21 Temporary Threshold Shift (TTS) is a temporary reduction in hearing 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.

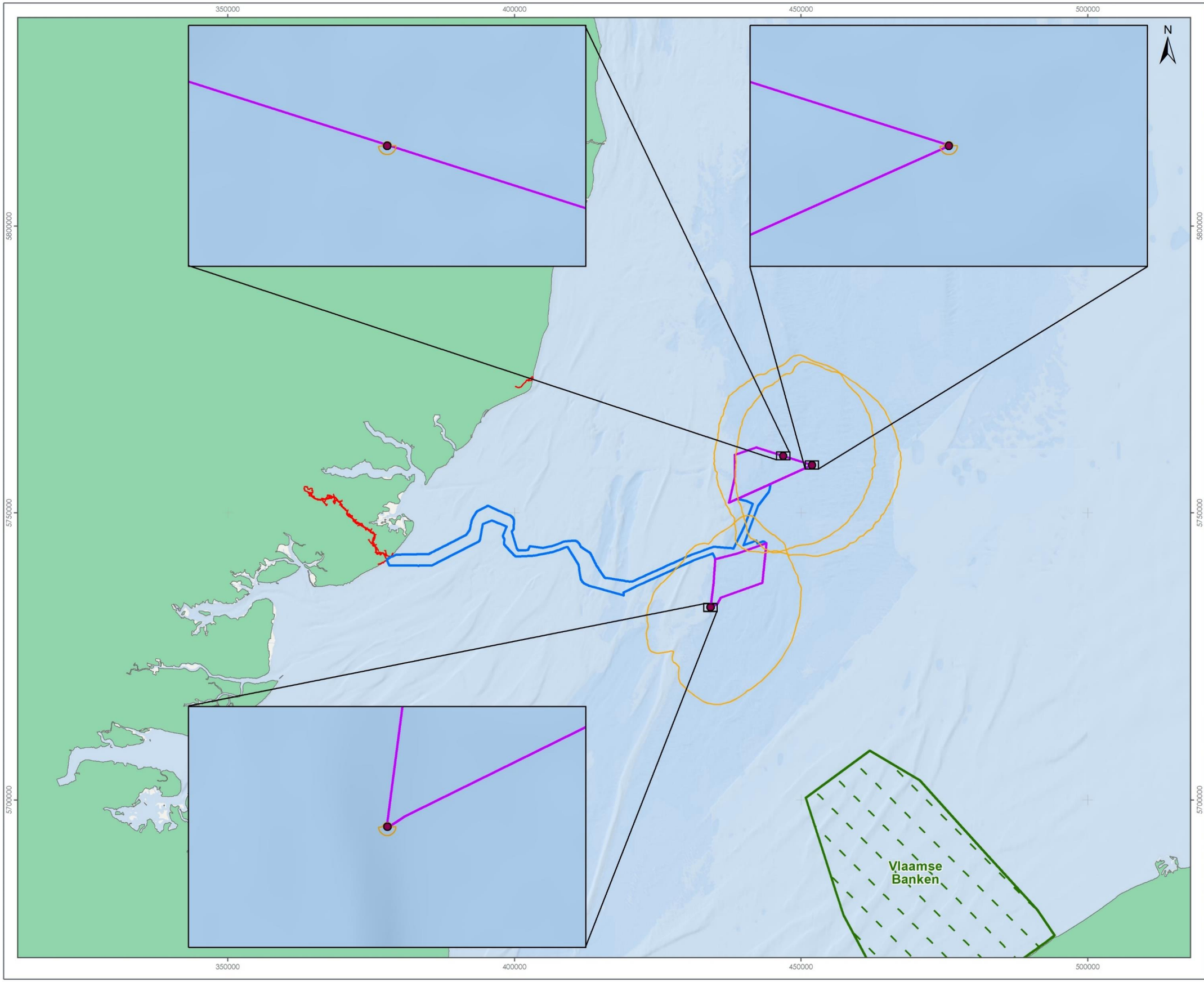
11.5.22 Normal hearing ability returns following cessation of the noise causing TTS. When experiencing TTS, fish may have decreased fitness due to a reduced ability to communicate, detect predators or prey, and/or assess their environment. Recoverable injury is a survivable injury with full recovery 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 range for recoverable injury in the temporal MDS is <100 m, the impact range for recoverable injury in the spatial MDS using SEL_{cum} is greater, at 23 km.

11.5.23 ES Volume 6, Part 5, Annex 6.2: Underwater Noise Technical Report presents the ranges at which TTS in fish may occur as a result of piling operations during the VE construction phase (23 km for the spatial MDS and 19 km for temporal MDS).There are no available thresholds for TTS effects from other noise sources, however, any impacts are likely to be localised, and from single sound sources such as that from UXO explosion.

11.5.24 Table 11.45 summarises the maximum predicted impact ranges for mortality, injury and TTS described in twaite shad for both the spatial and temporal MDS. UXO detonations are considered to have a lower likelihood of triggering a population level effect than that associated from piling operations, due to the significantly reduced temporal footprint that would arise from UXO operations; therefore, effects are likely to be within that from cumulated piling exposure. Visual representations of the maximum predicted impact ranges for both the temporal and spatial MDS' are shown in Figure 11.10 and Figure 11.11, respectively.

Table 11.45 Summary of the maximum modelled impact ranges for the assessed underwater noise effects for both the spatial and temporal MDS for twaite shad.

Impact	Maximum Predicted Impact Ranges from Piling Activity
Mortality and mortal injury	**SPATIAL MDS** Fleeing receptor – <100 m from all piling locations (SEL_{cum}). **TEMPORAL MDS** Fleeing receptor - <100 m from all piling locations (SEL_{cum}).
Recoverable injury	**SPATIAL MDS** Fleeing receptor – 1.6 m from the north array north edge and south array southwest corner piling locations (SEL_{cum}). **TEMPORAL MDS** Fleeing receptor - 260 m from south array southwest corner piling locations (SEL_{cum}).
Temporary threshold shift (TTS)	**SPATIAL MDS** Fleeing receptor – 23 km from the north array NE corner and north edge piling locations (SEL_{cum}). **TEMPORAL MDS** Fleeing receptor - 19 km from all piling locations (SEL_{cum}).



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Special Area of Conservation
- Underwater Noise Modelling Locations

Noise Contours, Fleeing Receptors

- 186dB
- 203dB
- 207dB

0 5 10 20
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
Temporal MDS noise contours for migratory fish: sequential piling of 4 pin piles within the array areas (fleeing receptor, 3,000 kJ)

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 11.10

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:600,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

350000
400000
450000
500000
5800000
5750000
5700000
N
Vlaamse Banken
0 5 10 20
Kilometers
Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
LEGEND
Array Areas
Offshore Export Cable Corridor
Onshore Order Limits
Special Area of Conservation
Underwater Noise Modelling Locations
Noise Contours, Fleeing Receptors
186dB
203dB
207dB
PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM
DRAWING TITLE:
Spatial MDS noise contours for migratory fish:single piling of monopile foundations within the array areas (fleeing receptor, 7,000 kJ)
VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ
DRAWING NUMBER: 11.11
SCALE: 1:600,000 | PLOT SIZE: A3 | DATUM: WGS84 | PROJECTION: UTM31N
FIVE ESTUARIES OFFSHORE WIND FARM

11.5.25 The full assessments of the risks of potential impacts underwater noise on twaite shad are presented in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. The assessments draw on results from underwater noise modelling at three separate locations (S-SW, N-NE, N-N) and are summarised below.

11.5.26 Table 11.45 demonstrates that for twaite shad the impact range at which there is a risk of mortality or mortal injury from piling is extremely localised (at <100 m in both the spatial and temporal MDS). Likewise, the impact range at which there is the risk of recoverable injury for the temporal MDS is also highly localised for the temporal MDS: the spatial MDS impact range is larger at 700 m. By far the largest impact ranges are those associated with TTS, whereby an impact may be experienced by twaite shad up to 22 km for the spatial MDS and 18 km for the temporal MDS.

MITIGATION

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

- Project design;
  - Identification of maximum hammer energy to be used during pile driving (7,000 kJ for monopile, 3,000 kJ for pin-pile).
  - Inclusion of soft-start and ramp up procedures for pile driving; and
  - Maximum of 2 simultaneous piling events.
- Marine Mammal Mitigation Protocol (MMMP) (Piling specific);
  - A piling MMMP will be implemented as a condition in the dML (see Volume 9, Report 14.1: MMMP Piling). The MMMP will be secured as a condition within the Marine Licence.
- Decommissioning Plan;
  - A Decommissioning Programme will be developed to cover the decommissioning phase as required under Chapter 3 of the Energy Act 2004. As the decommissioning phase will be a similar process to the construction phase but in reverse (i.e., increased project vessels on-site, partially deconstructed structures) the mitigation measure will be similar to those for the construction phase. The Decommissioning Programme will be secured as a condition in the deemed Marine Licence.
- MMMP (decommissioning);
  - Implementation of a decommissioning MMMP subject to a condition in the dML application prior to decommissioning should this be required

11.5.28 The information presented in represents the maximum impact ranges in the absence of any mitigation. The above mitigatory measures, as well as compliance with best and established practice, will manage and mitigate the impacts from piling on twaite shad. Therefore, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; concludes that all impacts on Group 3 species from underwater noise are minor adverse and therefore 'not significant' in EIA terms.

MAXIMUM DESIGN SCENARIO

11.5.29 The assessment undertaken for migratory fish is based on the MDS within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, which is repeated in Table 11.46 for clarity.

Table 11.46 The Maximum Design Scenario considered for migratory fish as established within Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology.

Potential effect	Maximum design scenario assessed	Justification
Construction and Decommissioning[21]		
Impact 1: Mortality, injury, behavioural impacts and auditory masking arising from noise and vibration	**Array areas:** **Spatial MDS (for fleeing receptors)** > Piling of one monopile in a 24 hour period > 79 monopiles (15m monopile diameter) > 2 OSP monopile foundations (15 m diameter) > Maximum hammer energy of 7,000 kJ > 7.5 hour piling duration per pile > 592.5 hours of piling. **Temporal MDS (for fleeing receptors):** > The sequential installation of piling four pin piles at the same WTG location in 24 hours > Total 340 pin piles > 79 small WTGs on piled jacket foundations (four 3.5m diameter pin piles per jacket) –316 pin piles	For the array area, the spatial MDS for stationary receptors results from the sequential piling of pin piles for 79 WTGs, and two OSPs using 3,000 kJ hammer energy (a total of 340 pin piles). This would result in the largest spatial noise impact at any given time when considering impacts to stationary receptors. The spatial MDS for fleeing receptors results from the piling of monopiles for 79 WTGs and 2 OSPs, using 7,000 KJ hammer energy. This would result in the largest spatial noise impact at any given time when considering impacts to fleeing receptors. The temporal MDS for the array area would be associated with the sequential piling of pin piles for 79 WTGs, and two OSPs using 3,000

[21] The maximum design scenarios within this table represent construction in reverse for decommissioning.

Potential effect	Maximum design scenario assessed	Justification
	> Two Offshore Substation Platform (OSP) foundations (six 3.5m diameter pin piles per jacket) –24 pin piles > Maximum hammer energy of 3,000 kJ > Four hours piling duration per pile > 1,360 hours of piling > Array areas and offshore ECC **UXO clearance:** > Estimated 2,000 targets; > 60 UXO may require clearance; and > Up to 2 clearance events within 24 hours. **Offshore ECC** > Piling of sheet pile exit pits: > Installation of 660 sheet piles using percussive drilling in the shallow subtidal > 750mm wide sheets > Piling of eight piles within a 24 hour period > Maximum hammer energy of 300 kJ	kJ hammer energy. Total of 1,360 hours of piling across the whole project within a one-year construction window.
Operation and Maintenance		

Potential effect	Maximum design scenario assessed	Justification
Impact 8: Mortality, injury, behavioural impacts and auditory masking arising from noise and vibration	**Array areas:** Underwater noise during the operational phase from 79 small WTGs and maintenance vessel operations over the design lifetime of VE (i.e., up to 40 years).	Maximum number of operational WTGs and related Operation and Maintenance visits by vessels during the lifetime of the project.

11.5.30 The spatial MDS for migratory fish is the **largest** impact range from underwater noise impacts at any given time and results from the single piling of a monopile, at 7,000 kJ hammer energy, in 24 hours. For 81 foundations this equates to 607.5 hours monopiling duration.

11.5.31 The temporal MDS for migratory fish represents the **longest** duration of effects from underwater noise which is considered to result from the sequential installation of four pin piles at the same location, at 3,000 kJ hammer energy, in 24 hours. For 316 pin piles in the array areas this equates to 1,360 hours pin piling duration.

11.5.32 As part of the site preparation activities for VE, high-order UXO clearance may be required; however, until detailed pre-construction surveys are undertaken across the VE site, the exact number of potential UXO which will need to be cleared is unknown. In any case, detonation of UXO would represent a short-term (i.e. seconds) increase in underwater noise (i.e. sound pressure levels) and are considered to have a lower likelihood of triggering a population level effect than that associated from piling operations, due to the significantly reduced temporal footprint that would arise from UXO operations. Any work required for high-order UXO clearance will be consented at a later date within a separate Marine Licence application.

11.5.33 General construction noise, arising from vessel movements, dredging and seabed preparation works 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 VE site is subject to 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). Therefore, general construction noise levels are considered to be within the levels of noise assessed herein for piling (i.e. they will emit lower levels of noise and have less significant impacts) such that the assessments presented for piling demonstrate, by proxy, the severity of impacts from general construction noise.

ASSESSMENT OF ADVERSE EFFECT ON INTEGRITY ALONE

VLAAMSE BANKEN SAC – TAITE SHAD

ASSESSMENT OF MORTALITY, MORTAL INJURY AND RECOVERABLE INJURY ASSOCIATED WITH UNDERWATER NOISE ON TWAITE SHAD

11.5.34 There is one designated site for twaite shad screened in for potential LSE from impacts of underwater noise during construction and decommissioning: Vlaamse Banken SAC (see screening presented in the Screening Report and a site summary in Volume 5, Report 4, Annex 4.4). At the closest point, the VE site is located 34.75 km away from Vlaamse Banken SAC.

11.5.35 No information on the conservation status or conservation targets for the Vlaamse Banken SAC features have been sourced. Therefore, as a proxy the conservation objective for twaite shad at Severn Estuary SAC[22] has been applied here. This is:

- To maintain the feature in a favourable condition, which is, subject to natural processes, considered to be achieved when each of the following conditions are met:
  - The migratory passage of both adult and juvenile twaite shad (through the Severn Estuary between the Bristol Channel) and their spawning rivers is not obstructed or impeded by physical barriers, changes in flows or poor water quality;
  - The size of the twaite shad population (within the Severn Estuary and the rivers draining into it) is at least maintained and is at a level that is sustainable in the long term;
  - The abundance of prey species forming the twaite shad's food resource (within the estuary, in particular at the salt wedge), is maintained; and
  - Toxic contaminants in the water column and sediment are below levels which would pose a risk to the ecological objectives described above.

11.5.36 Of the above ecological conditions that must be met in order to achieve favourable condition of twaite shad, it is considered that underwater noise has the potential to affect only one, which is the condition that relates to the maintenance of the size of the twaite shad population. Therefore, it is appropriate to primarily consider the potential for the risk of mortality, mortal injury or recoverable injury to impact the twaite shad population abundance and distribution within the region. This will then allow inferences for twaite shad of Vlaamse Banken SAC to be drawn.

11.5.37 Although Group 3 fish species are considered to be the most sensitive to underwater noise, due to their mobile nature twaite shad are considered a fleeing/ mobile receptor in the assessment presented in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; as they are expected to transit an impacted area (unlike some spawning receptors that exhibit site fidelity such as herring and sandeel). Therefore, twaite shad are expected to recover quickly, returning to normal behaviours and recolonise areas shortly after an impact. Furthermore, Group 3 species are broadly distributed and present in abundance within the southern North Sea region with the small impact range potentially affecting only a small proportion of the regional population, according to ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. Therefore, given that any impacts from underwater noise are expected to be of local scale and the intermittent nature of the noisy activities, the maximum magnitude of impact from mortality, potential mortal injury and recoverable injury is reported to be negligible, with an overall impact conclusion of minor adverse which is 'not significant' in EIA terms.

[22] http://publications.naturalengland.org.uk/publication/3184206?category=3212324

11.5.38 If it is assumed that effects on a designated site generally reduce with increasing distance from an impact source, considering the distance of Vlaamse Banken SAC to VE (34.75 km to array area), the likelihood of exposure to lethal or injurious sounds levels (i.e., limited to within <100 m of the array for mortality, mortal injury and recoverable injury for both the temporal and spatial MDS') is expected to be low and limited to sporadic, low numbers of twaite shad associated with Vlaamse Banken SAC. As such, mortalities and or recoverable injuries due to exposure to underwater noise are not expected to manifest at levels that could compromise the maintenance of the twaite shad population.

11.5.39 **There is, therefore, no potential for an AEoI of the twaite shad feature of Vlaamse Banken SAC in relation to mortalities or injuries directly associated with underwater noise from VE alone. Therefore, subject to natural change, the feature will be maintained in the long term.**

ASSESSMENT OF TTS AND BEHAVIOURAL CHANGES ASSOCIATED WITH DISTURBANCE FROM UNDERWATER NOISE ON TWAITE SHAD

11.5.40 As with the mortal and recoverable injury assessment above, the assessment of whether TTS onset and behavioural changes could cause an AEoI on Vlaamse Banken SAC focuses on whether impacts could compromise the maintenance of the size of the site-specific twaite shad population.

11.5.41 As a worst-case impact, the spatial MDS presents the maximum predicted range of impact for TTS in twaite shad, which is expected to occur up to 23 km from the piling activity in the array areas. This impact range is larger than that identified for the temporal MDS (at 19 km) and also for the impact ranges calculated for injury to twaite shad; however, TTS is a recoverable impact and its extent is of variable duration and magnitude. Furthermore, normal hearing ability returns following cessation of the noise causing TTS.

11.5.42 ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; concludes that the significance of the residual effect of TTS in fleeing Group 3 fish species is minor adverse, which is not significant in EIA terms. This is because, as for injurious impacts, Group 3 species are broadly distributed and present in abundance within the southern North Sea region, with the limited TTS impact range potentially affecting only a small proportion of the regional population.

11.5.43 Regarding noise-induced behavioural changes, 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 a population level (e.g., avoidance or delayed migration to key spawning grounds); however, according to ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; these may result in short-term, intermittent changes in behaviour only that have no wider effect, particularly once acclimatisation to the noise source is taken into account.

11.5.44 Furthermore, there is a paucity of evidence on behaviour of migratory species that suggests that migration would be an equally strong biological driver, with damping of behavioural reactions. Taking this into consideration, the magnitude of the behavioural impact on Group 3 species is considered to be low in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, with an overall conclusion of minor adverse impact on behavioural changes (which is 'not significant' in EIA terms). Therefore, it can be concluded that significant effects on behaviour (including, for example, migration and any associated barrier effects, or movement to/from coastal habitats during key migration periods) as a result of noise impacts would not be expected.

11.5.45 As explained above, it is assumed that effects on a designated site generally reduce with increasing distance from an impact source. Therefore, it is reasonable to conclude that very low numbers of twaite shad associated with Vlaamse Banken SAC (34.75 km from array area) will be exposed to TTS or behavioural change impacts. Therefore, effects from these impacts are not expected to manifest at levels that could compromise the maintenance of the twaite shad population.

11.5.46 **There is, therefore, no potential for an AEoI of the twaite shad feature of Vlaamse Banken SAC in relation to TTS or behavioural changes directly associated with underwater noise from VE alone. Therefore, subject to natural change, the feature will be maintained in the long term.**

11.6 ONSHORE

ONSHORE MAXIMUM DESIGN SCENARIO

11.6.1 The Onshore ECC and substation arrangement have been designed in co-ordination with the adjacent NF OWF project, and the onshore cable routes of the two projects will run immediately adjacent. Moreover, the substations have been co-located in the same location to the west of Little Bromley. Due to electrical requirements separate cables and transformers are required for each project. Therefore, while the projects have considered physical sharing of assets it is not considered to yield significant benefits. This approach allows for opportunities to minimise environmental and community disruption through coordinated delivery.

11.6.2 Three scenarios for onshore delivery with NF OWF are foreseen:

- Scenario 1 – VE proceeds to construction and undertakes the additional onshore cable trenching and ducting works for NF OWF as part of a single civils campaign (ducting for four electrical circuits). VE would undertake the cable installation and OnSS build for its project only (two electrical circuits). The two projects would share accesses from the public highway for cable installation and substation construction. The projects would utilize and share the same TCCs for the cable installation works.
- Scenario 2 – Both VE and NF OWF projects proceed to construction on different but overlapping timescales (between 1 and 3 years apart), with civil works undertaken independently but opportunities for reuse of enabling infrastructure e.g. haul roads / site accesses etc. with the other project reinstating.
- Scenario 3 – NF OWF does not proceed to construction; or both VE and NF OWF projects proceed to construction on significantly different programmes (over 3 years apart). In the latter case the significantly different programmes would mean that haul roads and TCC's are reinstated prior to the second project proceeding. In such case cumulative impacts are for a potential construction period of 6 years+. No reduction in overall impacts for the schemes from sharing of infrastructure.

11.6.3 Scenario 1 is assumed to be the MDS for the RIAA and referred to as 'the Project', for more information on delivery scenarios refer to Volume 6, Part 3, Chapter 1: Onshore Project Description.

11.6.4 The onshore aspects of the Project - Scenario 1 are:

- Landfall: the area from Mean Low Water (MLW) to where the offshore export cables are connected to the onshore cable circuits within Transition Joint Bays (TJBs);
- Onshore ECC: where permanent infrastructure connects the cables at Landfall to the proposed OnSS;
- OnSS: where the power supplied from the OWF is adjusted (including voltage, power quality and power factor as required) to meet the UK System-Operator Transmission-Owner Code (STC) for supply to the East Anglia Connection Node (EACN) Substation; and.
- Connection to the National Grid will include 400 kV underground circuit(s) running from the proposed VE OnSS to the new National Grid EACN Substation.

11.6.5 Within these areas, VE will comprise cable circuits and associated infrastructure required to transmit the electricity generated to the National Grid network via a proposed grid connection. The transmission voltage will be up to 400 kV, with a maximum two circuits, and will use High Voltage Alternating Current (HVAC) technology.

11.6.6 The key permanent onshore components of VE will include:

- Infrastructure at landfall where the offshore cables are brought ashore;
- Up to two TJBs connecting the offshore cables to the onshore cables;
- Underground cable ducts, joint pits, and cables;
- The construction of the proposed OnSS; and
- Underground cable ducts, joint pits, and cables for the grid connection from the proposed OnSS to the proposed EACN.

11.6.7 The Onshore ECC will be approximately 22 km from the landfall compound to National Grids proposed EACN substation, but cables will be installed in lengths of around 500 to 800 m typically. A MDS length of 24.5 km per circuit of onshore cabling has been included to allow for micrositing within the Onshore ECC.

11.6.8 Along the Onshore ECC a number of off route haul roads are identified, where works access will be required. These generally allow routing of vehicles through existing gaps in the hedgerows or over existing watercourse crossings, which are nearby but not exactly on the Onshore ECC.

11.6.9 To support the operation, operation and maintenance access routes have been defined which generally follow existing farm tracks. These will primarily be used for routine maintenance access to joint pits during operation, with access in 4x4 vehicles or similar.

11.6.10 The MDS for onshore infrastructure is detailed in Table 11.47.

Table 11.47 VE onshore infrastructure information

Project Parameter	Maximum Design Scenario (MDS)
TJB footprint area (area per TJB)	100 m²
Number of TJBs	Up to 2 (1 per export cable)
Total Onshore ECC length	Up to 24.5 km
Number of onshore export cable circuits	Up to 2 (with ducting for additional 2 circuits)
Number of power cables per circuit	3
Number of ducts per circuit	Up to 7 (3 x power cables, 3 x comms. cables and 1 x earth)

11.6.11 The onshore red line boundary (Figure 11.11) is up to 22 km running in a general east west direction. It has been sub-divided into Route Sections, which do not reflect any proposed phasing of the works.

610000 615000 620000 625000

230000 225000 220000 215000

Section 7
Section 6
Section 5
Section 4A
Section 4B
Section 3
Section 2
Section 1

N

LEGEND

- Onshore Order Limits
- Offshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Substation Operational Boundary
- North Falls Indicative Substation Operational Boundary
- 400kV Underground Cable Zone
- Landfall Compound Zone
- Landfall Exit Pit Sheet Piling Zone
- National Grid EACN Substation Zone

0 0.5 1 2
Kilometres

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
PROJECT OVERVIEW

VER	DATE	REMARKS	Drawn	Checked
1	09/02/2024	ES Submission	DB	JRS

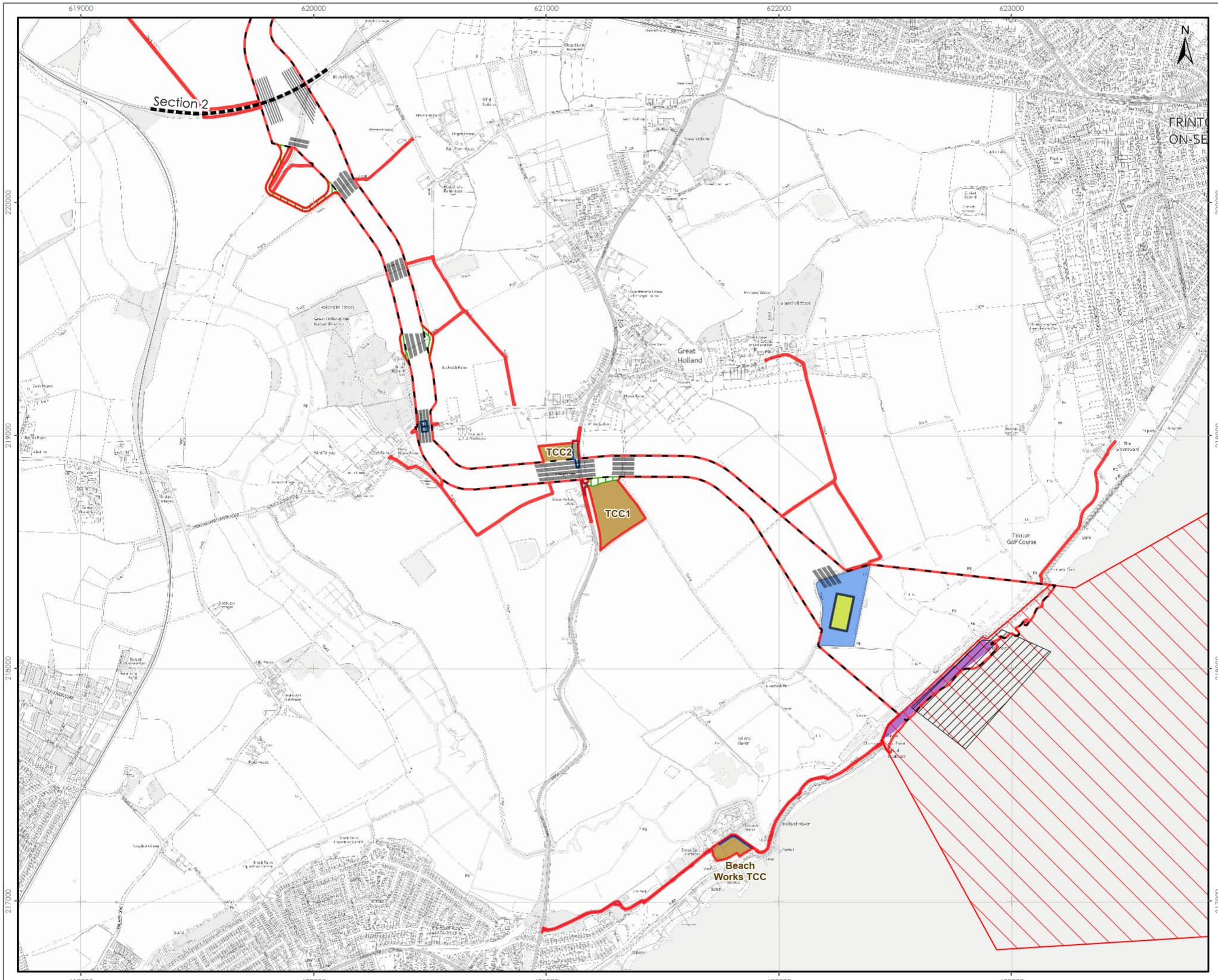
DRAWING NUMBER: 11.1

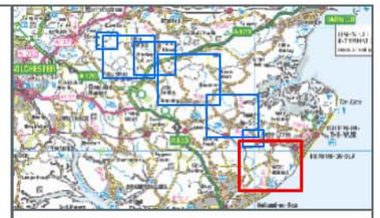
SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:60,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES
OFFSHORE WINDFARM

11.6.12 Route Section 1 shown on Figure 11.15 encompasses the landfall at Sandy Point between Frinton-on-sea and Holland-on-sea. From the Landfall HDD compound, located to the north west of Frinton golf course, adjacent to Short Lane, the Onshore ECC continues northward to the Great Eastern Coast Main Line spur between Holland Brook and Park Lane. The rail line will be crossed using a trenchless crossing technique, such as HDD, which will require a drilling compound to the south of the rail line.

11.6.13 Within this section is the provision for three TCCs. The proposed Beach Works TCC is located at Manor Way to support any works or access which may be required on the beach. Proposed TCC no.1 and TCC no.2 are located either side of Clacton Road. Then there is the indicative landfall compound located to the north west of Frinton golf course, adjacent to Short Lane.





LEGEND

- Onshore Order Limits
- Offshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Temporary Beach Access Zone
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone
- Landfall Compound Zone
- Indicative Landfall Compound
- Landfall Exit Pit Sheet Piling Zone

0 0.25 0.5
Kilometres

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

ONSHORE ORDER LIMITS ROUTE SECTION 1

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.1

Sheet No: 1 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:15,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES OFFSHORE WIND FARM

11.6.14 Route Section 2 shown on Figure 11.3 continues north from the Great Eastern Coast Main Line spur between Holland Brook and Park Lane to the west of Kirby Cross across agricultural fields towards the B1033 (Thorpe Road). There will need to be a trenchless crossing technique, such as HDD, underneath the rail line for the cable. This will require a drilling compound to the north of the railway line. This section includes TCC (TCC no. 43) to service it. The crossing of the B1033 (Thorpe Road) and the Porklane Grove woodland will be by trenchless means.

620000

221000

N

Section 3

TCC3

Track

Alder Car

Track

THORPE PARK LANE

25m

26m

24m

The Firs

THORPE ROAD

B1033

25m

Drain

Bluehouse Farm

24m

Porklane Grove

Thorpe Park Cottages

Track

Section 2

PORK LANE

Brook Cottage

Ws

LC

Birch Hoe Farm

24m

PORK LANE

Mayfields Farm

Drain

Reservoir (cov)

Hogen House

620000

221000

LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone

0 0.1 0.2

Kilometres

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

ONSHORE ORDER LIMITS ROUTE SECTION 2

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.2

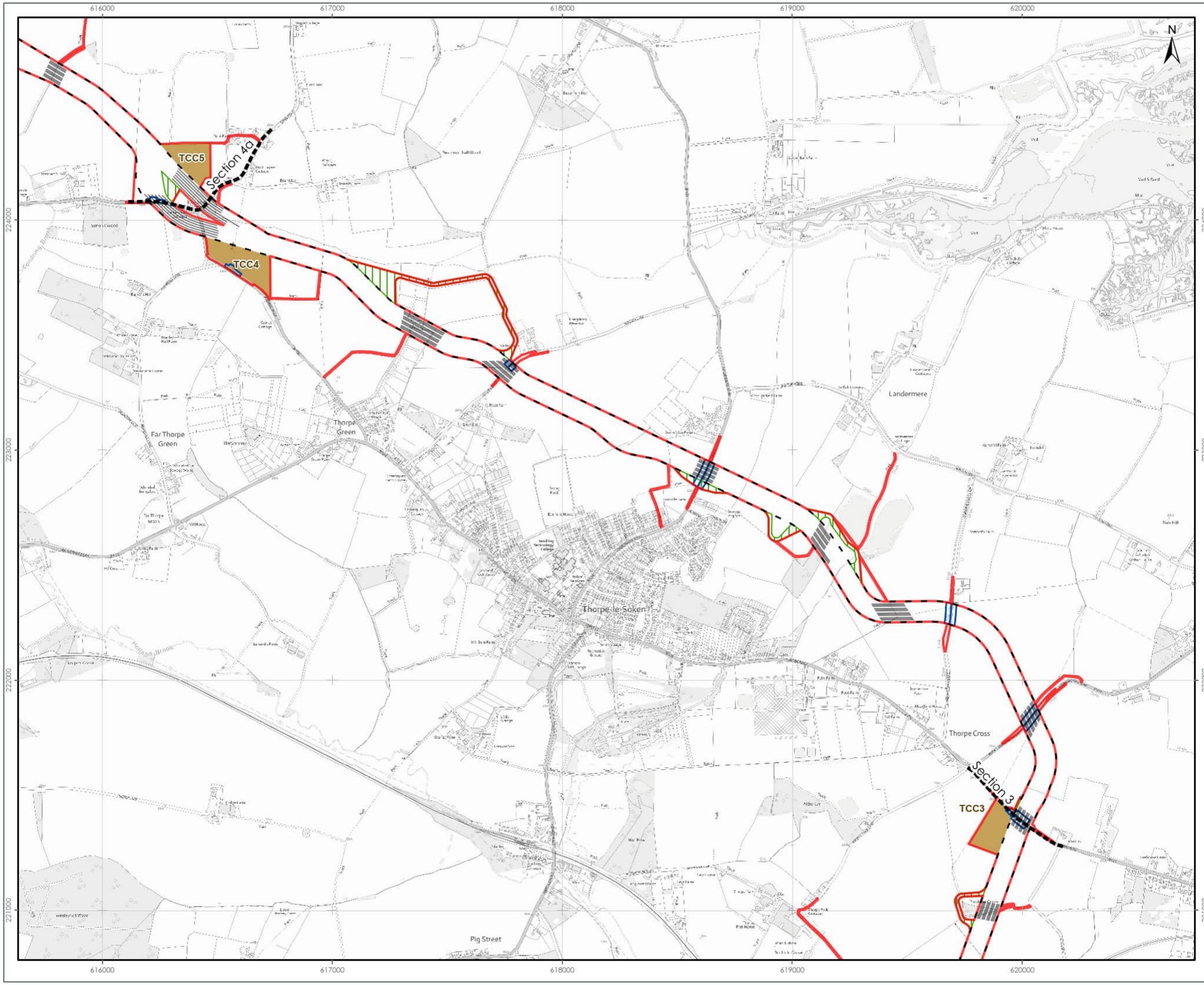
Sheet No: 2 of 7

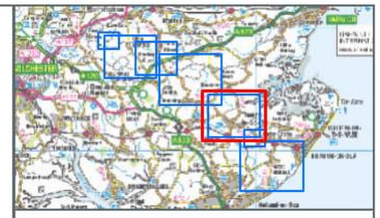
SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:5,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES OFFSHORE WINDFARM

11.6.15 Route Section 3 shown on Figure 11.1 passes north of the B1033 (Thorpe Road) and the B1034 (Sneating Hall Lane) then continues north-west through agricultural land around Thorpe Le Soken, then crossing Landermere Road and Golden Lane towards the intersection of Thorpe Road/Swan Road. This section includes provision for one TCCs (TCC no.45) to the north of Tendring Road, which will be used for access to the section. The following crossings will be made by trenchless means:

- B1033 Thorpe Road;
- B1034 Sneating Hall Lane;
- The Woodland Block Northeast of Thorpe-le-Soken;
- B1414 Landemere Road;
- Golden Lane; and
- Swan Road / Thorpe Road / Tendring Road Junction.





LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone

0 0.25 0.5
Kilometres

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
ONSHORE ORDER LIMITS ROUTE SECTION 3

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.3

Sheet No: 3 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:15,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES
OFFSHORE WINDFARM

11.6.16 Route Section 4 shown on Figure 11.5 continues northwards through agricultural fields to the east of Tendring village, passing to the east of Tendring Heath towards the A120 (Harwich Road). TCC (TCC no.5) is located north of Thorpe Road to service the south of this section, as it may not be suitable to use the existing crossing of the Tendring Brook to access this section from the north. A main TCC (TCC no.6) is located just south of the Horsley Cross roundabout on the A120, which will service the north of this section.

11.6.17 Adjacent to the proposed TCC (TCC no.7) to the north and adjacent to the B1035/A120 is an indicative haul road access, providing access from the TCC to the cable route, The following crossings will be made by trenchless means:

- Swan Road / Thorpe Road / Tendring Road Junction
- Tendring Brook
- Lodge Lane
- Wolves Hall Lane
- Stones Green Road
- A120

613000 614000 615000 616000 617000

227000 226000 225000 224000

TCC7

Horsley Cross

Section 5

TCC6

Goose Green

Tendring Heath

Stones Green

Mill Green

Tendring Green

Goose Green

Section 4b

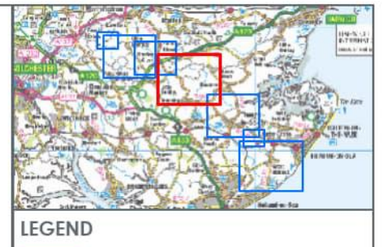
Tendring

TCC5

Section 4a

TCC4

N



LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone

0 0.25 0.5

Kilometres

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

ONSHORE ORDER LIMITS ROUTE SECTION 4

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.4

Sheet No: 4 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:15,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES OFFSHORE WINDFARM

11.6.18 Route Section 5 shown on Figure 11.17 and Figure 11.18 extends from the north of the crossing of the A120 to Bentley Road as shown on Figure 11.16.

11.6.19 The Onshore ECC continues westwards through agricultural fields passing Clacton Road towards Bentley Road.

11.6.20 Two potential TCC locations (TCCs no.7 and no.8) have been defined either side of Clacton Road to service the parts of the route on either side. The crossings of Clacton Road and Bentley Road as well as the watercourse to the west of Clacton Road will be by trenchless means. A further TCC (TCC no.19) is located to the east of Bentley Road but is primarily intended to service Sections 6 and 7 but may also service the western parts of Section 5.

11.6.21 Route Section 6 (Figure 11.18) extends from Bentley Road to the crossing of Ardleigh Road as shown on Figure 1.8. The Onshore ECC continues westwards in this section through agricultural fields passing Payne's Lane, Spratts Lane and Barlon Road. The crossings of Bentley Road, Spratts Lane, and Ardleigh Road will be by trenchless means.

11.6.22 A TCC (TCC no.10) has been identified to the west of Bentley Road servicing this section. As described above a further TCC (TCC no.9) is located to the east of Bentley Road and this will also support the cable construction operation along Section 6 and 7.

11.6.23 This section of the Onshore ECC will also be used during construction for access to the OnSS. A TCC (TCC no.11) has been identified to the west of Bentley Road, south of the Onshore ECC. This TCC is specifically designed to provide space for marshalling of construction traffic accessing or leaving the OnSS as this will be the point substation construction traffic leaves / enters the public highway.

11.6.24 Junction improvement works are proposed where Bentley Road meets the A120. With further widening of the public highway is needed along Bentley Road to where it meets TCC no.12.

11.6.25 Route Section 7 (Figure 11.19) includes the OnSS. It extends north from the crossing of Ardleigh Road to the proposed location of the National Grid substation. This section of the Onshore ECC will also be used during construction for access to the substation.

11.6.26 A short section of 400 kV cable will connect the VE onshore substation with the National Grid EACN substation. The cable section will cross Grange Road, and a trenchless crossing is intended for this crossing. The full National Grid GET Substation Construction and Operation Zone has been included in the Order Limits as there is some uncertainty regarding the exact proposed location.

611000
612000
613000
228000
227000
N
Horsleycross Street
Horsley Cross
Section 5
Section 6
TCC6
TCC7
TCC8
TCC9
TCC10
TCC11
Holland Brook
Aldercar
Mulley's Wood
New Hall
Mulley's Farm
Hawkins Farm Cottages
Red House Farm
Kelly's Farm
Byeland Orchard
Abbotts Hall Cottages
Arch Cottages
Knight's Farm
Stanley House
Jubilee Cottages
Track
Public Footpath
Public Bridleway
Restricted Byway
Private Road

LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Substation Temporary Construction Haul Road
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone

0 0.25 0.5
Kilometres

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
ONSHORE ORDER LIMITS ROUTE SECTION 5

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.5

Sheet No: 5 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:10,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES
OFFSHORE WIND FARM

608000 609000 610000 611000 612000

229000 228000 227000 226000

N

Section 7

Section 6

Little Bromley

Great Bromley

Cowey Green

Little Bentley

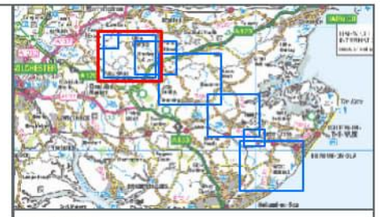
TCC7

TCC8

TCC9

TCC10

TCC11



LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Substation Operational Boundary
- Substation Compound
- Substation Temporary Construction Compound
- Ardleigh Road Drainage Zone
- Indicative Substation Access Route
- Substation Temporary Construction Haul Road
- North Falls Indicative Substation Operational Boundary
- North Falls Indicative Substation Compound
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone
- National Grid EACN Substation Zone

0 0.25 0.5

Kilometres

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

ONSHORE ORDER LIMITS ROUTE SECTION 6

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.6

Sheet No: 6 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:15,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES OFFSHORE WINDFARM

608000

229000

N

Track

37m

HUNGERDOWN LANE

ds Farm

36m

Badley Hall

Track

GRANGE ROAD

36m

Track

Path

Track

HARTONE

Track

GRANGE ROAD

36m

WATERHOUSE LANE

ESS

35m

Cattsgreen Farm

Section 7

Norman's Farm

34m

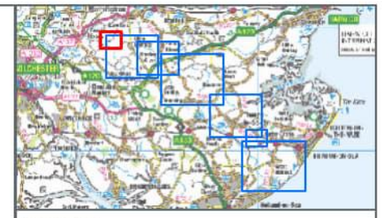
ARDLEIGH ROAD

Jenning's

Waterhouse Farm

608000

229000



LEGEND

- Onshore Order Limits
- Onshore Export Cable Corridor Section Division
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Substation Operational Boundary
- Substation Compound
- Substation Temporary Construction Compound
- Ardleigh Road Drainage Zone
- Indicative Substation Access Route
- Substation Temporary Construction Haul Road
- North Falls Indicative Substation Operational Boundary
- North Falls Indicative Substation Compound
- Access and Crossing Zone
- National Grid EACN Substation Zone

0 0.1 0.2

Kilometres

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

ONSHORE ORDER LIMITS ROUTE SECTION 7

VER	DATE	REMARKS	Drawn	Checked
1	15/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.7

Sheet No: 7 of 7

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:5,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES OFFSHORE WINDFARM

11.6.27 For the assessment presented in this RIAA, open trenching will be used within 60 m of the 90 m Onshore ECC Order Limits. Where trenchless techniques such as HDD are used along the ECC, the width will need to increase to approximately 90 m. In route Section 6 and 7 the Onshore ECC is slightly wider (72 m for scenario 1 and approximately 50 m for scenario 2 and 3) as a dedicated haul road is incorporated to allow for construction traffic access to the onshore substation.

ONSHORE DESIGNATED SITES

11.6.28 The onshore designated sites within 15 km of the Onshore ECC in line with standard practice and as set out in the screening report have been screened into the assessment. The relevant qualifying interest features i.e. those where likely significant effects were identified at screening stage, are detailed in Table 11.48. The initial study area based on 15 km is a pragmatic starting point and is based on existing guidance for plans rather than projects. It is precautionary and exceeds the IRZs for designated sites that have been set by NE.

Table 11.48 Summary of onshore designated sites and qualifying features

Designated Site	Distance to Onshore ECC (km)	Qualifying Features
Hamford Water SAC	0.80	Fisher's estuarine moth *Gortyna borelii lunata*
Hamford Water SPA	0.78	**Over winter:** > Avocet > Black-tailed godwit > Dark-bellied brent goose > Grey plover > Redshank > Ringed plover > Shelduck > Teal **During the breeding season:** > *Little tern (considered offshore and screened out at stage 1)*
Hamford Water Ramsar Site	0.78	**Important wintering populations of**: > Black-tailed godwit > Dark-bellied brent goose > Redshank > Ringed plover

Designated Site	Distance to Onshore ECC (km)	Qualifying Features
Stour and Orwell Estuaries SPA	3.15	**Over winter:** > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot > Pintail > Redshank > Waterbird assemblage **On passage:** > Redshank **During the breeding season:** > Avocet
Stour and Orwell Estuaries Ramsar Site	3.15	**Important wintering populations of:** > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot > Pintail > Redshank **Important passage populations of** redshank. **Also qualifies for:** > Wintering waterbird assemblage > Nationally important higher plant species occurring on the site, *Puccinellia rupestris*, *Spartina maritima*, *Sarcocornia perennis*, *Limonium humile*, *Zostera angustifolia*, *Zostera noltei*. > Nationally important Invertebrate species occurring on the site, *Phaonia fusca*, *Haematopota grandis* (Meigen), *Arctosa fulvolineata*, *Baryphyma duffeya*.

Designated Site	Distance to Onshore ECC (km)	Qualifying Features
Colne Estuary (Mid-Essex Coast Phase 2) SPA	7.30	**Over winter:** > Dark-bellied brent goose > Hen harrier > Pochard > Redshank > Ringed plover > Waterbird assemblage **During the breeding season:** > *Little tern (considered offshore and screened out at stage 1)*
Colne Estuary (Mid-Essex Coast Phase 2) Ramsar Site	7.30	**Over winter:** > Dark-bellied brent goose > Redshank > Waterbird assemblage > Wetland invertebrate assemblage > Wetland plant assemblage
Abberton Reservoir SPA	12.08	**Breeding:** > Cormorant **Non-breeding:** > Coot > Gadwall > Goldeneye > Great crested grebe > Mute swan > Pochard > Shoveler > Teal > Tufted duck > Wigeon > Waterbird assemblage

Designated Site	Distance to Onshore ECC (km)	Qualifying Features
Abberton Reservoir Ramsar Site	12.08	**Wintering:** > Gadwall > Shoveler > Wigeon > Waterbird assemblage
Blackwater Estuary (Mid-Essex Coast Phase 4) SPA	14.37	**Non-breeding:** > Black-tailed godwit > Dark-bellied Brent goose > Dunlin > Grey plover > Hen harrier > Waterbird assemblage **Breeding:** > Little tern (considered offshore and discussed in that section) > Pochard > Ringed plover
Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar Site	14.37	**Wintering:** > Black-tailed godwit, > Dark-bellied brent goose > Dunlin > Grey plover > Waterbird assemblage > Saltmarsh > Wetland invertebrate assemblage (considered too distant from the Project and not assessed) > Wetland plant assemblage (considered too distant from the Project and not assessed)

11.6.29 The conservation objectives for the Hamford Water SAC are to:

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 habitats of qualifying species

The structure and function of the habitats of qualifying species

The supporting processes on which the habitats of qualifying species rely

The populations of qualifying species and,

The distribution of qualifying species within the site.

11.6.30 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 Bird Directive, by maintaining or restoring:

The extent and distribution of the habitats of qualifying features

The structure and function of the habitats of qualifying features

The supporting processes on which the habitats of qualifying features rely

The populations of qualifying features, and,

The distribution of qualifying features within the site.

FEATURE 1: FISHER'S ESTUARINE MOTH (HAMFORD WATER SAC)

11.6.31 Fisher's estuarine moth is a qualifying interest feature of Hamford Water SAC located 780 m from the Onshore ECC, refer to Appendix 1 for full details of Hamford Water SAC. This moth is present in only two locations in the UK, Kent, and Essex. The citation document for Hamford Water SAC states a population size of 2000 to 4000 individuals.

DISTRIBUTION AND CONSERVATION STATUS

11.6.32 For Fisher's estuarine moth the population is dependent on hog's fennel *Peucedanum palustre* as its food plant and rough grassland, specifically the following species: Cock's-foot *Dactylis glomerata*, Couch *Elytrigia spp*. and False Oatgrass *Arrhenatherum elatius*. Hog's fennel is on the GB red list of plants and classified as a nationally rare species, this is primarily due to geographic restriction to north Essex and north Kent coast. The coastal locations of Fisher's estuarine moth make it susceptible to sea level rise, for example, in 2013 the largest population on Skippers Island in Hamford water was inundated by a tidal surge (Butterfly Conservation).

11.6.33 Within the Onshore ECC, Holland Haven Marshes SSSI hog's fennel plants were identified as part of the North Falls National Vegetation Classification (NVC) survey in 2021 (Wild Frontier Ecology 2021), this is potentially within the Order Limits. Although, the SSSI will be crossed via HDD, therefore no surface soil or vegetation disturbance will occur.

11.6.34 A total of six hog's fennel and three Fisher's estuarine moth desk study records were identified within the Onshore ECC, the locations were Holland Haven Marshes (five records, one moth and four hog's fennel plants) and the verge of the A120 (four records, two months, and two hog's fennel plants).

11.6.35 The population of Fisher's estuarine moth present at the SAC also utilises areas beyond the site boundary where the larval food plant hog's fennel is present, along with rough grassland suitable for egg laying. Except at Holland Haven Marshes SSSI, surveys to date have found no evidence of hog's fennel within the Survey Area (i.e. within the Order Limits plus 100 m), though desk study data indicates it may be present northwest of Thorpe le Soken and at the A120.

11.6.36 A conservation programme was set up in 2006 that aims to create a landscape-scale network of sites for Fisher's estuarine moth, 25 new areas have been created and the project has been classed as 'very successful'. There is also a captive breeding program at Colchester Zoo. Although no empirical evidence was identified in relation to the moth's current population level, there are clearly projects that are ensuring the moths survival.

11.6.37 On a precautionary basis, due to the lack of recent population data, the conservation status of Fisher's estuarine moth within Hamford Water SAC is assumed to have unfavourable conservation status for this assessment and the population requires restoration.

11.6.38 Conservation objectives that could be undermined by activities within the project, by impacting populations outside the SAC that are linked to the SAC are:

- no. 1 - restore the extent and distribution of the habitats of qualifying species with the SAC;
- no. 4 – restore the population of qualifying species within the SAC; and
- no. 5 - restore the distribution of qualifying species within the SAC.

PATHWAY 1: PHYSICAL HABITAT LOSS

11.6.39 Although the ECC would not impact habitat within the boundary of the Hamford Water SAC, there is a risk of habitat loss impacting supporting populations of the moth and its food plant, hog's fennel, outside the SAC. The moth does occur outside Hamford Water SAC in Essex, for example its food plant and habitat are recorded within Holland Haven Marshes SSSI, and the moth does occur within the Onshore ECC. Impacts on populations of the moth or its food plant could therefore have knock-on effects for the moth population within the SAC, for example, populations outside the SAC could be important meta populations that support genetic diversity in the SAC population of moths.

CONSTRUCTION AND DECOMISSIONING

11.6.40 Habitat loss, specifically loss of rough grassland supporting hog's fennel could occur during construction. Specifically in relation to TCC, HDD pits, open trenching and temporary haul roads. Although habitat will be restored as part of the construction, the loss of hog's fennel, which has very limited distribution, would likely negatively impact the Fisher's estuarine moth population. Equally, loss of rough grassland nearby would also have a negative impact on the moth, to a lesser extent as the moth uses this habitat, although is not reliant on it for food. Construction of the ECC is expected to take around 18 months, this has the potential to remove suitable habitat and food plants for two entire generations as a worst-case scenario. Eggs over winter on grasses could be destroyed at the start of construction, depending on the timing. Any Fisher's estuarine moths would be prevented from colonising due to a lack of grassland and later hog's fennel for larval foot plant and pupation location (pupation occurs below ground between hog's fennel and surrounding soil).

11.6.41 Risks of destroying hog's fennel plants at the landfall are reduced as the more suitable habitat is located within Holland Haven Marshes SSSI and around the A120. The landfall site is north of Frinton golf club on arable land, where habitats are more managed, the soil is more improved and therefore less likely to support hog's fennel, although the plant could be present in unmanaged areas or along the sea wall to the north.

11.6.42 Both the Holland Haven Marshes SSSI and the A120 will be crossed using HDD, or similar technique, rather than open trenching. This limits the ground disturbance and the risk to habitats to the location of the TCC, entry and exit pits, which are distinctly further from the locations of hog's fennel.

11.6.43 The risk at the A120 location is deemed de minimis as hog's fennel and Fisher's estuarine moth are limited to the verge of the A120. TCC and HDD entry and exit pits would likely be located away from the A120, as an appropriate slope/ angle will be required for the HDD, therefore the verge will remain intact and undisturbed. **Any adverse ecological impacts arising from habitat loss on this area can be excluded for the Project alone - Scenario 1.**

11.6.44 As part of construction, the majority of the EEC will be restored, with minimal above ground infrastructure (with the exception of the OnSS, which is located away from any records of Fisher's estuarine moth and excluded from further discussion) and unrestored areas (link boxes 2x2m every approx. 500 m, two TJBs onshore within the landfall compound zone), located in areas not suitable for hog's fennel. There will be a delay in vegetation establishment, depending on the seasonal timing of restoration and as Fisher's estuarine moth has a short life cycle (approximately one year), it could impact more than one generation.

11.6.45 No decision has yet been made regarding the final decommissioning policies for VE as it is recognised that industry best practice, rules and legislation change over time. The detail and scope of decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator with a decommissioning plan provided. However, it is likely that the proposed onshore substation would be removed and will be reused or recycled and that the onshore cables would also be removed and recycled, with the transition bays and cable ducts (where used) left *in situ*. For the purposes of a worst-case scenario, it is considered that magnitude of impact and effects associated with decommissioning would be no greater than those identified for the construction phase. This is considered for all features and is not repeated further, construction and decommissioning are assumed to have the same effect and are discussed as one throughout the rest of the onshore section.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.46 Unmitigated habitat loss specifically rough grassland with hog's fennel plants present, undertaken during construction and decommissioning (if cabling is removed) in relation to equipment and compounds required for cable removal impacting hog's fennel, rough grassland could negatively impact Fisher's estuarine moth through loss of food plants- hog's fennel and/ or loss of rough grassland where eggs are laid. As suitable habitat potentially used by the moth could be removed and this could support meta populations associated with the SAC. There is a greater risk of such habitat loss occurring at coastal locations, the A120 corridor and Holland Haven Marshes SSSI. There is a risk that the conservation objectives to restore the population in the SAC could be undermined by activities on VE site by removing or diminishing a potential source of colonizing individuals for the SAC (CO4). The lack of recruitment from outside the SAC also has the potential to impact restoring the distribution of the qualifying species within the SAC (CO5). Therefore, there is a pathway to undermine the conservation objectives of Hamford Water SAC through the Project alone - Scenario 1 and this would adversely affect the integrity of the SAC.

MITIGATION

11.6.47 Mitigation measures to minimise this risk will include pre-construction/ pre decommissioning (if cable removed) checks for the presence of Hog's fennel in areas 1 km from the coast and around the A120 during the June - September period prior to work commencing. If a plant(s) is located and cannot be retained *in situ*, then options for translocation and/or propagation will be explored. It is anticipated that any such exercise would be informed by/in collaboration with conservation work already ongoing, involving Natural England, Tendring District Council, Colchester Zoo, Essex Wildlife Trust, and Writtle College. Details are provided in the OLEMP (Volume 9, Application Document 9.22).

EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.48 With the mitigation described above the risk of damage or disturbance to Fisher's estuarine moth foodplants, and/or individuals outside of the designated site is very low, and the success of mitigation (if required) is highly likely to be successful based on reported conservation efforts to date (Gardiner ., 2016). **The impacts of habitat loss described that could impact Fisher's estuarine moth will not undermine the conservation objectives for Hamford Water SAC and therefore will not have an adverse impact on the integrity of the Hamford Water SAC, when considering the Project alone - Scenario 1.**

OPERATION

11.6.49 During the operational life span 24-40 years of the Project there will be no further planned excavation along the Onshore ECC in relation to scheduled maintenance. There will be some minimal maintenance of habitat around joint bays, TJBs and the OnSS to ensure access is possible for inspection. The OnSS would require the largest amount of habitat maintenance, however this is located the furthest from suitable coastal habitat and does not support rough grassland and hog's fennel required for Fisher's estuarine moth. **Habitat maintenance at the OnSS would not impact Fisher's estuarine moth, and no adverse effect on integrity of the Hamford water SAC is predicted from OnSS maintenance.**

11.6.50 Scheduled maintenance to each cable joint would occur annually, by a pair of personnel. Access could be on foot or by 4x4 vehicle, as this would occur only once per year, no trackway would be required. The potential for impacts on Fisher's estuarine moth is unlikely as link boxes and TJBs will be located inland beyond Holland Haven SSSI, away from the grassland habitats where hog's fennel is likely to occur. No vegetation clearance beyond minor uncovering of the observation chambers will occur. Therefore, the risk to hog's fennel and therefore Fisher's estuarine moth is regarded as de minimus.

11.6.51 On rare occasions (for example, one to two occasions during life span), unscheduled maintenance may be required. This is unknown, but for the basis of an assessment, this could result in up to 80 m of excavation, with habitat damage in any works areas (which may include small compounds) and access areas requirement. Depending on the location, there is the potential for this to negatively impact hog's fennel/ associated grassland and therefore populations of Fisher's estuarine moth.

EFFECTS ON SITE INTEGRITY -UNMITIGATED

11.6.52 Unmitigated habitat loss specifically rough grassland with hog's fennel plants present, undertaken during unscheduled maintenance could negatively impact Fisher's estuarine moth, by impacting suitable habitat for the species, outside of the SAC. This has the potential to undermine the Hamford Water SAC conservation objective four, population of qualifying species and five, distribution within the SAC, by reducing the abundance of a source population to the SAC. This would have an adverse effect on integrity considering the Project alone - Scenario 1.

MITIGATION

11.6.53 For any rare, unscheduled maintenance required, if this is occurring in habitat where hog's fennel could be present (approximately 1 km inland of the coastline and the verge of the A120), a check of the habitat for hog's fennel would be undertaken and inform micro siting to avoid destruction of such plants if present. As unscheduled maintenance would by its nature be rapid and impossible to seasonally schedule, there is a chance that checks for hog's fennel may not be possible, e.g. timed outside of the growing season. The chances of a hog's fennel plant being located within an 80 m stretch where the maintenance would occur is de minimis, as Holland Haven Marshes SSSI would not be disturbed due to the ducted approach used. Therefore, the maximum number of plants which could be lost during such works is not enough to affect the overall population of hog's fennel plants and by association not enough to affect the local Fisher's estuarine moth population or its ability to support the population within Hamford Water SAC.

CONCLUSION FOR THE PROJECT ALONE- SCENARIO 1 - EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.54 With the mitigation outlined, there would be de minimis risk (for unscheduled maintenance only, no risk for scheduled maintenance) of undermining the conservation objectives for Fisher's estuarine moth through habitat loss. As with the outlined mitigation, hog's fennel plants would remain in place, available for the larval stage of the moth, leading to population outside of the SAC being maintained. Such populations will support the restoration of the Fisher's estuarine moth population within the SAC via immigration. **In light of the mitigation, there will be no adverse effects on the integrity of the Hamford Water SAC during scheduled or unscheduled maintenance, as a result of habitat loss when considering the Project alone- Scenario 1**.

PATHWAY 2: CHANGES IN AIR QUALITY

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.55 The habitat of Fisher's estuarine moth (sea walls and dry coastal grassland) is sensitive to increases in nitrogen and acid deposition, and to increases in ammonia, nitrogen oxide and sulphur dioxide levels (APIS, 2022). Changes in the levels of these pollutants in the air may occur during construction and decommissioning when increases in vehicle activity will be required.

11.6.56 For Hamford Water SAC, there is a specific target for air quality which reads "Maintain concentrations and deposition of air pollutants at or below the site-relevant Critical Load or Level values given for the feature's supporting habitat on the Air Pollution Information System" (APIS,2022). For Hamford water SAC these critical levels are:

- For NH_3 level 3 -2-4 µg NH_3 m-3;
- For NO_x/m3 annual mean 30 µg NOx m-3, 24 hour mean 75 µg NOx m-3;
- No SO_2 provided; and
- Nitrogen critical load (kg N/ha/yr) Maximum: 12.6 Minimum: 11.5 Average: 12.1.

11.6.57 The air quality assessment, refer to ES Volume 6, Part 3, Chapter 10: Air Quality, concluded that: Construction road traffic flows generated by VE (in-combination with other relevant plans/ projects) are below the IAQM prescribed screening criteria on road links within 200 m of all SSSIs (and therefore Hamford Water SAC).

EFFECTS ON THE SITE INTEGRITY - UNMITIGATED

11.6.58 Changes in air quality as a result of the Project alone - Scenario 1 will not undermine the conservation objectives of the Hamford Water SAC and not have an adverse effect on the integrity of Hamford Water SAC.

OPERATION

11.6.59 During operation there will be minimal increases in traffic associated with VE, only vehicles associated with annual scheduled maintenance and potentially unscheduled maintenance (similar, although on a smaller scale to construction activity), if required. Both scheduled and unscheduled maintenance will generate less air pollution than during construction.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.60 As construction air quality level changes were below threshold, maintenance levels will be considerably below threshold and will not undermine the conservation objectives for avocet and other species with similar thresholds. Air quality impacts during operation will not have an adverse effect on the relevant designated sites, in relation to air quality during operation for VE alone.

PATHWAY 3: CHANGES IN WATER QUALITY

11.6.61 Declines in water quality or changes in water quantity have the potential to impact Fisher's estuarine moth. Polluted water could kill caterpillars or food plants, changes in water quantity could inundate or dry out habitat, leading Hog's fennel, and rough grassland habitat not to have the correct levels of water (too much or too little), impacting the life cycle of the moth.

11.6.62 Mitigation in the form of the CoCP (Volume 9, Report 21: Code of Construction Practice) includes the following measures in relation to water contamination:

- Areas at risk of spillage, such as vehicle maintenance areas and hazardous substance stores (including fuel, oils, and chemicals) will be bunded and carefully sited to minimise the risk of hazardous substances entering drainage systems or local watercourses. Additionally, the bunded areas will have impermeable bases to limit the potential for migration of contaminants into groundwater following any leakage/spillage. Bunds used to store fuel, oil etc. will have a 110% capacity.
- All fuel and chemical storage will comply with relevant storage regulations. Any refuelling of machinery or washout of concrete transportation vehicles will be undertaken within designated areas. Concrete and cement mixing and wash out areas will be located minimum of 10 m from nearest surface water features, where spillages can be easily contained. These areas will incorporate settlement and recirculation systems to allow water to be re-used. All wash out of equipment would take place in a contained area and the water either treated or collected for disposal off-site.
- All oil and diesel storage facilities will be at least 30 m from any watercourse and at least 50 m from any borehole or well, where practicable;
- A spill procedure will be documented and suitably sized and stocked spill kits kept in the vicinity of potentially hazardous materials storage areas.
- Spill kits and drip trays will be provided for all equipment and at locations where any liquids are stored and dispensed;
- Storage facilities will be provided for solid materials to prevent deterioration of the materials and their escape;
- Storage facilities will be kept secure to prevent acts of vandalism that could result in leaks or spills; and
- All containers of any size will be correctly labelled indicating their contents and any hazard warning signs.
- Where fuel is delivered through a pipe permanently attached to a tank or bowser the pipe will be fitted with a manually operated pump or a valve at the delivery end which closes automatically when not in use. The following management controls will also be implemented:
- The pump or valve will be fitted with a lock;

- The pipe will be fitted with a lockable valve at the end where it leaves the tank or bowser;
- The pipework will pass over and not through bund walls;
- Tanks and bunds will be protected from vehicle impact damage; and
- Tanks will be labelled with contents and capacity information.

For deliveries and dispensing activities, it will be ensured that:

- Site-specific procedures are in place for bulk deliveries;
- Delivery points and vehicle routes are clearly marked;
- Emergency procedures are displayed and a suitably sized spill kit is available at all delivery points, and staff are trained in these procedures and the use of spill kits;
- Suitable facilities (for example, drip trays, drum trolleys, funnels) meet the sites specific dispensing needs and are maintained and used;
- Tank capacities and current contents levels are checked prior to accepting a delivery to ensure that they are not overfilled;
- All deliveries are supervised throughout the delivery operation;
- Spill prevention equipment is used during dispensing activities; and
- All spillages occurring during dispensing and handling activities are cleared up and reported via the appropriate site manager/agent.
- All flammable and hazardous substances will be kept in a secure bunded cupboard, cabinet or tank constructed of materials which are chemically resistant to its contents and suitably ventilated.
- The use of vehicles and plant poses similar risks to those posed by storage of liquids. Fuel and oil may leak from such equipment which may enter drains and/or watercourses, as well as contaminating the ground itself. Vehicle checks will be conducted to ensure fuel storage and engine condition is satisfactory and that no fuel or chemical release will occur during site operations.
- The following measures will be implemented to minimise the risk of pollution through release of silts and sediments:
- Stockpiling of excavated materials during earthworks will be temporary and will only be permitted in designated areas. Designated stockpile areas will be located a minimum of 10 m from any open watercourse features where practicable;
- Disturbance to areas close to watercourses will be reduced to the minimum necessary for the work;
- Excavated material will be placed in such a way as to avoid any disturbance of areas close to the banks of watercourses and to prevent spillage into water features;
- Use of sediment fences along watercourses when working in close proximity to prevent sediment being washed into watercourses;
- Covers will be used by lorries transporting materials to/ from site to prevent releases of dust/ sediment to watercourses or drains; and
- If applicable, storage of stockpiled materials should be on an impermeable surface to prevent leaching of contaminants and covered when not in use to prevent materials being dispersed by wind or rainfall runoff.

The potential for release of drilling fluids as a result of frac-out will be reduced by:

- Undertaking appropriate ground investigation/desk study to inform drilling parameters such as drilling pressures;
- Monitoring of drilling fluid properties (i.e. mud weight, viscosity, gel strength, volume and pressure) during drilling to prevent frac-outs;
- Stopping drilling if unexpected variations or trends are observed and investigating the cause;
- Having frac-out contingency plans and response equipment such as sand bags and clean-up equipment in place; (CoCP and Outline Landfall HDD Method Statement) and
- Regular inspections should also be conducted along the drill path during pilot hole drilling.

11.6.63 Furthermore, the following will be implemented in relation to flood prevention and water crossings:

11.6.64 Any works in a floodplain will incorporate measures to minimise possible obstruction or deviation of floodwater. For example, this will include leaving gaps in soil stockpiles, minimising the height of possible raised structures (e.g. haul road and working areas).

- The contractor should consider implementing measures to manage runoff, particularly to limit runoff directly to roads. These control measures for managing runoff and minimising risk of water pollution include, but not limited to:
- Staff toolbox talks on pollution prevention and spill procedures;
  - The Principal Contractor will sign up to the Environment Agency Flood Alerts and 'Floodline' flood warning services;
  - Visual checks on flood defences, watercourses and drainage culverts will be carried out following a flood event within the working area will be undertaken after any significant weather event. Any signs of degradation reported to the EA and relevant landowner immediately;
  - Debris will be safely contained, reducing the risk of large items entering the flood flow;
  - Monitoring of construction drainage sediment traps (visual inspection) with increased monitoring during inclement weather. If required these traps can be pumped via settling tanks to remove sediment, based on a pre-defined level / depth of sediment; and
  - Machinery will be stored or returned to areas of hard standings, preferably remote from flood waters, or where this is not possible, sufficiently constrained so as not to wash away.
- Flood response awareness and procedures will be included in the principal contractor's emergency response planning where there are works near to a flood zone or residual risk existing from coastal flood defence failure and the risk of tidal flooding to any landfall activities on the seaward side of coastal defences during the construction phase. In the unlikely event of a flood emergency the Principal Contractor will follow its specific flood warning and evacuation plans.

11.6.65 Temporary access track crossings over main rivers will where practical be designed as clear span bridges (i.e. they will span the entire watercourse from bank top to bank top) to minimise disturbance of the channel and maintain water flowing along the watercourse.

- Watercourse crossings will be designed to suit the type of watercourse that is being crossed and will be constructed in a way that minimises the disturbance of channel bed and banks as far as possible.
- The number of haul routes crossing watercourses will be minimized and existing crossings used where practical.
- In order to mitigate the potential impacts to water quality where crossing or working near water courses, the following principles will be applied:
  - Entry into water will be avoided where possible;
  - All cables will be installed beneath the active channel bed;
  - Temporary crossings will be appropriately sized to maintain flow patterns and sediment conveyance, and avoid unnecessary changes to the hydromorphology of the watercourses;
  - Clear span bailey bridges (or similar) or suitable sized culverts will be used to avoid impacts to the hydromorphology of the watercourses. Adherence to best practices and guidance to ensure the risk of pollution is minimised;
  - A temporary haul road bridge, culvert or other temporary measure may be constructed if repeated crossings are required;
  - Where the water flow is high, water will be over pumped during construction to prevent flooding upstream;
  - Cables may be installed under smaller watercourses or ditches using open-cut techniques. Such smaller watercourses or ditches may be temporarily flumed, dammed-up and over-pumped or diverted to allow installation to take place. Trench support may be required to temporarily hold open the excavated trenches either side of the ditch. Trench support will be removed prior to reinstatement, including reinstatement of the watercourse or ditch.

IMPLICATIONS ON CONSERVATION OBJECTIVES

11.6.66 With the actions outlined above from the CoCP in place, there will be no impact on water quality or quantity, in relation to the construction of the Project - Scenario 1.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.67 Qualifying interest features of any identified designated sites will not be affected by any hydrological changes and there will be no adverse effect on designated sites identified. Water quality changes during construction are not discussed further for each individual feature.

OPERATION

11.6.68 Once operational the pathways to impact water quality or quality will be limited to potential changes during unscheduled maintenance. Any unscheduled maintenance would be subject to the same actions outlined in the CoCP (Volume 9, Report 21). Therefore, there will be no impact on water quality or quantity in relation to the operation of the Project.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.69 Qualifying interest features of any identified designated sites will not be affected by any hydrological changes and there will be no adverse effect on designated sites identified. Water quality changes during operation are not discussed further for each individual feature.

PATHWAY 4: LIGHTING

11.6.70 Lighting has the potential to impact Fisher's estuarine moth as moths are shown to be distracted and attracted by artificial light sources, leading to increased mortality through predation or exhaustion (Keinath ., 2021).

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.71 The flying season of the moth is generally September–October, when they fly around or rest upon the food plant; however, there are apparently no data on the dispersal ecology of the Fisher's estuarine moth from the UK or elsewhere in Europe.

11.6.72 Lighting from the construction phase of the Project may affect nocturnal invertebrate behaviour, including that of Fisher's estuarine moth, if present close to construction areas. Fisher's estuarine moth flight times are early September to late October. Lighting of the ECC and TCCs, except for minimal motion activated security lighting would only be during the months when construction hours are in darkness (i.e. at dawn and dusk Oct-April) with one month overlap in the flight times of adult moths (October). Working times are 07:00 to 19:00 from Monday to Saturday. With the sunrise/ sunset in October there are 26 days that will require illumination of which 26 of the 61 nights (42.6%) are during the flight period of the Fisher's estuarine moth. Lighting would also be required where 24-hour working is required, e.g. at major HDD locations only.

11.6.73 The Order Limits i separated from the SAC by at least 717 m of intervening landscape such that light spill is not anticipated to reach the SAC itself. The potential for a significant proportion of the SAC population of Fisher's estuarine moth to be present outside of the SAC boundary is low, based on the lack of desk study records, lack of suitable habitat and lack of larval food plants.

IMPLICATION FOR CONSERVATION OBJECTIVES - UNMITIGATED

11.6.74 Whilst the period of illuminated construction partially overlaps with the flight period during a maximum of two years, there is little possibility for it to interact with the individuals that form part of the population for which the SAC is designated and limited interaction with a supporting population outside the SAC and therefore would not affect the population of moths. Therefore, lighting will not undermine the conservation objectives of Hamford Water SAC when considering the Project alone - Scenario 1.

EFFECTS ON SITE INTEGRITY

11.6.75 On the basis of the above assessment and mitigation, VE alone will not undermine the conservation objectives for Hamford Water SAC and will **therefore not have an adverse effect on the integrity of Hamford Water SAC.**

AVIAN FEATURES

11.6.76 For all avian features, the peak counts which are compared to the SPA populations are derived from birds observed within 400 m of the Order Limits only. The 400 m buffer was requested by Natural England in line with advice provided to other offshore wind farm projects. No significant construction-related disturbance effects to birds are likely beyond 400 m from the Order Limits.

FEATURE 2: AVOCET

DISTRIBUTION AND CONSERVATION STATUS

11.6.77 The coastal survey (SLR 2022) identified avocet at location 1 (near Beach Works TCC on Manor Way and Holland Haven Marshes SSSI) in 9/14, 63% of the survey counts, with a peak count of 45 in March 2022. Observations ranged from an individual to 45 (mean 8.5). Avocet were most frequently observed foraging or roosting on land 42.59% and 29.41% of observations, respectively. At location 2, near the Landfall, avocet were recorded on seven occasions, all observations were on land. Flock size ranged from two to 40 in March 2022. Roosting was more frequently observed, 57.14% of observations were roosting individuals, other behaviours or loafing were recorded for the rest of the observations.

11.6.78 The peak count at location 1 of 45 avocet is equivalent to 14.2% of the Hamford Water SPA avocet population. Birds were observed frequently inland near a pool within Holland Haven Marshes SSSI. These birds are assumed to be part of an SPA population.

11.6.79 During the 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, avocet were only recorded in Section 1 within 400 m of the Order Limits on three occasions, with a peak count of five individuals.

11.6.80 NF OWF has undertaken relevant surveys in the vicinity of the cable route, which covers a similar area to VE, detailed in Figure 11.20 for the immediate onshore areas and Figure 11.21 for the cable route. MacArthur Green has granted permission for the data to be used to inform the VE RIAA, these reports are included as a technical appendix to the PEIR and are specifically:

- Part 6, Annex 4.24: North Falls Offshore Wind Farm Onshore Landfall Area: 2020/21 Non-breeding Bird Surveys;
- Part 6, Annex 4.25: North Falls Offshore Wind Farm Onshore Landfall Area: 2021/22 Non-breeding Bird Surveys;
- Part 6, Annex4.26: North Falls Offshore Wind Farm Onshore Cable Route: Non-breeding Bird Surveys 2021-22; and
- Part 6, Annex 4.27: North Falls Offshore Wind Farm Onshore Landfall Area: Breeding Bird Surveys 2021.

11.6.81 During surveys for NF OWF, avocet has been confirmed as present within compartment D (Holland Haven Marshes SSSI) within Section 1 throughout the winter, peak count 42 (March) in year one 2020/21, and 37 (March) in year two 2021/22, observed in 9/14 surveys. Avocet were also confirmed as breeding within the central lagoon within the Holland Haven Marshes SSSI, near Beach Works TCC on Manor Way, likely to be the location of the peak count described. A peak count of 39 avocets were recorded in 2021, that included fledged young.

11.6.82 Within the summary report that consolidates all bird records, avocet were only observed with Section 1, the peak count of individuals (45) was observed within 400 m of Beach Works TCC and the associated access along Manor Way (SLR 2023). All observations of avocet within 400 m of the Order Limits are presented in Appendix A Drawing 3, Sheet 29 in Part 6, Volume 4, Annex 4.6.

618000 619000 620000 621000 622000 623000

220000 219000 218000 217000 216000

A B C D E

Legend:

- Search Area
- Survey Area
- Survey Compartment
- Holland Haven Marshes Site of Special Scientific Interest (SSSI)
- Holland Haven Local Nature Reserve
- Breeding Bird Survey (BBS) Transect Route
- Vantage Point (VP)

Source: RHDHV, MacArthur Green

MacArthur Green

North Falls Onshore

Figure 11.20

Landfall Search Area: Survey Area

0 250 500 Metres

MAP SCALE: 1:17,500 @ A3

N

Map Author: LNF Checked: RD Approved: RD Status: Rev0

Document Path: S:\Projects\RHDHV\North Falls_NFA\03_Data\O_CF_Fig1_LSA_SvA_NFA.mxd

Datum: OSGB 1936, Projection: British National Grid

Date: 26/08/2021

Stour and Orwell Estuaries (SPA)

Hamford Water (SPA)

Colne Estuary (Mid-Essex Coast Phase 2) (SPA)

Holland Haven (LNR)

Holland Haven Marshes (SSSI)

a

b

c

d

e

f

g

TENDRING DISTRICT

Legend:

- Landfall Search Area
- **Ornithological Designated Sites**
- *Source: Natural England*
- Special Protection Area (SPA)
- Site of Special Scientific Interest (SSSI)
- Local Nature Reserve (LNR)
- Survey Tile Extent
- Survey Area

Source: MacArthur Green, RHDHV

MacArthur Green

North Falls Onshore Cable Route

Figure 11.21

Onshore Cable Route: Survey Area

0 1 2 km

MAP SCALE: 1:60,000 @A3

N

Map Author: LM Checked: LNF Approved: RD Status: Rev1

Document Path: S:\Projects\RHDHV\North Falls_NFA\03_Data\O_R_Annual_OnshoreCableRoute_Fig1_SvA_NFA.mxd

Datum: OSGB 1936, Projection: British National Grid

Date: 28/06/2022

EUROPEAN AND RAMSAR SITE CONTEXT

11.6.83 Avocet is a non-breeding qualifying interest feature, for Hamford Water SPA and a breeding interest feature for the Stour and Orwell estuaries SPA, refer to Appendix 1 for full details of any of the mentioned designated sites.

11.6.84 Breeding avocet located within the Stour and Orwell Estuaries SPA are only considered for direct impact on potential water quality changes and through potential effects on a possible supporting population via habitat loss and disturbance impacting recruitment into the breeding population. This is because the Stour and Orwell estuaries SPA breeding colony is too distant from the ECC to be affected by disturbance or habitat loss when at the colony and there is no suitable habitat for this species within the ECC that is within foraging range (6 km; Enners ., 2019) of this breeding colony.

11.6.85 Wintering or passage birds within the Hamford Water SPA will utilise habitat outside of the Hamford Water SPA, potentially within the Onshore ECC, and therefore a broader set of pathways are assessed for this SPA.

11.6.86 Breeding avocet located within Holland Haven Marshes SSSI could be a supporting population for Hamford Water SPA and/ or the Stour and Orwell Estuaries SPA, through exchange of individuals in the relevant seasons to each designation. Avocet have been observed to not have high site fidelity (Lengyel, 2006), i.e. avocet fledged at Holland Haven Marshes SSSI could breed at Hamford Water SPA or the Stour and Orwell Estuaries SPA in the future.

11.6.87 The conservation status of non-breeding avocet was identified as favourable for Hamford Water SPA, as the most recent BTO Wetland Bird Survey (WeBS) five-year mean (2017/19-2021/22) was 772 and the number of avocet when the site was designated (as stated in the SPA citation) was 317. Therefore, the conservation objective will be to maintain the non- breeding population within Hamford water SPA.

11.6.88 For breeding avocet within the Stour and Orwell Estuaries SPA, 21 pairs are detailed in the citation. Information on current breeding population was limited, although a report by NE regarding assessment of a coastal path proposal from 2020 suggests breeding success has been variable for this species in the Stour and Orwell Estuaries SPA in the last decade. Essex bird reports from 2019 (2020 excluded due to reduced survey during Covid lockdown) (Essex Birdwatching society 2019) identified 14 pairs nesting in locations within the Stour and Orwell Estuary SPA, below the 21 pairs in the citation. Therefore, avocet have an unfavourable conservation status for the Stour and Orwell Estuaries SPA. The conservation objective will therefore be to restore this population.

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.89 Direct habitat loss will not occur in any onshore, coastal, or intertidal SAC, SPA or Ramsar site.

11.6.90 The majority of habitat loss will be temporary, only during construction. With permanent habitat loss limited to only the footprint of TJBs, junction boxes and the OnSS. There will be no permanent intertidal habitat loss. Any permanent habitat loss for avocet will be minimal (refer to Volume 6, Part 3, Chapter 1: Onshore Project description) and could not undermine the conservation objectives for any SPA; it is therefore excluded from the assessment.

11.6.91 As described above, avocet have been recorded during extensive surveys within the intertidal landfall area (Section 1) and Holland Haven Marshes SSSI (in the vicinity of the Beach Works TCC and Manor Way Access track) but not within the Onshore ECC (as amended). Therefore, habitat loss that could impact avocet would be in relation to the landfall and within the intertidal area, Beach Works TCC. This will be temporary loss of foraging habitat for the duration of the construction works in this location only. Holland Haven Marshes SSSI will be crossed by HDD to preserve the habitats present, ensuring no permanent infrastructure would be located within the SSSI boundary.

11.6.92 During construction, temporary habitat loss would displace foraging avocet from the intertidal area for the duration of drilling activities. However, there will be intertidal habitat available in adjacent areas (but see also Pathway 2: Disturbance, below). Temporary loss of foraging habitat could lead to increased travel distances to find food during the winter. However, avocet were rarely recorded between November and December and numbers were low during January and February (max three individuals), suggesting the intertidal area is relatively infrequently used in the core winter months by this species and the most important foraging habitats for this species during the winter are elsewhere.

11.6.93 Breeding avocet forage between 0.3-5.9 km from nests mainly during the daytime (Enners ., 2019), the intertidal area at the landfall is within this distance from Hamford Water SPA. Therefore, birds which breed at Hamford Water SPA could forage at the landfall location along with birds that breed at Holland Haven Marshes SSSI, although there is likely to be much better foraging habitat within Hamford Water SPA and the birds which breed at that locality would be expected to remain there to forage at least most of the time.

11.6.94 Despite Hamford Water SPA being designated only for wintering avocet, the majority of which are likely to be birds which breed on the continent (Brown and Grice, 2010), recruitment into this wintering population could come partly from birds which breed at Hamford Water, Holland Haven and other local sites. Therefore, breeding success at Hamford Water and Holland Haven may influence the qualifying interest wintering population of avocet at Hamford Water SPA.

11.6.95 In the worst-case scenario, the intertidal habitat is an important resource for breeding adults and the temporary loss of intertidal habitat during construction means that a greater distance must be travelled by breeding adults, away from nests and chicks, increasing the risk of nest failure. There will still be other intertidal habitat available for foraging avocet during the construction, however the use is dependent on disturbance, discussed later. Consequently, the breeding site within Holland Haven Marshes SSSI may become less viable, as adults would not have a nearby intertidal foraging resource during the construction period.

11.6.96 During decommissioning, there will be minimal temporary loss of habitat at the key sensitive locations that will have been crossed by HDD, as underground cable will likely be left *in situ* when ducted. In areas where cabling is removed the effects would be similar to construction and are therefore considered to be the same. This is the same for all avian features and therefore decommissioning is not discussed further within this RIAA with the exception of the in-combination assessment with regard to habitat loss.

IMPLICATION ON CONSERVATION OBJECTIVES - UNMITIGATED

11.6.97 Temporary habitat loss during construction will be minimal, and intertidal habitat will still be available in the vicinity for foraging avocet. However, there is a potential to impact upon conservation objectives of Hamford Water SPA and Stour and Orwell Estuaries SPA by impacting the population of avocet, if breeding is impacted by the location of the manor way access, beach works TCC and beach haul road, through limiting access to the intertidal foraging area during the breeding season. This assumes, based on the precautionary principle, that the immediate landward intertidal area is important for foraging adults during the breeding season and that any avocet that fledge from Holland Haven Marshes SSSI are part of the Hamford Water SPA winter population or become part of the Stour and Orwell Estuaries SPA breeding population. This could undermine conservation 4, population of avocet within both SPAs, by reducing recruitment into the population. The risk is greater for the Stour and Orwell Estuaries SPA breeding population, since it is known that avocet fledged in one location will move to another to breed (Grice and Brown, 2010), and the Stour and Orwell breeding population is thought to be in unfavourable condition (whereas the wintering population of avocet at Hamford Water is likely to comprise mainly continental migrants and is in favourable condition (the population now being much higher than when the site was designated).

MITIGATION

11.6.98 Construction land loss will be minimal and temporary, for the construction time frame only. For the landfall, this will be a maximum of one breeding season. As avocet are a Schedule 1 species, intentional or reckless disturbance of this species while breeding is an offence. Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation sets out the following in relation to Schedule 1 species in relation to survey: *Surveys for Schedule 1 bird species and other breeding species of conservation concern which are likely to be particularly sensitive to disturbance, e.g. breeding waders, will take place prior to and during construction (as required). Avoidance of disturbance to these species whilst nesting will be achieved through the implementation of disturbance-free buffer zones around active nests. The extent of any buffer zones will be species and location-specific and will be determined by the ECOW, taking into consideration relevant guidance and experience from other sites, as appropriate. The ECOW will also monitor nesting attempts to check that the agreed buffer zones are successful.*

EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.99 Therefore, relevant precautions will be undertaken to prevent habitat loss impacting breeding pairs as set out in 11.6.98. This will not undermine the conservation objectives for Hamford Water SPA or Stour and Orwell Estuaries SPA. **Therefore, there will be no adverse effect on integrity of the afore mentioned sites in relation to habitat loss and avocet, with mitigation in place, for the Project alone - Scenario 1.**

OPERATION

11.6.100 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE OF THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.101 During construction activities there is a risk of disturbing avocet, and other bird species.

11.6.102 Disturbance of birds during construction (and de-commissioning), through noise, lighting or the presence of site workers/machinery/boats displacing birds using intertidal habitat or land used for foraging near the coast or inland in proximity to the Onshore ECC, TCC, access routes (i.e. existing network used more frequently by Heavy Goods Vehicles (HGVs) or temporary haul roads (e.g. within the ECC working area) from their habitat with knock-on effects on survival. Disturbance can lead to effective habitat loss, as birds will not utilise the habitat impacted by the noise or visual disturbance.

11.6.103 Birds can be affected by either visual or noise disturbance resulting from development schemes (Prater, 1978). The susceptibility of birds to disturbance depends on the intensity, frequency, and duration of the source of disturbance. In general, infrequent, high-intensity activities tend to cause more disturbance than continuous low-intensity activities. In terms of visual disturbance vehicles and vehicle movements tend to be tolerated much better than people on foot. With noise disturbance, birds appear to quickly habituate to continual noises so long as there are no large amplitude ‘startling’ components (Hill ., 1997).

11.6.104 In general, larger bird species, particularly those which form flocks in open habitats, tend to be more vulnerable to disturbance than smaller species in more enclosed habitats. Although different species vary in their tolerance of disturbance, waterbirds are generally susceptible to disturbance and tend to preferentially select roosting or foraging sites where levels of disturbance are low.

11.6.105 Taken in isolation, disturbance from a single development may simply result in birds being displaced into alternative habitat further from the source of disturbance. In many cases this may have no discernible effect on the population of the species concerned. However, if birds are unable to compensate for lost feeding time, disturbance can affect their ability to maintain their energy reserves and may therefore affect individuals' chances of surviving cold weather. A study from Cardiff Bay highlighted that redshank that were displaced to other habitats in the winter had lower survival rates and adults were significantly lighter than non-displaced redshank (Burton ., 2006). Sustained disturbance can also affect numbers of birds using a site in the longer term. The impact of disturbance on whole sites depends on the availability and carrying capacity of alternative habitats within the site. The carrying capacity of sites is rarely known with certainty and as such a precautionary approach should be adopted.

11.6.106 Visual disturbance is possible if works take place adjacent to areas used by SPA / Ramsar site qualifying bird species.

11.6.107 Noise disturbance must also be considered in the context of an environment subject to relatively low existing levels of background noise. As such 'general' construction noise is likely to have a significant effect, with noise disturbance even more likely during construction works involving loud, irregular noise such as the occasional use of loud machinery and piling.

11.6.108 The waterbird tool kit was used where possible to gain an understanding of a species sensitivity to visual and noise disturbance.

11.6.109 This resource classifies visual disturbance in three ways:

- High level disturbance - Regular reactions by birds to stimuli, birds remaining in the affected area may not forage efficiently. Caused by workers operating outside equipment, fast movement of plant, large plant in close proximity to birds.
- Moderate level - High level disturbance that has occurred over a long time, so birds are habituated or less intrusive works, that cause a degree of disturbance.
- Low level - Stimuli that is unlikely to cause a response from birds, i.e. work out of sight of birds. Plant that birds have become habituated to.

11.6.110 A visual representation is provided in Figure 11.22.

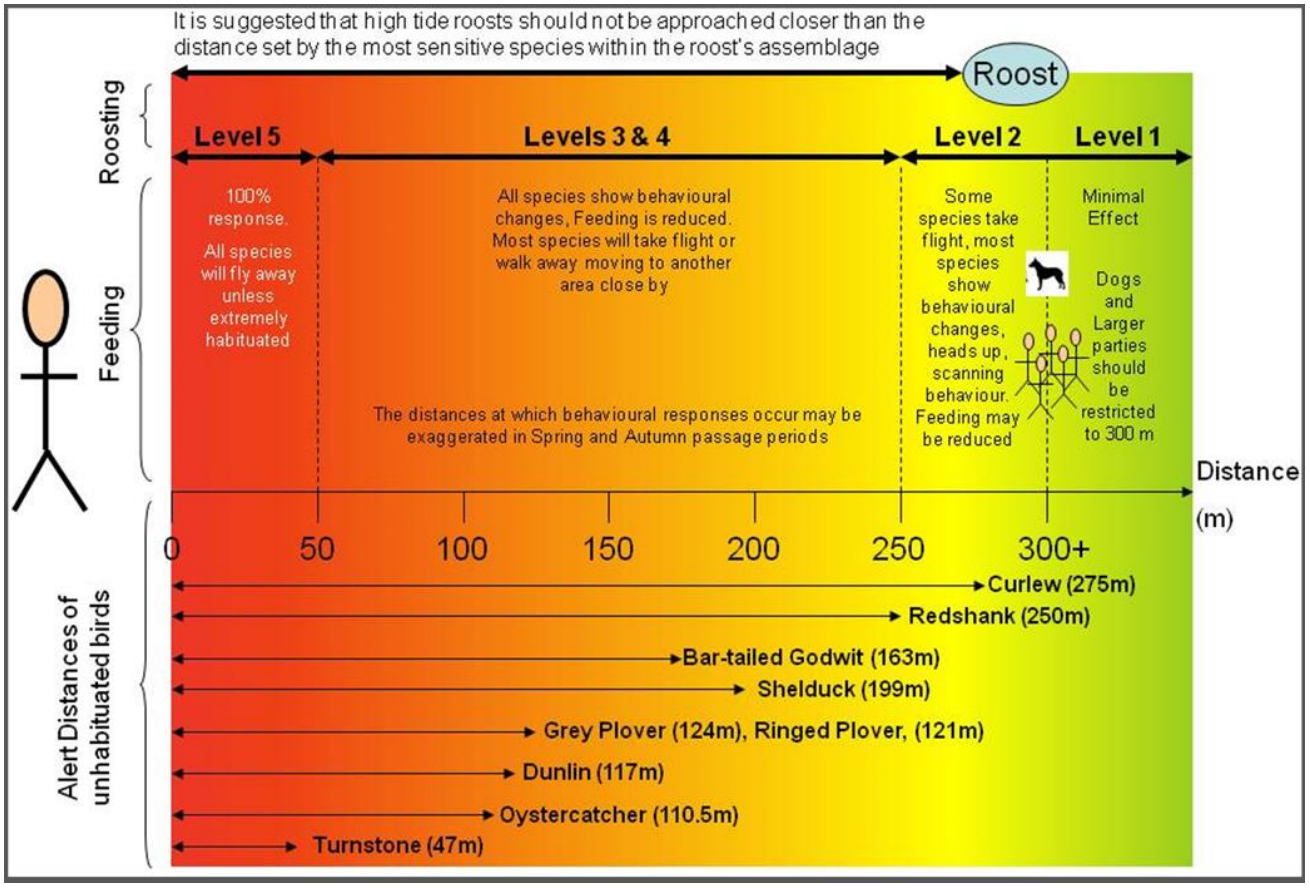


Figure 11.22 Visual Representation of Visual Disturbance from Cutts *et al*., 2009

11.6.111 Avocet were identified from the survey data to utilize the intertidal habitat occasionally and Holland Haven Marshes SSSI. Directional drilling will be used to go under Holland Haven Marshes SSSI. Therefore, the associated Beach Works TCC, piling and drilling rigs will be located either side of the SSSI at approximately 245 m from the main lagoon used by avocet.

11.6.112 The HDD exit pits may be located within the intertidal zone or the shallow subtidal depending on the type of drill used. The drilling rig would be located on the coast. Boat movements to bring the cable to shore would also occur in the subtidal/ intertidal zone. In terms of disturbance, the coast, intertidal and subtidal zone would experience disturbance during construction. The existing Manor Way will be used for access near the SSSI and Beach Works TCC will be located at the end of this road.

11.6.113 Avocet are not included in the waterbird disturbance and mitigation toolkit. However, a study by Cutts and Hemingway 2021 concluded that avocet have a visual disturbance tolerance no greater than the generic wader tolerance (80 -100 m) and for noise disturbance, the generic wader threshold of response 70dBAfmax was considered suitable for avocet. Habituation was noted, with tolerance of some percussive impulse events greater than the 70dBAfmax threshold. Although sudden loud noises, approx. 120-140dBAFmax at source still induced a response. At the start of the day or following a period of cessation of activity, there were also instances of responses from noise below 70dBAfmax.

11.6.114 The noise assessment is provided in Table 11.49 and location of the noise is provided in Figure 11.23. Note that the A-weighting is a filter applied to a spectrum of noise that best represents the human response to sound rather than birds. Furthermore, the equivalent continuous noise level considers a fluctuating level and provides a fixed value with the same sound energy over the assessment period and is not the maximum noise level that may be experienced in the same period, which will be higher than the figures stated.

621000
622000
623000
219000
218000
217000
N
Great Holland
Clacton Road
Short Lane
CR-1
AC-2
TCC2
AC-1
TCC1
Clacton Road
Frinton Golf Course
Short Lane
Holland Haven
Sewage Works
AC-0
Beach Works TCC
Clacton Road
Thorpe-le-Soken
Kirby-le-Soken
Kirby Cross
WALTON-ON-THE-NAZE
A133
Wrabness
Wix
Wrabness Heath
Wix Heath
FRINTON-ON-SEA
Little Clacton
Great Holland
Great Oakley
Holland-on-Sea
St Osyth
CLACTON-ON-SEA

LEGEND

- Onshore Order Limits
- Offshore Order Limits
- Onshore Export Cable Corridor
- Trenchless Crossing Indicative Alignment
- Temporary Beach Access Zone
- Temporary Construction Compound
- Off Route Haul Road
- Access and Crossing Zone
- Landfall Compound Zone
- Indicative Landfall Compound
- Landfall Exit Pit Sheet Piling Zone

Obstacle Crossing Register - Five Estuaries Circuits (Excluding Utilities Crossings)

- Committed Trenchless
- Haul Road Obstacles
- Trenched, Trenchless or Other (To be Determined at a Later Date)

Obstacle Crossing Register - North Falls Ducts (Excluding Utilities Crossings)

- Committed Trenchless
- Haul Road Obstacles
- Trenched, Trenchless or Other (To be Determined at a Later Date)

0 0.1 0.2 0.4
Kilometres

PROJECT TITLE:
FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
COASTAL LOCATION FOR THE MAIN NOISE AREAS

VER	DATE	REMARKS	Drawn	Checked
1	14/03/2024	ES Submission	DB	JRS

DRAWING NUMBER: 11.22

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:10,000	A3	OSGB 1936	British National Grid

FIVE ESTUARIES
OFFSHORE WINDFARM

Table 11.49 Noise assessment at different distances data presented refers to A-weighted equivalent continuous noise level (LAeq) Bold figures ≥70LAeQ. Some tasks could take place at the same time as a number of other operations – those marked in the table with an '*', '+' or '#' could occur at the same time as others with a matching symbol, all other works are likely to happen after each other.

Ref	Construction Activity	Location	Distance From Source (m)								
			25	**50**	**75**	**100**	**150**	**250**	**500**	**750**	**1000**
1*	Construction of Landfall TCC	Manor Way Beach Works TCC	76	69	65	63	59	54	47	43	40
2+	Construction compound operations	Manor Way Beach Works TCC	73	66	62	60	56	51	44	40	37
3	TCC site removal	Manor Way Beach Works TCC	75	68	64	62	58	53	46	42	39
4	Landfall HDD compound establishment	Landfall HDD compound	86	79	75	73	69	64	57	53	50
5	HDD Rig mobilisation/ demobilisation	Landfall HDD compound	83	76	72	70	66	61	54	50	47

Ref	Construction Activity	Location	Distance From Source (m)								
			25	50	75	100	150	250	500	750	1000
6*#	HDD operations from the Landfall compound	Landfall HDD compound	81	74	70	68	64	59	52	48	45
7*#	Excavation of transition joint bays	Landfall HDD compound	83	76	72	70	66	61	54	50	47
8*#	Excavation of transition joint bays	Landfall HDD compound	83	76	72	70	66	61	54	50	47
9*#	Construction of TJBs	Landfall HDD compound	78	71	67	65	61	56	49	45	42
10	Pull-in of export cables from onshore	Landfall HDD compound	78	71	67	65	61	56	49	45	42
11	Open Trenching and onshore cables up to and into TJB (trench excavation)	Landfall HDD compound	85	78	74	72	68	63	56	52	49

Ref	Construction Activity	Location	Distance From Source (m)								
			25	50	75	100	150	250	500	750	1000
12	Open Trenching and onshore cables up to and into TJB (trench backfill)	Landfall HDD compound	85	78	74	72	68	63	56	52	49
13	Open trenching and onshore cables up to and into TJB (trench reinstatement)	Landfall HDD compound	85	78	74	72	68	63	56	52	49
14	Jointing of onshore and offshore cables in TJBs	Landfall HDD compound	79	72	68	66	62	57	50	46	43
15	Roof and backfill over TJBs	Landfall HDD compound	84	77	73	71	67	62	55	51	48
16	TCC and access road removal	Landfall HDD compound	85	78	74	72	68	63	56	52	49

Ref	Construction Activity	Location	Distance From Source (m)								
			25	50	75	100	150	250	500	750	1000
17	Establish beach compound	Beach	72	65	61	59	55	50	43	39	36
18#	Excavation of intertidal exit pit	Beach	79	72	68	65	62	57	50	46	43
19+	Excavation on the beach of open trench	Beach	72	65	61	59	55	50	43	39	36
20	Pull-in of export cables from offshore and backfilling open trench on beach	Beach	72	65	61	59	55	50	43	39	36

11.6.115 Noise greater than 70 dB up to 100 m from the activity is predicted for:

- Landfall HDD compound establishment (activity ref:4);
- HDD rig mobilisation (activity ref: 5);
- Landfall HDD compound removal (activity ref: 7);
- Excavation of TJB (activity ref:8);
- Open trenching and onshore cables up to and into TJB (trench excavation) (activity ref: 11);
- Open trenching and onshore cables up to and into TJB (trench backfill) (activity ref: 12);
- Open trenching and onshore cables up to and into TJB (reinstatement) (activity ref:13);
- Roof and backfill over TJBs (activity ref: 15); and
- TCC and access road removal (activity ref: 16).

11.6.116 These works are at or beyond the threshold for avocet at average levels, however, the distance at which the 70dBAfmax threshold is exceeded on occasion will be a greater distance from the activity as the average (LAeq) is only presented here and this does not incorporate sudden louder noise.

11.6.117 These activities would be primarily located within:

- The Manor Way TCC (1) 50 m from intertidal habitat and 230 m from the lagoons within Holland Haven Marshes SSSI (where breeding avocet have been recorded),
- Landfall HDD compounds 800 m north from the lagoons within Holland Haven Marshes SSSI or;
- Beach operations, adjacent to the intertidal area and 800 m (beach haul road, Manor Way access and Beach TCC) from the lagoons within Holland Haven Marshes SSSI. Refer to Figure 11.23.

11.6.118 From the distances where the construction noise will be above 70dB on average detailed in cover the intertidal area but exclude the lagoons within Holland Haven Marshes SSSI. However, the area experiencing noise greater than 70dB on occasion (non LAeq, but the more erratic loud noises) will be wider and may include the lagoons within Holland Haven Marshes SSSI.

11.6.119 Visual disturbance would also impact birds using the intertidal area, specifically, the Manor Way access and Beach Works TCC is located approximately 190 m from the lagoons within Holland Haven Marshes SSSI, landfall HDD compound and the off-route haul road runs alongside the beach area.

11.6.120 Avocet are likely to be disturbed to a point where they are displaced from parts of the intertidal and onshore habitat, specifically the haul road throughout the duration of construction, based on noise and visual disturbance. Avocet are not predicted to be displaced from Holland Haven Marshes SSSI, due to the distance of this habitat from the TCC and haul road, although the birds may occasionally be disturbed by construction noise here. The likelihood of this is increased when activities occur at the landfall HDD compound, Manor Way, and Beach Works TCC or the beach simultaneously.

IMPACTS FOR CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

HAMFORD WATER SPA

11.6.121 Visual and noise disturbance will limit the use of the intertidal habitat in the immediate vicinity of the project by avocet for the duration of construction and potentially decommissioning if cabling is removed. Displacing a maximum of c. 45 avocet at location 1 near Beach Works TCC and beach access and c. 40 at the landfall location during the winter, from 2021/22 wintering bird data. Other foraging locations may be present, however these are unknown. In the worst-case scenario, displacement of birds from the intertidal area could result in death of avocets, as displaced birds either do not find alternative foraging habitat, they expend too much energy being flushed from foraging grounds or loose condition and have a subsequent increased mortality risk (Burton *et al.*, 2002 and Burton *et al.*, 2006).

11.6.122 Displacement of adult avocet from the intertidal area opposite the SSSI during the breeding season has the potential to impact breeding success and recruitment into the Hamford Water SPA wintering (and breeding) population. Considering the duration of the landfall works (seven months), the maximum impact would be one breeding season during construction another during decommissioning, if cabling is removed. The peak count of avocet in Holland Haven Marshes SSSI in the 2021 breeding survey was 39, and all were likely to comprise breeding birds (MacArthur Green 2021). This would equate to approximately 19-20 breeding pairs. If one chick reached independence from each nest a recruitment to the Hamford water SPA non-breeding population would be a maximum of 20 avocets.

11.6.123 However, taking account of juvenile mortality at 0.41 (BTO), the recruitment from Holland Haven Marshes SSSI would be 8.2, 1% of the current Hamford Water SPA population in the longer term. This would be the maximum loss of winter recruitment if avocet breeding at Holland Haven Marshes failed for one season, due to temporary disturbance (and temporary) habitat loss on the intertidal habitat, and all the surviving fledged birds joined the wintering population at Hamford Water SPA, which is unlikely as most avocet migrate southwards from their breeding grounds for winter. **Overall, this loss could not undermine the conservation objectives or have an adverse effect on the integrity of the Hamford Water SPA because the population of avocet now is very much higher than when the site was designated; a small population decline as a result of habitat loss or disturbance from the Project would not be enough to affect the favourable conservation condition of avocet within Hamford Water SPA.**

STOUR AND ORWELL ESTUARIES SPA

11.6.124 The possible reduction in recruitment to the Stour and Orwell Estuaries SPA is harder to calculate as avocets breed at around two to three years of age, applying the juvenile mortality (0.41) and then the adult mortality (0.78) gives approximately 2.62 avocets, so a maximum of roughly another breeding pair, 4.7% of the Stour and Orwell SPA breeding population. In contrast to the situation at Hamford Water SPA, interchange of individuals between breeding sites is likely, the population is unfavourable and any reduction in recruitment into the population could hinder the restoration of the population to a favourable conservation condition.

11.6.125 Therefore, there is potential for the Project alone - Scenario 1 unmitigated to undermine the conservation objectives (CO4 restore the population of the qualifying interest features within the SPA) due to temporary disturbance (and temporary habitat loss) during construction disturbing breeding avocet potentially reducing recruitment into the Stour and Orwell estuaries breeding population in the long term.

MITIGATION

11.6.126 The landfall location is located over 500 m from areas occupied by SSSI breeding waders and based on current data, timing restrictions on piling are not considered necessary. However, the Beach Works TCC is located in proximity to the SSSI. Where significant disturbance to important breeding bird species is likely, HDD pits and other working areas at the landfall would be fenced during the bird breeding season (March to August inclusive) to provide an element of visual and acoustic screening of active working areas. The aim of the fencing would be to reduce disturbance to Schedule 1 birds and other breeding species of conservation concern, e.g. breeding waders such as avocet (qualifying features of the SPA), within Holland Haven Marshes SSSI.

11.6.127 Surveys for Schedule 1 bird species will take place, as detailed in 11.6.75.

11.6.128 The OLEMP (Volume 9, Annex 9.22: Outline Landscape and Ecological Management Plan) and CoCP includes measures to reduce disturbance to important populations of non-breeding birds at the landfall including:

- Impact piling (if required at the landfall) would either take place outside the winter period (October to March) or would utilise less noisy, vibro or push -piling technology.
- Fencing/ hoarding would be used during the winter months to provide visual and acoustic screening of the landfall compound Where practical, in areas where disturbance to significant numbers of non-breeding waterbirds is likely, measures such as fencing/ hoarding would be used during the winter months to provide visual and acoustic screening of active working areas. The requirement for such measures would be determined by the ECoW, considering the nature and timing of the works and relevant bird data, including previous survey data and observations made during the construction period. Full details of proposed fencing type and approach would be provided in the final LEMP stage, post consent but prior to construction commencing, once detailed construction designs and programmes are available.
- If necessary, works at the landfall 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. Any cold weather suspension of works, if required, would only apply at the landfall as non-breeding waterbirds are likely to move to the coast during such conditions (as the inland fields would be frozen).
- Construction lighting at other HDD locations would be at the lowest, safest permissible level and with light spill minimised.

- On site measures would be overseen by an ECoW during construction to carry out pre-commencement checks for the presence of designated features and to ensure that mitigation measures are in place and that the impacts are either being avoided or satisfactorily mitigated, Mitigation measures that would fall within the remit of the ECoW would include cessation of works in very cold weather, review of effectiveness of acoustic and/or visual screening.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - MITIGATED

11.6.129 As explained above, even without mitigation the conservation objectives for Hamford Water SPA will not be undermined by the Project alone - Scenario 1, **therefore there will be no adverse effect on integrity of Hamford Water SPA in relation to wintering avocet for the Project alone - Scenario 1 during construction and decommissioning**.

11.6.130 With the mitigation in place, disturbance will be reduced and the conservation objective to restore the population of avocet within **the Stour and Orwell estuaries SPA will not be undermined by the Project alone - Scenario 1, therefore there will be no adverse effect on integrity of the Stour and Orwell SPA in relation to breeding avocet for the Project alone - Scenario 1 during construction and decommissioning**.

OPERATION

11.6.131 Refer to paragraphs 11.6.49 to 11.6.51 for full detail on scheduled (annual, access by a pair of personnel on foot or in a 4x4) and unscheduled maintenance (rare occasions, unknow events, basis of assessment 80 m of excavation with habitat damage in the TCC and access areas required).

11.6.132 Scheduled maintenance would occur once annually, this will result in minor disturbance. Inspection would be comparable to walkers or a single vehicle accessing habitat. If the visit occurred during a spell of freezing weather, temperatures below zero °C when the ground is frozen for seven days or more, there is the potential for a negative impact, disturbing foraging avocet when they are most energetically fatigued, this could impact survival of wintering avocet, if present. Survey data suggests that avocet are rarely present in the intertidal area in the coldest parts of winter (peak counts recorded in March).

11.6.133 Unscheduled maintenance could result in considerable amount of disturbance, and due to nature, would not be possible to seasonally schedule. Holland Haven Marshes SSSI would not be impacted by any unscheduled maintenance due to the ducted approach used. The intertidal area accounts for approximately 0.7% of the onshore cable route, the chances of an unscheduled maintenance event occurring in this small proportion of the route is relatively low. Although climate change and associated sea level rise and adverse weather conditions will make the intertidal area more unpredictable, this will be incorporated into the calculations for the design and location of onshore infrastructure.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

11.6.134 Scheduled maintenance presents minimal risk, as it occurs very briefly once a year and will not disturb breeding avocet, as scheduled maintenance will be located outside of the Holland Haven Marshes SSSI, as no above ground infrastructure or non- reinstated ground will be present within the SSSI. Avocet are not recorded in the coldest months, therefore if avocet are disturbed in the intertidal area during scheduled maintenance they will not be thermodynamically stressed and there will be no increase in mortality. Scheduled maintenance will not undermine conservation objectives of either the Hamford Water SPA or the Stour and Orwell SPA, **therefore no adverse effect on integrity of either site is predicted from disturbance of avocet during scheduled maintenance occurring during operation.**

11.6.135 Unscheduled maintenance has the potential to cause disturbance, if located within the intertidal area Holland Haven Marshes SSSI would not be a location for any unscheduled maintenance due to the ducted approach used. As breeding avocet are listed as a schedule 1 species within the Wildlife and Countryside Act, disturbing breeding avocet during unscheduled maintenance would class as an offence. Therefore, disturbance of nesting birds within the SSSI can be ruled out. The chances are low of unscheduled maintenance occurring, but if such maintenance is required it could have an impact on avocet using the intertidal area, depending on time of year. **There is no potential to undermine the conservation objectives of Hamford Water SPA. There would be no adverse effect on the integrity of Hamford Water SPA is possible because the wintering population of Hamford Water is now very much higher than when the site was designated, the number of birds affected by disturbance would be low and the incidence of disturbance would be rare.**

11.6.136 However, as described for the construction stage, there is the potential to undermine conservation objective four: maintain populations of interest feature for Stour and Orwell Estuaries SPA, if adult breeding avocet are disturbed during unscheduled maintenance and breeding is subsequently negatively impacted. **This could have an adverse effect on the integrity of Stour and Orwell estuaries SPA for the Project alone - Scenario 1 unmitigated.**

MITIGATION

11.6.137 The following mitigation would be used for unscheduled maintenance: Schedule 1 breeding bird checks (if during the breeding season), refer to Table 8.1. Timing of piling (October- March) if required, fencing of works if within or within 100 m of the Holland Haven Marshes SSSI.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - MITIGATED

11.6.138 As described above, the conservation objectives for Hamford Water SPA would not be undermined, even without mitigation. **Therefore, in terms of the Project alone - Scenario 1 during operation would have no adverse effect on the integrity of Hamford Water SPA.**

11.6.139 With mitigation in place Conservation objective four would not be undermined for the Stour and Orwell Estuaries SPA. **Therefore, the Project alone - Scenario 1 during operation, with mitigation would have no adverse effect on the integrity of the Stour and Orwell estuaries SPA due to the disturbance of avocet outside the SPA boundary during the breeding or non- breeding season.**

PATHWAY 3 – DECREASE IN WATER QUALITY AND QUANTITY (IMPACTING PREY AVAILABILITY)

11.6.140 Changes in water quality could lead to decreases in prey species for waterbirds, reducing foraging success and survival in the long term. In addition, decreasing water availability could also impact foraging habitat, leading lead to prey no longer having habitat available and equally declines in foraging success, impacting survival in the long term.

CONSTRUCTION AND DECOMMISSIONING

11.6.141 With standard mitigation detailed within the CoCP (Volume 9, Report 21) implemented, there will be no impact on water quality or quantity, due to the method of working outlined in the CoCP summarised in Section 11.6.62. For avocet, and all avian features this means water will still support suitable prey items and as quantity will not be impacted, there will be no drying of habitat used by foraging avocet or avian features in relation to the Project.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY – UNMITIGATED

11.6.142 The conservation objectives of any qualifying interest features will not be undermined by any hydrological changes and there will be no adverse effect on integrity on the relevant SPAs in relation to the Project alone - Scenario 1 with avocet in the citation. The same conclusion is reached for all subsequent avian features and this pathway is not discussed further.

OPERATION

11.6.143 Once operational the pathways to impact water quality or quality will be limited to potential changes during unscheduled maintenance. Any unscheduled maintenance would be subject to the same actions outlined in the CoCP, Therefore, there will be no impact on water quality or quantity in relation to the operation of the Project.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY – UNMITIGATED

11.6.144 Qualifying avian interest features of any identified designated sites will not be affected by any hydrological changes and there will be no adverse effect on designated sites identified. Water quality changes during operation are not discussed further for each individual feature.

PATHWAY 4 – DECREASE IN AIR QUALITY

11.6.145 Changes in air quality have the potential to impact habitats that Avocet rely upon. Changes in vegetation structure and diversity can impact prey availability and therefore impact survival.

CONSTRUCTION AND DECOMMISSIONING

11.6.146 Air quality assessment, refer to Volume 6, Part 3, Chapter 10: Air Quality of the ES identified four pathways that could impact designated sites during construction and decommissioning:

- Vessel emissions
- Dust
- Road traffic emissions
- Non-Road Mobile Machinery (NRMM) emissions

11.6.147 Analysis found there was no adverse effect on any designated sites. Habitats within the Holland Haven Marshes SSSI were potentially at risk from road traffic emissions. However, the analysis identified that emissions from vehicle movements upon SSSIs will be below the IAQM screening thresholds (1,000 / 200 HDV AADT) including in-combination with relevant committed developments.

11.6.148 Nevertheless, data from the APIS website was collated to inform the assessment of the impacts of air quality changes on avocet for Hamford Water SPA/ Ramsar site and the Stour and Orwell Estuaries SPA. This is detailed in Table 11.50.

Table 11.50 Data from APIS website pertaining to thresholds for air quality for avocet at relevant designated sites

Species	Nutrient Nitrogen Empirical Critical Load kgN/ha/yr	Acidity Class	NH3 Critical Level (µg NH3/m3 Annual Mean)	Critical Level (µg NOx/m3 Annual Mean)	SO_2
Hamford Water SPA					
Avocet	20-30	Intertidal- Not sensitive	3	30	Intertidal - No critical level assigned
Stour and Orwell SPA					
Avocet	20-30	Not sensitive	3	30	Intertidal - No critical level assigned

11.6.149 The levels of nutrient nitrogen kg N/ha/yr for the maximum modelled impact of VE, primarily during construction were 0.1 for identified woodland sites, the nitrogen deposition on the SPA/ Ramsar sites is considered to be similar. This is substantially below the threshold.

11.6.150 Ammonia (NH3) is used in relation to fertilizer application to arable land. The VE and NF Project will not include any addition of fertilizer and therefore NH3 is not considered further and is excluded from the assessment.

11.6.151 The air quality chapter of the ES (Volume 6, Part 3, Chapter 10: Air Quality) reports the in maximum annual mean background NOx µg/m3 in 2022 as 10.2 and 2027 as 8.8. Changes in NOx are associated with construction traffic flow generated by VE, NOx changes were modelled and then described in the Air Quality chapter. The result was significantly below the threshold of 30 µg/m3 being between 0.6 and 0.1 µg/m3 for the identified ecological receptors. This will be similar or lower for SPAs and Ramsar sites.

11.6.152 SO2 has no critical level assigned for avocet in the SPAs and therefore is not discussed further.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.153 All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website for avocet in both SPAs. Therefore, the conservation objectives would not be undermined by any changes associated with the Project and air quality. **There will be no adverse effect on Hamford Water or the Stour and Orwell estuaries SPA in relation to air quality during construction for VE and NF (Scenario 1) alone in relation to avocet.**

11.6.154 The threshold values in Table 11.50 are taken from the threshold values for higher plants and are the same for the majority of features and for all the designated sites. Therefore, for other features in this assessment unless otherwise stated, **there will be no adverse effect on the relevant designated sites, in relation to air quality during construction for VE alone.** Cross reference is made to this section and new data is only provided for species where this differs to the thresholds provide in Table 11.50.

OPERATION

11.6.155 During operation there will be minimal increases in traffic associated with VE, only vehicles associated with annual scheduled maintenance and potentially unscheduled maintenance (similar, although on a smaller scale to construction activity), if required. Both scheduled and unscheduled maintenance will generate less air pollution than during construction.

IMPLICATION FOR CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.156 As construction air quality level changes were below threshold, maintenance levels will be considerably below threshold and will not undermine the conservation objectives for avocet and other species with similar thresholds.

11.6.157 Air quality impacts during operation will not have an adverse effect on the relevant designated sites, in relation to air quality during operation for VE alone.

FEATURE 3: BLACK-TAILED GODWIT

DISTRUBUTION

11.6.158 Black-tailed godwit were recorded within the NF OWF survey area (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), predominantly associated with the coastal area and Holland Haven Marshes. One was recorded from Compartment E (Route Section 3), which covered a small area of Hamford Water SPA, and the bird is likely to be associated with the SPA.

11.6.159 Coastal surveys (SLR 2022) recorded black-tailed godwit near the Beach Works TCC on Manor Way and Holland Haven Marshes SSSI, with a peak count of 15 individuals (mean 6.42), and the birds most frequently observed foraging around water bodies associated with Holland Haven Marshes SSSI. At location 2 (landfall), there was peak count of two individuals (mean 1.33), observed on three occasions, located beyond 400 m from the Order Limits boundary. Foraging was the most frequently observed behaviour.

11.6.160 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, black-tailed godwit were recorded within 400 m of Route Section 3 of the Order Limits, on two occasions in October 2022.

11.6.161 During the breeding bird survey for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), three black-tailed godwits were observed in compartment D (Holland Haven Marshes SSSI) and these were classified as non-breeding.

11.6.162 During the non-breeding bird surveys for the NF OWF Landfall, there was a peak count of 16 black-tailed godwit in compartment B Holland Brook in the winter of 2021/22 and a peak count of five black-tailed godwit in the preceding winter (2020/21). In addition, there was peak count of 21 in the 2021/22 winter in compartment D, Holland Haven Marshes.

11.6.163 Within the summary report that consolidates all non- breeding bird season records, black-tailed godwit were observed within 400 m of Route Section 3 and within 400 m of Beach Works TCC and the associated access along Manor Way (SLR 2023). All observations of non- breeding black-tailed godwit within 400 m of the Order Limits are presented in Appendix A, Drawing 3, sheet 41 and 42 in. Volume 6, Part 4, Annex 4.6.

CONSERVATION STATUS

11.6.164 Black-tailed godwit are designated as a non-breeding qualifying interest feature within the following designated sites that are screened in for assessment, refer to:

- Hamford Water SPA;
- Hamford Water Ramsar site;
- Stour and Orwell Estuaries SPA;
- Stour and Orwell Estuaries Ramsar site;
- Colne Estuary SPA;
- Blackwater Estuary SPA; and
- Black Water Estuary Ramsar site.

11.6.165 Conservation objectives are as stated in 11.6.30.

11.6.166 As described in 11.6.87, WeBS data was compared to the citation population figures (i.e. the qualifying population size) for the different designated sites. For all sites the black-tailed godwit population was favourable, except Hamford Water SPA and the Stour and Orwell Estuaries SPA, refer to Table 11.51. Even for these two sites, the current population has declined by less than 10%.

Table 11.51 Conservation status analysis for black-tailed godwit

Designated Site	Citation Population	BTO WeBS Count 17/18-21/22 for Relevant Area	Change	Favourable Conservation Status Y/N	CO Restore or Maintain	Survey Peak Count (%) of Citation Population
Hamford water SPA	1121	844	-277	N	Restore	**1.87**
Hamford Water Ramsar site	377	844	+467	Y	Maintain	**5.57**
Stour and Orwell Estuaries SPA	2559	2841	+282	Y	Maintain	0.82
Stour and Orwell Estuaries Ramsar site	2157	2841	+684	Y	Maintain	0.97
Colne Estuary SPA	606	955	+349	Y	Maintain	**3.47**
Blackwater Estuary SPA	1280	3070	+2315	Y	Maintain	**1.64**
Blackwater Estuary Ramsar site	2174	3070	+896	Y	Maintain	0.97

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.167 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.168 During construction, temporary habitat loss would displace foraging black-tailed godwit from the intertidal and immediate onshore area for the duration of construction activities, this could result in as many as 21 black-tailed godwit being displaced (peak number observed near Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI), the percentage of the citation population represented by the peak count of black-tailed godwit is provided in Table 11.51.

11.6.169 Similar habitat would be available outside the works compounds and haul road. However, the use of this habitat is likely to be limited due to disturbance, discussed as a separate pathway below.

11.6.170 Impacts would be greatest at Beach Works TCC, Manor Way access and the beach access, compared to the landfall location, as greater numbers of black-tailed godwit were observed in the vicinity of Beach Access TCC in breeding and non-breeding months.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.171 Temporary habitat loss during construction has the potential to undermine conservation objective four, restoring the population of qualifying features for:

- Hamford Water SPA

11.6.172 It is assumed that black-tailed godwit that were recorded during the surveys form part of the wintering population of this SPA.

11.6.173 For the other designations, the populations are in favourable condition, in excess of the citation populations and therefore habitat loss outside the SPA/Ramsar affecting a relatively small number of birds (21 or less) would not be enough to undermine the conservation objective to maintain the populations of black-tailed godwit within these designated sites.

11.6.174 The construction of the onshore cable route has the potential to impact black-tailed godwit within the intertidal habitat and habitat near the existing pumping station, specifically the Manor Way access, Beach Works TCC and HDD landfall compounds. Birds were less frequently recorded in the intertidal area. Temporary loss of habitat will prevent access to foraging habitat. Temporary habitat loss will be for a maximum of two seasons. The actual area of habitat loss will be small, with the majority of loss being temporary (TCC, access haul roads etc.) disturbance, which is discussed later, will be the key pathway and will have the bigger effect.

11.6.175 Habitat loss will be limited and will not undermine conservation objectives and therefore will have no adverse effects on the integrity of the designated sites identified (Hamford water SPA/ Ramsar site, Stour and Orwell estuaries SPA/ Ramsar site, Colne estuary SPA or Black water estuary SPA/ Ramsar site).

OPERATION

11.6.176 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE OF AN SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.177 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.178 Black- tailed godwit are specified in Cutts *et al.,* 2013 as a species of moderate sensitivity, tolerant of moderate visual (80-100 m) and noise disturbance threshold of 70dBAfmax.

11.6.179 Noise assessment: refer to Figure 11.23 and Table 11.49.

11.6.180 The assessment is the same as for avocet, refer to 11.6.119. Black-tailed godwit are likely to be disturbed to a point where they are displaced from intertidal and coastal habitat near Beach Works TCC and potentially from Holland Haven Marshes SSSI habitat throughout the duration of construction at this location, based on noise and visual disturbance.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.181 The black-tailed godwit using the habitat within the coastal area could be part of the qualifying population of any of the identified designated sites detailed in the HRA screening; there is no information on core foraging distances in the regular literature (SNH, 2016). Therefore, designated sites cannot be ruled out based on distance. Disturbance during construction has the potential to cause mortality of black-tailed godwit, though reduced foraging, and increased expenditure of energy. However, the survey results confirm that the number of birds affected is small, maximum 21. As described above, disturbance of a relatively small number of birds outside the relevant sites could not undermine the conservation objectives for the sites where the population is in favourable condition. **However, for Hamford Water SPA where the population is in unfavourable condition, there is a risk that such disturbance and potential mortality would undermine conservation objective 4: to restore the population of black-tailed godwit. This would have an adverse effect on the integrity of the identified designated sites.**

MITIGATION

11.6.182 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.183 With the mitigation outlined above, the conservation objectives would not be undermined for the identified sites in relation to non-breeding black-tailed godwit during construction and decommissioning for the Project alone - Scenario 1. **Therefore, there would be no adverse effect on integrity of the identified sites (Hamford water SPA/Ramsar site, Stour, and Orwell estuaries SPA/Ramsar site, Colne estuary SPA or Black water estuary SPA/Ramsar site), in relation to disturbance of black-tailed godwit during construction and decommissioning for the Project alone - Scenario 1.**

OPERATION

11.6.184 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.185 Scheduled maintenance would occur once annually, this will result in minor disturbance. If the visit occurred during a spell of freezing weather, there is the potential for a negative impact on disturbing foraging black-tailed godwit when they are most energetically fatigued. This could impact the survival of black-tailed godwit utilising the habitat.

11.6.186 Unscheduled maintenance could result in considerable amount of disturbance, and due to nature of the works, would not be possible to seasonally schedule. Disturbance could impact black-tailed godwit using coastal habitat for foraging in the winter. The coastal area accounts for approximately 0.7% of the onshore cable length, the chances of an unscheduled maintenance event occurring in this small proportion of the route is relatively low. Although climate change and associated sea level rise and adverse weather conditions will make the intertidal area and immediate onshore area more unpredictable, this will be incorporated into the calculations for the design and location of onshore infrastructure.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.187 As scheduled maintenance is only one visit annually, this disturbance is very limited, the only pathway to undermine conservation objectives is if birds were disturbed when highly stressed, i.e. in cold weather. Additional energy expenditure and lack of foraging time could cause changes in survival for those birds involved (Burton *et al.*, 2002 and Burton *et al.*, 2006). There is potential to undermine CO 4: population but only where the objective is to restore the population and only if the birds affected could form part of those populations. **Therefore, there is a risk of an adverse effect on the integrity of the Hamford Water SPA.**

11.6.188 Unscheduled maintenance has the potential to cause disturbance, if located within the intertidal or immediate onshore area, such maintenance would not be located within Holland Haven Marshes SSSI due to the ducting process used. The chances are low of the unscheduled maintenance occurring within the key intertidal area used by black-tailed godwit, but if such maintenance is required it could have an effect on black-tailed godwit using the intertidal area, depending on time of year. **There is potential to undermine conservation objective 4: restoring populations of black-tailed godwit for Hamford Water SPA and therefore an adverse effect on integrity of this site.** The chance of such maintenance being required at the intertidal or immediate inshore locations is relatively low and it would be infrequent and short duration and therefore very unlikely to result in the mortality of any black-tailed godwit.

MITIGATION

11.6.189 Scheduled maintenance should only occur in weather above freezing, to ensure that any birds that are disturbed are not thermodynamically stressed, refer to 11.6.137. Screening of unscheduled maintenance, if in the vicinity of Holland Haven

11.6.190 Marshes SSSI as detailed for construction, refer to 11.6.128.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.191 As described for the construction stage, disturbance of a relatively small number of birds could not undermine the conservation objectives or have an adverse effect on site integrity, for the sites where black-tailed godwit is in favourable condition, even without mitigation.

11.6.192 For the site where the restore objective applies (Hamford Water SPA), with the mitigation outlined in place, the conservation objectives of this SPA would also not be undermined and **there would be no adverse effect on site integrity of Hamford water SPA/Ramsar site, Stour and Orwell estuaries SPA/Ramsar site, Colne estuary SPA or Black water estuary SPA/Ramsar site, in relation to non-breeding black-tailed godwit, for the Project alone - Scenario 1 arising from disturbance during operation.**

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.193 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE alone.**

FEATURE 4: DARK-BELLIED BRENT GOOSE

DISTRIBUTION

11.6.194 Within the coastal area, brent geese were recorded at landfall location 1 (near Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI) in 15.48% of the survey counts, with a peak count of 900 in December 2021. Observations ranged from 1 to 900 (mean = 85.42). Brent Geese were most frequently observed in flight offshore (79%) with 21% of observations being of birds in flight onshore (SLR 2022). At the landfall, brent geese were recorded on thirty-six occasions. Observations ranged from 1 to 1,100 with a peak count of 1,100 in December 2021 (mean = 148.86). Brent Geese were most frequently observed in flight offshore (77%) with 23% of observations being of birds onshore. The highest density of Brent geese was located along the shore adjacent to Holland Haven Marshes SSSI.

11.6.195 The peak count at location 1 of 900 brent geese is equivalent to 0.667% of the UK non-breeding population and the peak count at location 2 of 1,100 brent geese is equivalent to 0.815% (SLR 2022).

11.6.196 During the 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, Brent geese were recorded within 400 m of Route Section 3 on three occasions, where counts ranged between 65, 40 and nine individuals. From the North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), three onshore locations are important for over wintering Brent goose. A peak count of 1,100 was observed in Compartment C, Great Holland, in year 2 (2021-22), a peak count of 770 was observed in Compartment E at Frinton golf club in year 1 (2020-21), and there was a peak count of 248 in Compartment D at Holland Marshes in year 2 (North Falls, 2021).

11.6.197 From the NF OWF surveys within the cable route, Brent geese were observed on one occasion, in November where 124 were recorded south of Manningtree near Lawford, this is approximately 2 km from both the proposed OnSS or onshore cable route for VE.

11.6.198 Within the summary report that consolidates all non- breeding bird season records, Brent geese were recorded within 400 m of the Order Limits in only two Route Sections, Route Section 3 (three observations refer to Figure 11.15). The rest of the observations were concentrated in Route Section 1, within the Onshore Order Limits there was a peak count of 1,000 Brent geese, within the 400 m buffer at the landfall the peak count of 1,100 was recorded, on land and within the intertidal area. Within the location of Beach Works TCC, Manor Way and beach access near Holland Haven Marshes SSSI Brent geese were recorded within the 400 m buffer on nine occasions, with counts ranging from one to 900 and were associated with Holland Haven Marshes SSSI north of Manor Way. All observations of Brent geese within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 1 and 2 in Volume 6, part 4, 4.6.

11.6.199 Brent geese were recorded in the winter only, Rowell and Robinson (2004) identified that the majority of Brent geese occur at estuarine sites, from late September to March, when they depart from the UK. The first habitats used by the geese are intertidal areas and inland feeding only occurs when the intertidal areas are depleted of food in early/ late winter, with inland feeding highest at high tide. The Hamford Water SPA population is reported use habitat inland, specifically at Holland Haven Marshes.

CONSERVATION STATUS

11.6.200 Brent geese are designated as a qualifying interest non-breeding bird species in the following citations for designated sites:

- Hamford Water SPA;
- Hamford Water Ramsar site;
- Stour and Orwell Estuaries SPA;
- Stour and Orwell Estuaries Ramsar site;
- Colne Estuary SPA;
- Colne Estuary Ramsar site;
- Blackwater Estuary SPA; and
- Blackwater Estuary Ramsar site.

11.6.201 The designated sites in consideration are those within 5 km of the Project, as this is the distance the Brent geese fly inland from roost sites, (McKay *et al.*, 2001). The designated sites within 5 km of the Project are:

- Hamford Water SPA;
- Hamford Water Ramsar site;
- Stour and Orwell SPA; and
- Stour and Orwell Ramsar site.

11.6.202 For all SPAs the conservation objectives are the same and are detailed in 11.6.30

11.6.203 As described in 11.6.87 WeBS data was compared to the citation population figures for the different designated sites, refer to Table 11.50.

Table 11.52 Conservation status analysis for brent goose

Designated Site	**Citation Population**	**BTO Webs Count 17/18 - 21/21 for Relevant Area**	**Change**	Favourable **Conservation Status** Y/N	**CO Restore or Maintain**	**Survey Peak Count (%) of Citation Population**
Hamford water SPA	6892	4609	-2283	N	Restore	**16.0**
Hamford Water Ramsar site	3629	4609	+980	Y	Maintain	**30.3**
Stour and Orwell Estuaries SPA	2627	3497	+870	Y	Maintain	**41.9**
Stour and Orwell Estuaries Ramsar site	2133	3497	+1364	Y	Maintain	**51.6**

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.204 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.205 The majority of Brent geese were observed flying offshore from the intertidal surveys, some observations were inland, specifically within the locality of Clacton Road and these are assumed to be foraging flocks, this is close to the vicinity of TCC 1 and 2. During construction temporary habitat loss could displace any foraging Brent geese from inland areas, however there will be other similar habitat available nearby. The reason habitat nearby would not be used is due to disturbance (see pathway 2), not direct habitat loss.

IMPLICATION ON CONSERVATION OBJECTIVES – UNMITIGATED, AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.206 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, conservation objective four for the identified designated sites, maintaining/ restoring the population of qualifying features, for the identified designated sites would not be undermined by habitat loss during construction or decommissioning of the Project alone - Scenario 1. The construction of the onshore cable route has the potential to impact non-breeding Brent geese within the landfall habitat, specifically the landfall HDD exit pit, the TCC 1 near great Holland Lodge. Temporary loss of habitat will prevent access to foraging habitat, however similar habitat will be available outside of the relatively small construction areas. **The impact of habitat loss alone (excluding disturbance, discussed later) would not undermine any of the conservation objectives, therefore would not have an adverse effect on integrity of Hamford Water SPA/Ramsar site and Stour and Orwell SPA/Ramsar site and mitigation for habitat loss is not required.**

OPERATION

11.6.207 During operation of the Project – Scenario 1 there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.208 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.209 Brent geese are specified in Cutts *et al.* 2013 as a species of high sensitivity. Being sensitive to moderate and high levels of visual disturbance, geese within 400 m of the works would be disturbed by construction works. Visual disturbance is dependent on behaviour. When foraging, visual disturbance is tolerated, relatively nearby, with a threshold of 105 m for first reaction. When roosting, this increases to 205 m. Brent geese are sensitive to noise disturbance, partly due to their liability to flush 100 m is considered the approach distance and therefore 110-115 dB at source would be the threshold for this species, increasing to 300 m at 120-125 dB.

11.6.210 For the noise assessment, refer to Figure 11.23 and Table 11.49. Brent geese are unlikely to be found in areas of high disturbance, within 100-150 m of the construction noise, further when there are louder noises (table only contains Laeq).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.211 As Brent geese have been identified using onshore habitat within 93 m (observations adjacent to Holland Haven Marshes SSSI along the coast)-400 m of TCC/off site haul roads there is a considerable risk of disturbance because Brent geese are a species of high sensitivity to disturbance. The largest number recorded inland was 1,100 individuals at the location along Clacton Road, Frinton and Walton, CO13 0JU, grid ref TM 20957 17953 (approximately 250 m from TCC 2 and 3), a considerable proportion of the citation population for the SPA and Ramsar sites where Brent geese are included on the citation, refer to Table 11.52. Brent geese in Route Section 1 have also been recorded using Holland Haven Marshes SSSI, the intertidal area near Beach Works TCC and Manor Way access and using habitat north of Frinton golf club, near Beach Works TCC. Within Route Section 3 the majority of records of Brent geese are on the edge of the 400 m buffer, with only one observation within approximately 300m of the Order Limits. Disturbance has the potential to limit foraging and therefore has the potential to impact survival of Brent geese within the vicinity (Burton ., 2002 and Burton ., 2006). **This would undermine conservation objective four, the restoration of the population for Hamford Water SPA where Brent goose is in unfavourable condition, leading to an adverse effect on integrity of the identified designated sites.**

MITIGATION

11.6.212 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

11.6.213 Planting of unsuitable crops in advance of construction to deter Brent geese from foraging on land near construction locations was considered as a mitigation option, however this was ruled out for the following reasons:

- Practically the Project only has control land effectively within the order limits and therefore, planting in these areas only is unlikely to be effective.
- Co-ordinating farmers over a large area (route section 1) with uncertainty on start dates etc. would take a great amount of persuasion and co-ordination. Any uncertainty in start dates could cause bad feeling amongst the local community.
- Brent geese were recorded in highest numbers near landfall, where screening will be employed to reduce disturbance.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY- MITIGATED

11.6.214 With the mitigation outlined, the conservation objectives of SPA and Ramsar sites with Brent goose in the citation would not be undermined in relation to disturbance. Therefore, with the mitigation outlined, no adverse effect on site integrity of Hamford Water SPA/Ramsar site and Stour and Orwell SPA/Ramsar site with regard to non-breeding Brent goose in the citation, during construction and decommissioning, for the Project alone - Scenario 1.

OPERATION

11.6.215 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.216 Scheduled maintenance would occur once annually, this will result in minor disturbance if undertaken during the winter. Inspection would be comparable to walkers and or a single vehicle accessing the habitat. If the visit occurred during a spell of freezing weather when they are most energetically fatigued, there is the potential for a negative impact, disturbing foraging Brent geese in Route Section 1 (near Clacton Road TTC 1 and 2) and Dairy House Farm on the ECC. This could impact survival of non-breeding Brent goose, if present (Burton ., 2002 and Burton ., 2006).

11.6.217 Unscheduled maintenance could result in a considerable amount of disturbance, and due to the nature, would not be possible to seasonally schedule. Disturbance could impact non-breeding brent goose within the immediate landfall/ inland habitat. This accounts for approximately 5% of the onshore cable route, the chances of an unscheduled maintenance event occurring in this small proportion of the onshore cable route is relatively low. Although climate change, associated sea level rise and adverse weather conditions will make the intertidal and immediate coastal land more unpredictable, this will be incorporated into the calculations for the design and location of onshore infrastructure.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.218 As scheduled maintenance is only one visit annually, this disturbance is very limited, the only pathway to undermine conservation objectives is if birds were disturbed when highly stressed, i.e. in cold weather (Burton ., 2002 and Burton ., 2006). Additional energy expenditure and displacement from foraging resources could cause changes in survival for those birds involved. **Impacting Conservation Objective four: restoring the population within the SPA or Ramsar site and an adverse effect on integrity, due to the numbers seen in this vicinity.**

11.6.219 The same can be said for unscheduled maintenance, although this could last considerably longer; days to weeks rather per event rather than a single day per annum, be harder to schedule and create more disturbance. However, the chance of such maintenance being required at the immediate inshore locations during the winter and cold weather is relatively low, and its incidence would be rare (one year of many) and temporary. Therefore, it would not have lasting effects on the Brent goose population.

MITIGATION

11.6.220 Scheduled maintenance should only occur in weather above freezing, to ensure that any birds that are disturbed are not thermodynamically stressed, refer to 11.6.133.

11.6.221 Unscheduled maintenance is harder to mitigate, timings are harder to implement due to the nature of the requirement. Implementation of screening of any maintenance near coastal grassland habitat would limit disturbance to an extent.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.222 With the mitigation outlined for scheduled maintenance there would be no adverse effect on site integrity, through undermining the conservation objectives of the identified sites in relation to non-breeding Brent goose, due to disturbance and potential impacts on survival.

11.6.223 The incidence of unscheduled maintenance in the coastal area during cold weather in the winter will be so low that it could not affect the non-breeding Brent geese population, and the screening used during mitigation would also lessen any disturbance impact. With mitigation in place conservation objective four would not be undermined for any of the identified SPAs or Ramsar sies where Brent goose have been identified. **Therefore, the Project alone - Scenario 1 during operation, with mitigation would have no adverse effect on the integrity of the designated sites identified via the disturbance of Brent geese outside the SPA or Ramsar site boundary during the non- breeding season.**

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.224 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE alone.**

FEATURE 5: GREY PLOVER

DISTRIBUTION

11.6.225 During the intertidal surveys (SLR 2022) no grey plover were during the landfall intertidal non-breeding bird surveys 2021/22.

11.6.226 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits did not record grey plover.

11.6.227 From North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) did record grey plover, but all records were outside 400 m of the Order Limits.

11.6.228 Grey plover were not recorded during the North Falls breeding bird survey 2021, between April and July 2021.

CONSERVATION STATUS

11.6.229 Grey plover are designated as a non-breeding species in the following citations for designated sites:

- Hamford water SPA;
- Stour and Orwell Estuaries SPA;
- Stour and Orwell Estuaries Ramsar site;
- Blackwater Estuary SPA; and
- Blackwater Estuary Ramsar site.

11.6.230 For all SPAs the conservation objectives are the same and are detailed in 11.6.30.

11.6.231 As described in 11.6.86, WeBS data was compared to the citation population figures for the different designated sites, for all sites the grey plover population was unfavourable, except Blackwater Estuary SPA, refer to Table 11.53.

Table 11.53 Conservation status analysis grey plover

Designated Site	Citation Population	BTO Webs Count 17/18-21/202 for Relevant Area	Difference	Favourable Conservation Status Y/N	CO Restore or Maintain
Hamford Water SPA	3251	1391	-1860	N	Restore
Stour and Orwell Estuaries SPA	3261	1955	-1306	N	Restore
Stour and Orwell Estuaries Ramsar site	3204	1955	-1249	N	Restore
Blackwater Estuary SPA	2172	2857	+685	Y	Maintain
Blackwater Estuary Ramsar site	4215	2857	-1358	N	Restore

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.232 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.233 Specifically foraging habitat will be temporarily lost for the duration of the works. Holland Haven Marshes SSSI and Frinton Golf Club will be crossed by HDD to preserve the habitats present, ensuring no permanent infrastructure are within the SSSI boundary.

11.6.234 During construction temporary habitat loss could displace grey plover from habitat if these birds were to use habitat nearer the Order Limits than previously recorded. Grey plover were only observed beyond 400 m of the Order Limits and in very low numbers less than 0.2% of the population of any designated site identified, in August. The birds are likely to be on migration or passing through, rather than resident for non- breeding season.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

11.6.235 The numbers of grey plover observed are so low, and its occurrence so infrequent, that permanent or temporary loss of habitat arising from the Project could not undermine the conservation objective to restore the population for any of the identified SPAs or Ramsar sites with grey plover is in unfavourable condition.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.236 There will be no adverse effect on the integrity of the identified designated sites for the Project alone - Scenario 1 in relation to grey plover and habitat loss.

OPERATION

11.6.237 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.238 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.239 Grey plover are classified as a moderate sensitivity bird, that is relatively disturbance tolerant, with a high tolerance of moderate and high-level visual disturbance, however, birds closer than 200 m to works should be considered prior to commencement of activity.

11.6.240 Noise assessment, refer to Figure 11.23 and Table 11.49.

IMPACTS ON CONSERVATION OBJECTIVES - UNMITIGATED

11.6.241 The numbers of grey plover observed are so low and observations are beyond 400 m, that the conservation objectives of any of the identified sites with grey plover as an interest feature will not be undermined in relation to disturbance caused by the Project alone - Scenario 1. **Therefore, there will be no adverse effect on the integrity for any of the identified SPA or Ramsar sites in relation to grey plover regarding disturbance by the Project alone - Scenario 1**.

OPERATION

11.6.242 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.243 Scheduled maintenance would occur once annually, this will result in minor disturbance within the Order Limits. Grey plover have been recorded in August only and 400 m beyond the Order Limits. In winter disturbance can have more of an impact because birds are more energetically fatigued. Therefore, disturbance of grey plover at the times they have been observed and at the distance from the Order Limits would not impact survival.

11.6.244 Unscheduled maintenance could result in considerable amount of disturbance, and due to the nature of the works, would not be possible to seasonally schedule. The proportion of habitat used by grey plover is very limited and may not be part of the Onshore ECC at all, depending on the landfall location chosen (only observed at Frinton Golf Club).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.245 The numbers of grey plover observed are very low and the distance from the Onshore Order Limit was greater than 400 m there would be no possibility to undermine the conservation objectives of any of the identified sites with grey plover as an interest feature. **There would be no adverse effect on Hamford Water SPA, Stour and Orwell Estuaries SPA/ Ramsar site and Blackwater estuary SPA/ Ramsar site regarding disturbance of grey plover by the Project alone - Scenario 1.**

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.246 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE alone.**

FEATURE 6: REDSHANK

DISTRIBUTION

11.6.247 During the intertidal survey (SLR 2022), two sightings of redshank were recorded at near Beach Works TCC, the Manor Way access and Holland Haven Marshes SSSI, with a peak count of four and another count of two (mean = 2.33). Of the six recorded individuals five were observed on land within Holland Haven Marshes SSSI and one was in the offshore area. The main behaviour observed was foraging (50%). No redshank were observed at the landfall location. Observations were in early November and late March, perhaps indicating passage birds.

11.6.248 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, recorded redshank on one occasion within the 400 m buffer of the Order Limits within Route Section 3, where two were observed.

11.6.249 From the North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), redshank were recorded breeding in low numbers (peak count of six) within Compartment D (Holland Marshes) in 2021 and were recorded twice within the same area during non-breeding surveys, with a peak count of three. Observations were in August and March, beginning and end of the non-breeding season. Along the North Falls Cable route, redshank were recorded in compartment E and F, outside the Onshore ECC search area for VE.

11.6.250 Within the summary report that consolidates all non- breeding season bird records, redshank were observed within 400 m of Route Section 3 and within 400 m of Beach Works TCC and the associated access along Manor Way, with a peak count of five (SLR 2023). All observations of redshank within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 52 and 53 in in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.251 Redshank are designated as a non-breeding bird species in the following citations for designated sites and also as a passage species within the Stour and Orwell Estuaries SPA:

- Hamford Water SPA;
- Hamford Water Ramsar site;
- Stour and Orwell Estuaries SPA (non-breeding and passage);
- Stour and Orwell Estuaries Ramsar site;
- Colne Estuary SPA;
- Colne Estuary Ramsar site; and
- Blackwater Estuary SPA.

Table 11.54 Conservation status analysis redshank

Designated Site	**Citation Population**	**BTO Webs Count 17/18-21/22 for Relevant Area**	**Difference**	Favourable **Conservation Status** Y/N	**CO Restore or Maintain**	**Survey Peak Count (% of The Citation Population)**
Hamford water SPA	1461	1960	+498	Y	Maintain	0.34
Hamford water Ramsar site	2099	1960	-139	N	Restore	0.24
Stour and Orwell Estuaries SPA	3687	2529	-1158	N	Restore	0.14
Stour and Orwell Estuaries Ramsar site	2657	2529	-128	N	Restore	0.19
Colne Estuary SPA	1252	1329	+77	Y	Maintain	0.40
Colne Estuary Ramsar site	1624	1329	-295	N	Restore	0.31
Blackwater Estuary SPA	1079	2856	+1777	Y	Maintain	0.46

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.252 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

11.6.253 The numbers of non-breeding redshank observed are so low that there is no appreciable risk to the redshank population, therefore the conservation objectives of the identified SPAs and Ramsar sites with redshank as an interest feature would not be undermined. **There will be no adverse effect on the integrity of the identified designated sites that include redshank within the designation in relation to habitat loss associated with the Project alone - Scenario 1.**

OPERATION

11.6.254 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.255 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.256 Redshank are described as highly sensitive to noise disturbance and tolerant of visual disturbance, allowing approach as close as 70-115 m. Noise up to 70 dB is acceptable at the bird, but with caution above 55 dB (60 dB is a highly disturbed area). Noise thresholds of 100-105 dB should be applied to this bird.

11.6.257 Noise assessment, refer to Figure 11.23 and Table 11.49

EFFECTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

11.6.258 The numbers of non-breeding redshank observed are so low that conservation objectives would not be undermined of any of the identified sites with redshank as an interest feature in relation to disturbance for the Project alone - Scenario 1.

11.6.259 There will be no adverse effect on the integrity of the identified designated sites that include redshank within the designation in relation to disturbance associated with the Project alone - Scenario 1.

OPERATION

11.6.260 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.261 Scheduled maintenance would occur once annually, this will result in minor disturbance. In the winter disturbance can have more of an impact because birds are more energetically fatigued. Redshank were not observed within the coldest months (early November and March), therefore, disturbance of redshank at the times they have been observed would not impact survival.

11.6.262 Unscheduled maintenance could result in considerable amount of disturbance, and due to its nature, would not be possible to seasonally schedule. The proportion of habitat used by redshank is limited to habitat within Holland Haven Marshes SSSI during the breeding season and the adjacent intertidal habitat during the non-breeding season. Holland Haven Marshes SSSI would not be impacted by unscheduled maintenance, due to the ducting process used. Leaving only unscheduled maintenance in the intertidal habitat with the potential to impact redshank.

IMPACTS ON CONSERVATION OBJECTIVES AND SITE INTEGRITY - UNMITIGATED

11.6.263 The conclusion is the same as for construction, refer to11.6.25711.6.249.

11.6.264 There will be no adverse effect on integrity of the identified designated sites in relation to disturbance of redshank during the operation of the Project alone - Scenario 1.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.265 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE alone.**

FEATURE 7: RINGED PLOVER

DISTRIBUTION

11.6.266 During intertidal surveys (SLR 2022), ringed plover were not recorded at landfall location 1 (near Holland Haven Marshes SSSI). At location 2 (near Frinton golf club) ringed plover was recorded on one occasion. Observation was of a single individual in flight offshore.

11.6.267 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, recorded no ringed plover within 400 m of the Order Limits.

11.6.268 North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) did not record ringed plover, either year one 2020/21 or year two 2021/22 non-breeding seasons of the land fall areas or the non- breeding season cable route surveys.

11.6.269 Ringed plover were recorded within the wetland areas at Holland Haven Marshes SSSI (mainly compartment D) between April and May 2021, a peak count of one was recorded during the North Falls surveys. This was classified as a non-breeding individual.

11.6.270 Within the summary report that consolidates all non- breeding season bird records, ringed plover were observed within 400 m of Route Section 1 on one occasion, when an individual was recorded and not within 400 m of Beach Way TCC and the associated access along Manor Way (SLR 2023). All observations of ringed plover within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 37 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.271 Ringed plover are a qualifying interest non-breeding bird species in the following citations for designated sites:

- Hamford Water SPA;
- Hamford Water Ramsar site;
- Colne Estuary SPA; and
- Blackwater Estuary SPA.

11.6.272 Conservation objectives are as stated in 11.6.30.

11.6.273 As described in 11.6.86, WeBS data was compared to the citation population figures for, for all sites with the ringed plover population as a qualifying interest, refer to Table 11.55.

Table 11.55 Conservation status analysis ringed plover

Designated Site	Citation Population	BTO Webs Count 17/18-21/22 For Relevant Area	Difference	Favourable Conservation Status Y/N	CO Restore or Maintain	Survey Peak Count (% Citation Population)
Hamford water SPA	520	187	-333	N	Restore	0.19
Hamford Water Ramsar site	1169	187	-982	N	Restore	0.09
Colne Estuary SPA	355	144	-211	N	Restore	0.28
Blackwater Estuary SPA	347	401	+63	Y	Maintain	0.29

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.274 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.275 Construction would displace the small number of birds using the intertidal area. However, the number of ringed plover observed were so low the conservation objectives would not be undermined. There will be no adverse effect on the integrity of any of the identified designated sites with ringed plover in the citation in relation to habitat loss for the Project alone - Scenario 1.

OPERATION

11.6.276 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.277 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.278 Ringed plover are described as a low sensitivity species in the waterbird tool kit (Cutts ., 2013), very tolerant of moderate to high visual disturbance, birds within 50 m should be given consideration. Ringed plover are not very sensitive to noise stimuli, and habituate rapidly. Noise levels up to 75 dB at the bird are acceptable, with caution given around 60 dB. Ringed plover forage close to plant and can tolerate noise of 107-112 dB, with caution above 93-98 dB.

11.6.279 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.280 During decommissioning there will be no requirement for activity on the intertidal area or within the SSSI, decommissioning is not discussed further.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.281 Due to the small number of ringed plover observed from surveys utilising the intertidal area, the numbers are small enough that none of the conservation objectives will be undermined.

11.6.282 In summary in relation to disturbance no adverse effect on the integrity of the relevant designated sites identified with ringed plover in the citation for the Project alone - Scenario 1.

OPERATION

11.6.283 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY UNMITIGATED

11.6.284 The conclusion is the same as construction, due to the small number of birds observed within the Project area there will be no pathway to undermine the conservation objectives.

11.6.285 Therefore, there will be no adverse effect on integrity of the identified designated sites for the Project alone - Scenario 1.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.286 Ringed plover differed from the majority of waterfowl in its threshold to nutrient nitrogen, with a critical load of 8-20 kg/N/ha/ye, for the Colne estuary only, due to this species using calcareous habitats, a more sensitive habitat type. As stated for avocet the kg N/ha during construction would increase to 0.1 during construction, below the threshold for ringed plover. Therefore, the conservation objectives would not be undermined in relation to ringed plover at the Colne Estuary SPA/ Ramsar site. For other aspects of air quality, the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone- Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and North Falls (Scenario 1) alone.**

FEATURE 8: SHELDUCK

DISTRIBUTION

11.6.287 During the non- breeding season intertidal surveys in 2021/22 (SLR 2022), within the coastal area, shelduck were recorded at location 1 on 57 occasions with a maximum flock size of 14 (mean = 4.16). The majority of observations (93.4%) were on land within Holland Haven Marshes SSSI, near the pumping station or Holland Bridge, with 6.6% being observed offshore. Foraging, or foraging and other behaviour (loafing, flying or other) attributed to 45.7% of all observations.

11.6.288 A total of six observations of shelduck were made at the landfall location, flock size ranged from one to 30 (mean = 12.5). Two observations offshore were of an individual and a flock of 30, which were flying and foraging respectively. The other four observations were on land near Holland Haven Marshes SSSI or near Beach Works TCC and were of loafing birds.

11.6.289 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, one shelduck were recorded within 400 m of Route Section 3 of the Order Limits, on one occasion in March 2023.

11.6.290 During the North Fall surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) shelducks were distributed widely across the landfall onshore areas, but particularly within wetland areas with a peak of 11 at Holland Brook in Compartment B in year 1, a peak of 19 at Holland Marshes in Compartment D in year 1, and 13 in Compartment C at Great Holland in year 2. No breeding locations were confirmed but fledged young were observed in Compartment D in July 2021 (North Falls 2021/22).

11.6.291 Within the summary report that consolidates all non- breeding season bird records, shelduck were observed within the 400 m buffer of Route Section 3 on seven occasions and within 400 m of Route Section 1, excluding the Beach Works TCC and Manor Way on four occasions. Counts ranged from one to 30. A total of 89 observations of shelduck were recorded within 400 m of Beach Works TCC and the Manor Way access the peak count of 19 individuals was observed at this location. Most observations were on land, with two out at sea and one on within the intertidal area (SLR 2023). All observations of non- breeding shelduck within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 9 and 10 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.292 Shelduck are designated as a non-breeding qualifying interest feature within the following citations:

- Hamford Water SPA
- Colne Estuary SPA
- Blackwater Estuary SPA

11.6.293 As described in 11.6.87, WeBS data was compared to the citation population figures for the different designated sites refer to Table 11.56.

Table 11.56 Conservation status analysis for shelduck

Designated Site	**Citation Population**	**BTO Webs Count 17/18-21/22 for Relevant Area**	**Difference**	Favourable **Conservation Status** Y/N	**CO Restore or Maintain**	**Survey Peak Count (% Citation Population)**
Hamford water SPA	1629	1089	-531	N	Restore	1.84
Colne Estuary SPA	1237	823	-414	N	Restore	2.43
Blackwater Estuary SPA	2425	3033	+608	Y	Maintain	1.24

PATHWAY 1: HABITAT LOSS

CONSTRUCTION AND DECOMISSIONING ASSESSMENT OF EFFECT ALONE

11.6.294 As per Brent goose.

IMPLICATION ON CONSERVATION OBJECTIVES - UNMITIGATED

11.6.295 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, conservation objective four for the identified designated sites, maintaining/ restoring the population of qualifying features, for the identified designated sites would not be undermined by habitat loss during construction or decommissioning of the Project alone - Scenario 1.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.296 The construction of the onshore cable route has the potential to impact non-breeding shelduck within the coastal habitat (Beach Works TCC near Holland Haven Marshes SSSI) and the haul road proposed along the beach. Temporary loss of habitat will prevent access to foraging habitat. The actual area of habitat loss will be small, located away from habitat most frequently used by shelduck, with the majority of loss being temporary (TCC, access tracks haul roads etc.). Disturbance discussed later will be the key pathway and will have the bigger impact. Temporary habitat loss will be for a maximum of two seasons. Overall, the conservation objectives of the identified designates sites would not be undermined by habitat loss, and there would be no adverse effect on the integrity of the designated sites identified with shelduck in the citation for the Project alone - Scenario 1.

OPERATION

11.6.297 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.298 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.299 Shelduck are specified in the Cutts . 2013 as a high sensitivity species. Approach to construction has been reported as being no closer than 300 m and shelduck are affected by visual disturbance up to 500 m from the source. Noise disturbance occurs from 72 dB upward. Shelduck within 500 m of the construction activity should be considered.

11.6.300 For the noise assessment, refer to Figure 11.23 and Table 11.49. Shelduck are unlikely to be found in areas of high disturbance, within 300-500 m of the construction noise, further when there are louder noises (table only contains Laeq).

11.6.301 Shelduck are likely to be disturbed to a point where they are displaced from some of Holland Haven Marshes SSSI throughout the duration of construction, based on noise and visual disturbance.

11.6.302 Displacement of shelduck from areas of near construction activity, Holland Haven Marshes SSSI and the landfall area, during the non- breeding season has the potential to impact winter survival. This is specifically the case if disturbance occurs in the coldest weather where shelduck are there most energetically stressed.

11.6.303 During decommissioning there will be no requirement for activity on the onshore habitat or within the SSSI, therefore decommissioning activity could not undermine the conservation objectives for shelduck or have an adverse effect on site integrity and is not discussed further.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE - INTEGRITY UNMITIGATED

11.6.304 As shelduck had been identified using the Holland Haven Marshes SSSI, habitat near the pumping station, Holland brook and onshore habitat within 400 m of Beach Works TCC/off site haul roads there is a considerable risk of disturbance because shelduck are a species of high sensitivity to disturbance. The largest number recorded inland was 19 individuals at Holland Haven Marshes SSSI. Disturbance has the potential to limit foraging and therefore has the potential to impact survival of shelduck within the vicinity. **This would undermine conservation objective four, the restoration of the population for the identified SPA and Ramsar sites with shelduck where it is in unfavourable condition, leading to an adverse effect on integrity for Hamford Water SPA and Colne Estuary SPA.**

MITIGATION

11.6.305 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS ON CONSERVATION OBJECTIVES EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.306 With the mitigation outlined above, the conservation objectives of the identified designated sites with non-breeding shelduck in the citation will not be undermined in relation to disturbance. **Therefore, with the mitigation outlined, no adverse effect on site integrity for the SPAs and Ramsar sites identified with non-breeding shelduck in the citation, during construction and decommissioning, for the Project alone - Scenario 1 are predicted.**

OPERATION

11.6.307 As for brent goose.

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.308 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone- Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE alone and NF (Scenario 1).**

FEATURE 9: TEAL

DISTRIBUTION

11.6.309 During the non- breeding season intertidal surveys in 2021/22 (SLR 2022), teal were recorded at location 1 (Beach Works TCC and Manor Way access) on 82 occasions with a maximum flock size of 260 (mean = 60.56). Observations were concentrated around the waterbody within Holland Haven Marshes SSSI, habitat near the pumping station near Holland Haven Marshes SSSI and coastal habitat adjacent to the pumping station. All but one of the observations were on land. Foraging accounted for 28.05% of observations, foraging and loafing attributed 19.51% and loafing 18.29%. The peak count at location 1 of 260 teal is equivalent to 0.06% of the UK non-breeding population. A total of eight observations of teal were made at location 2 (landfall), flock size ranged from 1 to 121 (mean = 88.37%). All but one of the observations were on land, with most concentrated within Holland Haven Marshes SSSI. Roosting accounted for 37.5% of observations, with flying accounting for 25%.

11.6.310 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, teal were recorded within 400 m of Route Section 3 of the Order Limits, on ten occasions, with counts ranging from one to 80.

11.6.311 The most important onshore areas for teal identified during surveys for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) were: - Holland Marshes in Compartment D with a peak observation of 324 in year 1 and Holland Brook in Compartment B with a peak observation of 305 in year 1. No breeding locations were confirmed but adults were observed in Compartment D in April and May.

11.6.312 During the North Falls cable route survey (North Falls) teal were recorded in compartments a, b, d, e, f, and g, with a peak count in compartment a of 79. It is likely that teal will have been recorded within the vicinity of the cable route, but no records were in the proposed OnSS area compartment e and f are outside of the Onshore ECC.

11.6.313 Within the summary report that consolidates all non- breeding season bird records, there was a total of 27 observations of teal within the 400 m buffer of the Order Limits excluding the Beach Works TCC and Manor Way access with observations concentrated in Route Section 3, but also with observations in Route Sections 1 and 4. Counts ranged between 1 and the peak count of 80, with observations spread relatively evenly across the months within which the surveys took place. There was one intertidal and one offshore observation for this species within Route Section 1. A total of 124 observations of teal were made within the 400 m buffer of the Beach Works TCC and the associated access along Manor Way, all observations were on land, with the exception of one which was observed offshore. A peak count of 324 individuals was recorded in December 2021. Observations were spread relatively evenly across the survey months (SLR 2023). All observations of non- breeding teal within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 17, 18 and 19 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.314 Teal are designated as a non-breeding bird species in the following citations for designated sites:

- Hamford Water SPA;
- Abberton Reservoir SPA; and
- Blackwater estuary SPA.

11.6.315 As described in 11.6.87, WeBS data was compared to the citation population figures for the different designated sites, refer to Table 11.57.

Table 11.57 Conservation status analysis for teal

Designated Site	Citation Population	BTO Webs Count 17/18-21/22 for Relevant Area	Difference	Favourable Conservation Status Y/N	CO Restore or Maintain	Survey Peak Count (% of Citation Population)
Hamford Water SPA	3631	3886	+255	Y	Maintain	**8.9**
Abberton Water SPA	2200	9105	+6905	Y	Maintain	**14.7**
Blackwater SPA	2190	3863	+1672	Y	Maintain	**14.8**

PATHWAY 1 – HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.316 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.317 Teal were found to utilise the grassland and wetland habitat, within Holland Haven Marshes SSSI in the largest numbers, this location supported the greatest number of individuals. Habitat within the Order Limits could also be used by teal, although this will be limited to ponds, waterbodies, and wetland/flooded land. The construction of the onshore cable route will not remove any waterbodies permanently or temporarily, as any water bodies will be avoided. Occasionally flooded land for one season could be part of the ECC. Flooded land is sporadic and as teal show winter site fidelity (Guilleman ., 2008) the changes in availability for one season will not affect the population of teal in any of the identified designated sites.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.318 As no regular habitat suitable for teal will be lost, there is no possibility for the Project to undermine the conservation objectives of the identified designated sites through habitat loss. Therefore, there is no adverse effect on integrity of the identified designated sites supporting teal in relation to habitat loss for construction and decommissioning of the Project alone - Scenario 1.

OPERATION

11.6.319 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.320 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.321 Teal have not had an assessment Cutts *et al.* 2013 and do not have a disturbance classification. Non–breeding season dabbling ducks have a suggested a flight-initiated disturbance (FID) of 100 m for pedestrian leisure (Borgmann 2012). This is taken to be an appropriate distance for teal.

11.6.322 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.323 For teal noise over 70 dB will cause disturbance, beyond 100 m from the landfall HDD compound establishment, open trenching and onshore cables up to and into TJB (trench excavation and backfill), landfall HDD compound establishment TCC and access haul road removal. Visual disturbance will also incorporate at least a 100 m buffer around work and transport activities. The temporary habitat loss will be substantial, at least 150 m around the haul road adjacent to the intertidal area and 100 m from the TCC.

11.6.324 Teal are likely to be displaced from areas of Holland Haven Marshes SSSI nearby throughout the duration of construction, based on noise and visual disturbance. Disturbance from Holland Brook and northern parts of Holland Haven Marshes SSSI, due to the distance from TCC and haul roads is less likely, based on the buffer recommended for teal. Although the loudest noises associated with construction may cause temporary disturbance in these locations.

11.6.325 During decommissioning there will be no requirement for activity nearby or within the SSSI, decommissioning is not discussed further.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.326 As teal use the habitat near the intertidal area, i.e. within Holland Haven Marshes SSSI could be part of the conservation objective of any of the identified designated sites detailed in 11.6.28 and Table 11.48 and there is no information on cores foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. **Disturbance during construction has the potential to impact mortality of qualifying features, though reduced foraging and increased expenditure of energy, which could impact populations in the long term, impacting impact on Conservation Objective 4: population of each qualifying interest feature. This would lead to an adverse effect on the integrity of the relevant designated sites.**

MITIGATION

11.6.327 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW)

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.328 With the mitigation outlined above, conservation objective four, maintain the population would not be undermined by the Project alone - Scenario 1, **therefore there would be no adverse effect on site integrity in relation to non-breeding teal during construction and decommissioning for the Project alone - Scenario 1.**

OPERATION

11.6.329 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.330 Impacts would be the same as for Brent geese, refer to 11.6.216 and 11.6.217.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.331 The impacts on teal will be the same as for Brent geese, refer to 11.6.216 and 11.6.217.

MITIGATION

11.6.332 The mitigation for teal will be the same as for Brent goose. Refer to 11.6.220 and 11.6.221 (scheduled maintenance occurring in weather above freezing and implementation of screening for unscheduled maintenance).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.333 The effects on conservation objectives and site integrity will be the same for teal as for brent geese, refer to 11.6.214. Therefore, with mitigation outlined, there will be no adverse effect on site integrity with regard to non-breeding teal in the citation, during construction and decommissioning, for the Project alone - Scenario 1.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.334 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 10: DUNLIN

DISTRIBUTION

11.6.335 A total of six dunlin observations were recorded at location 1 (Beach Works TCC and Manor Way access near Holland Haven Marshes SSSI), with a peak count of one on each occasion in September 2021 and February 2022. Four of the sightings were recorded on land whilst two sightings were recorded in the intertidal zone. The most common behaviours observed were foraging (33.33%) and roosting (33.33%) (SLR 2022).

11.6.336 Dunlin was not recorded at location 2 (landfall near Frinton golf club) during the landfall intertidal non-breeding bird surveys 2021/22.

11.6.337 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, dunlin were not recorded.

11.6.338 During surveys of the landfall area for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), dunlin have been confirmed as present within compartment D (Holland Haven Marshes SSSI), peak count of two in March observed in one survey in 2020/21, and six observations in year two 2021/22, observed on 4/14 surveys. Dunlin were also observed in compartment E (Frinton Golf Club), with a peak count of two in August 2021/22, observed in 1/14 survey. Dunlin were not recorded during the breeding bird survey 2021, between April and July 2021.

11.6.339 Within the summary report that consolidates all non- breeding season bird records, dunlin were only recorded within the 400 m buffer near the Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI. Only five observations of this species were recorded, with a peak count of four birds.

CONSERVATION STATUS

11.6.340 Dunlin are designated as a non-breeding species in the following nearby citations for designated sites:

- Stour and Orwell Estuaries SPA;
- Stour and Orwell Estuaries Ramsar site;
- Colne Estuary SPA;
- Blackwater Estuary SPA; and
- Blackwater Estuary Ramsar site.

11.6.341 As described in 11.6.86, WeBS data was compared to the citation population figures for the different designated sites.

Table 11.58 Conservation status in associated designated sites for dunlin

Designated Site	**Citation Population**	**BTO Webs Count 17/18-21/22 for Relevant Area**	**Difference**	Favourable **Conservation Status** Y/N	**CO Restore or Maintain**	**Survey Peak Count (% of Citation Population)**
Stour and Orwell Estuaries SPA	19114	11866	-7248	N	Restore	**0.03**
Stour and Orwell Estuaries Ramsar site	14262	11866	-2396	N	Restore	**0.04**
Colne estuary SPA	11272	5947	-5325	N	Restore	**0.05**
Blackwater Estuary SPA	33267	16106	-17161	N	Restore	**0.02**
Blackwater Estuary Ramsar site	27655	16106	-11465	N	Restore	**0.02**

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.342 As for grey plover.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.343 The numbers of dunlin observed are so low that there was no pathway to undermine the conservation objectives of any of the identified sites with dunlin as an interest feature would occur. **The temporary habitat loss alone, without considering disturbance would have no adverse effect on the integrity of the designated sites identified with dunlin in the citation.**

OPERATION

11.6.344 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.345 Refer to paragraphs 11.6.100 to 11.6.114 for background of disturbance impacts.

11.6.346 Dunlin are classified as having a low sensitivity to disturbance (Cutts ., 2013), tolerating people approaching up to 50-90 m before flushing. Dunlin have a moderate sensitivity to noise disturbance, moving away from highly disturbing stimuli. Bird closer than 75 m should be considered when commencing works and a noise of 73 dB at the bird was determined acceptable.

11.6.347 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.348 During decommissioning there will be no requirement for activity within the intertidal or landfall areas, decommissioning is not discussed further.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.349 The numbers of dunlin observed are so low that there is no pathway to undermine the conservation objectives of any of the identified sites with dunlin as an interest feature would occur. Therefore, the Project alone - Scenario 1 during construction and decommissioning, would have no adverse effect on the integrity of either the identified designated sites due to the disturbance of dunlin outside the SPA boundary during the non- breeding season.

OPERATION

11.6.350 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.351 Scheduled maintenance would occur once annually, this will result in minor disturbance. Winter disturbance during freezing conditions can have more of an impact because birds are more energetically fatigued. Therefore, disturbance of dunlin at these times could impact survival of the limited number observed within the Project area.

11.6.352 Unscheduled maintenance could result in considerable amount of disturbance, and due to its nature, would not be possible to seasonally schedule. The proportion of habitat used by dunlin is limited, depending on the landfall location chosen (only observed at southern location).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.353 The numbers of dunlin observed are so low there is no pathway to undermine the conservation objectives of any of the identified sites with dunlin as an interest feature. Therefore, the Project alone - Scenario 1 during operation, would have no adverse effect on the integrity of either the identified designated sites due to the disturbance of dunlin outside the SPA boundary during the non- breeding season.

PATHWAY 3 - DECREASE IIN AIR QUALITY

11.6.354 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.14711.6.138. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website**. Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 11: KNOT

DISTRIBUTION

11.6.355 Knot were not recorded during the intertidal non- breeding season bird surveys 2021/22 (SLR 2022).

11.6.356 Knot has been confirmed as present within compartment D (Holland Haven Marshes SSSI), with a peak count of 1 in October in year two 2021/22, observed in 1/14 surveys during non- breeding season bird surveys for North Falls (refer to for details of North Falls surveys). Knot were not recorded during the North Falls breeding bird surveys.

11.6.357 Within the summary report that consolidates all non- breeding season bird records, the only record of knot was located within the 400 m buffer form the Beach Works TCC and Manor Way access (SLR 2023) presented in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.358 Knot are designated as a non-breeding species in the following citations for designated sites:

- Stour and Orwell Estuaries SPA
- Stour and Orwell Estuaries Ramsar site

11.6.359 The citation population for the Stour and Orwell Estuaries SPA and Ramsar site is 5,970 individuals. The combined recent BTO WeBS count (17/18-21/22) for the Stour and Orwell was 12,941. This classifies the population as in favourable conservation status, with the conservation objective to maintain the population. The peak count observed on any of the surveys was one individual, 0.016% of the SPA and Ramsar site population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.360 The assessment for knot is the same as for grey plover, as very low numbers of this species were observed.

OPERATION

11.6.361 As for grey plover.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

11.6.362 As for grey plover.

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.363 As for grey plover.

FEATURE 12: PINTAIL

11.6.364 Pintail were not recorded during the intertidal landfall non- breeding season bird surveys 2021/22 (SLR 2022) or the non- breeding season cable route surveys of the Order Limits in 2022/23 (MacArthur Green 2023).

11.6.365 During the North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), pintail was confirmed as present within compartment A (Little Clacton- beyond the 400 m buffer from the Order Limits), with a peak count of 32 in February in year one 2020/21, observed in one survey. This species was also recorded in compartment B (Holland Brook beyond the 400 m buffer from the Order Limits), peak count eight in February in year one 2020/21, observed in one survey. Pintail has been confirmed as present within compartment D (Holland Haven Marshes SSSI), peak count of three in February in year one 2020/21, observed in one survey, with a peak count of 16 in December in year two 2021/22; and also in compartment E (Frinton Golf Club beyond the 400 m buffer from the Order Limits) during the non-breeding season, with a peak count of eight in September in year two 2021/22, observed in 1/14 surveys.

11.6.366 Pintail were not recorded during the breeding bird survey 2021, between April and July 2021.

11.6.367 Within the summary report that consolidates all non- breeding season bird records Pintail were recorded with the 400 m buffer of Route Section 1 excluding the Beach Works TCC and Manor Way access on one occasion, when a count of eight was recorded offshore. One observation of three individuals was also recorded in the 400 m buffer around the Beach Works TCC and Manor Way access. All observations of non- breeding black-tailed godwit within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 16 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.368 Pintail are designated as a non-breeding species in the following citations for designated sites:

11.6.369 Stour and Orwell Estuaries SPA

11.6.370 The citation population is 741, and the most recent WeBS count is a maximum of 347 (2017/18- 2021/22) within the Stour and Orwell estuary combined, therefore the conservation status of this species is unfavourable and the conservation objective will be to restore the population. The peak count within 400 m of the Order Limits was eight, this has been used as a comparison and is equivalent to 1.07% of the citation population of the Stour and Orwell estuaries SPA.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.371 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.372 Holland Haven Marshes SSSI, where pintail were recorded, will be crossed by HDD to preserve the habitats present, ensuring no permanent infrastructure are within the SSSI boundary.

11.6.373 During decommissioning, there will be no temporary loss of habitat, as underground cable will be left *in situ*.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

Pintail were observed within Holland Haven Marshes SSSI, no direct land take will occur here as it will be crossed by HDD. Therefore, the conservation objectives of the Stour and Orwell estuaries SPA will not be undermined through habitat loss. There will be no adverse effect on the integrity of the Stour and Orwell Estuaries SPA in relation to non- breeding pintail and habitat loss for the Project alone - Scenario 1.

OPERATION

11.6.374 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.375 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.376 Pintail are classed as a medium sensitivity bird, with a recommended buffer distance during the non-breeding season of 200 m (Nature Scot Research Report 1283).

11.6.377 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.378 The locations pintail were observed were at least 200 m from the Beach Works TCC and Manor Way Access.

11.6.379 During decommissioning there will be no requirement for activity within the intertidal or coastal landfall areas, decommissioning is not discussed further.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.380 Due to the distance from any construction that pintail were observed, and considering the infrequency of observations, the conservation objectives of the Stour and Orwell Estuaries SPA would not be undermined by disturbance of non- breeding pintail during construction or decommissioning. **For the Project alone - Scenario 1 during construction and decommissioning, would have no adverse effect on the integrity of the Stour and Orwell estuaries SPA due to the disturbance of pintail outside the SPA boundary during the non-breeding season.**

OPERATION

11.6.381 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.382 Scheduled maintenance would target TJB and joint sections, these would be located away from where pintail have been recorded during surveys.

11.6.383 Unscheduled maintenance could result in considerable amount of disturbance, and due to its nature, would not be possible to seasonally schedule. However, Holland Haven Marshes SSSI would not be a location for unscheduled maintenance due to the ducting process used. Therefore, the nearest location of pintail to such maintenance would be the immediate onshore area.

MITIGATION

11.6.384 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised lighting plan and suspending works during very cold periods on site measures overseen by an ECoW).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.385 Numbers of pintail are relatively low, and the use of the habitat appears to be sporadic, as they were infrequently recorded, over the two-year survey period. As previously described, there would also be a low incidence of maintenance meaning that the risk of disturbing this species in a way that would affect its population is negligible. **Therefore, the conservation objectives would not be undermined in relation to pintail for the Stour and Orwell estuaries SPA and the Project alone - Scenario 1 during operation, with mitigation would have no adverse effect on the integrity of the Stour and Orwell estuaries SPA due to the disturbance of pintail outside the SPA boundary during the non- breeding season.**

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.386 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 13: GOLDENEYE

DISTRIBUTION

11.6.387 Goldeneye were not recorded on any of the surveys. This species is associated with the Colne Estuary SPA, Abberton Reservoir SPA and the Blackwater Estuary SPA. Due to the lack of evidence that this species uses habitat in the vicinity of the Project, impacts on goldeneye can be excluded.

FEATURE 14: HEN-HARRIER

DISTRIBUTION

11.6.388 There was a total of three observations of hen harrier within the non-breeding season and within 400 m of the Order Limits across all surveys undertaken (North Falls, MacArthur Green and SLR). Observations were associated with Route Section 1, Route Section 3 and the Beach Works TCC and Manor Way Access. Two of the observations were in October 2021 and the final observation was in December 2021 refer to Appendix A Drawing 4., in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.389 Hen harrier are designated as a non-breeding species in the following citations:

- Colne Estuary SPA (19 individuals)
- Blackwater Estuary SPA (19 individuals)

11.6.390 A single bird represents 5.3% of the Colne Estuary and the Blackwater Estuary SPA hen harrier populations, due to the population of this species being so small. As with the other bird species, is not known if the birds observed during the surveys form part of either of the SPA populations, however, this is assumed. The total count of hen harrier in Essex (The Essex Bird watching society) in recent years was a maximum of 16 birds. This indicates that the population in both SPAs is unfavourable, and the objective is to restore the population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.391 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.392 Holland Haven Marshes SSSI, the key location of hen harrier observations will be crossed by HDD to preserve the habitats present, ensuring no permanent infrastructure are within the SSSI boundary. This will prevent habitat loss at the main location where hen harrier have been observed.

11.6.393 During decommissioning, there will be no temporary loss of habitat, as underground cable will be left *in situ*.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON DESIGNATED SITES INTEGRITY - UNMITIGATED

11.6.394 There will be no direct loss of habitat where hen harrier have been observed, as the Holland Haven Marshes SSSI will be crossed by HDD. Moreover, hen harrier forages over a large area relative to VE, has a population that is determined by breeding success rather than availability of wintering habitat and is more dependent on the availability of its prey species (small birds of open habitats such as arable farmland) than a given area of habitat., Given the avoidance of direct impacts on the SSSI, by use of HDD, no significant effects are likely on the SSSI populations of yellow wagtail *Motacilla flava*, skylark *Alauda arvensis*, meadow pipit *Anthus pratensis* and reed warbler *Acrocephalus scirpaceus*. All birds that could be prey for hen harrier.

11.6.395 Therefore, the conservation objectives of the Colne estuary SPA and Blackwater Estuary SPA will not be undermined by habitat loss in relation to hen harrier. There will be no adverse effect on the integrity of the Colne and/or the Blackwater estuary SPA identified for hen harrier in relation to habitat loss for the Project alone - Scenario 1.

OPERATION

11.6.396 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.397 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.398 Hen harrier are classified as having a medium sensitivity to disturbance, with a 750 m buffer recommended in the non- breeding season (Nature Scot Report 1283).

11.6.399 The Manor Way access and Beach Works TCC will be located within 750 m from Holland Haven Marshes SSSI and nearby habitat. Any hen harrier using the habitat will likely be disturbed at some point during the works. The non-breeding bird survey indicates that Holland Haven Marshes SSSI and the immediate vicinity supports a higher density of 'small birds' than surrounding farmland, with counts as high as 27 skylarks in the non-breeding season compared to a maximum count of 10 skylarks on arable only survey areas. Therefore, disturbance which causes hen harrier to be unable to forage in this locality for an extended period could affect over-winter survival of this species.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.400 Hen harrier were rarely observed on surveys, suggesting that Holland Haven Marshes SSSI is only sporadically used for foraging by this species. However, due to the exceedingly low population of this species, disturbance from nearby construction at Holland Haven Marshes SSSI could reduce hen harrier foraging efficiency. In the worst instance, this could lead to an increase in mortality, impacting conservation objective 4: to restore the population of hen harrier for the Colne and/ or the Blackwater Estuary SPAs. Without mitigation, there is a risk of an adverse effect on integrity in relation to the non- breeding hen harrier population using habitat outside of the SPA.

MITIGATION

11.6.401 The mitigation discussed previously would be implemented, refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

EFFECTS ON SITE INTEGRITY

11.6.402 With the mitigation outlined, the disturbance of hen harrier will be reduced, and the conservation objectives of the Colne and/ or the Blackwater estuary SPAs will not be undermined in relation to non-breeding hen harrier during construction and decommissioning. **There will be no adverse effect on the integrity of the Colne and/ or the Blackwater Estuary designated sites identified with hen harrier in the citation due to disturbance during construction with mitigation in place, for the Project alone - Scenario 1.**

OPERATION

11.6.403 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.404 Scheduled maintenance would occur once annually, this will result in minor disturbance. Inspection would be comparable to walkers accessing the habitat. If the visit occurred during a spell of freezing weather, there is the potential for a negative impact, disturbing foraging hen harrier in the immediate landfall areas or nearby, i.e. Holland Haven SSSI, when they are most energetically fatigued. This could impact survival of non-breeding hen harrier, as it could disrupt feeding when most thermodynamically stressed.

11.6.405 Unscheduled maintenance could result in considerable amount of disturbance, and due to nature, would not be possible to seasonally schedule. Although such maintenance would not occur within Holland Haven Marshes SSSI due to the nature of the ducting, disturbance could impact non-breeding hen harrier if it was required within the immediate landfall area nearby. This accounts for approximately 0.7% of the onshore cable route, the chances of an unscheduled maintenance event occurring in this small proportion of the route is relatively low. Although climate change, associated sea level rise and adverse weather conditions will make the intertidal and immediate land more unpredictable, this will be incorporated into the calculations for the design and location of onshore infrastructure.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY

11.6.406 As scheduled maintenance is only one visit annually, this disturbance is very limited, the only pathway to undermine conservation objectives is if birds were disturbed when highly stressed, i.e., in cold weather. Additional energy expenditure and displacement from foraging resources could cause changes in survival for those birds involved. Impacting Conservation Objective 4: to restore the population, due to the small number of hen harrier within the citation for Colne and/ or the Blackwater Estuary SPAs any reduction in over winter survival could hinder the ability to restore the population and would therefore undermine the conservation objectives for these sites. This would lead to an adverse effect on site integrity.

11.6.407 The same can be said for unscheduled maintenance, although this could last considerably longer; days to weeks rather per event rather than a single day per annum, be harder to schedule and create more disturbance. However, the chance of such maintenance being required at the immediate inshore locations during the winter and cold weather is relatively low, and its incidence would be rare (one year of many) and temporary. **Therefore, it would not have lasting effects on the hen harrier population and conservation objectives would not be undermined and there would be no adverse effect on site integrity.**

MITIGATION

11.6.408 Scheduled maintenance should only occur in weather with temperatures above freezing, to ensure that any birds that are disturbed are not thermodynamically stressed.

11.6.409 Unscheduled maintenance is harder to mitigate, timings are harder to implement due to the nature of the requirement. Implementation of screening of any maintenance if undertaken near Holland Haven Marshes SSSI or the intertidal area would limit disturbance to an extent.

IMPACTS ON CONSERVATION OBJECTIVES EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.410 With the mitigation outlined for scheduled maintenance there would be no adverse effect on site integrity, through undermining the conservation objectives of the Colne and/ or the Blackwater estuary SPAs in relation to non-breeding hen harrier, due to disturbance and potential impacts on survival.

11.6.411 For unscheduled maintenance with mitigation in the form of screening, will minimise disturbance to hen harrier and as Holland Haven Marshes SSSI will not be a location for unscheduled maintenance, due to the ducting. There is no potential to undermine the conservation objectives of the Colne or Blackwater estuary SPAs. **Therefore, the Project alone - Scenario 1 during operation, with mitigation would have no adverse effect on the integrity of either the Colne estuary SPA or the Blackwater estuary SPA due to the disturbance of hen harrier outside the SPA boundary during the non- breeding season.**

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.412 Hen harrier differed from the majority of waterfowl in its threshold to nutrient nitrogen, with a critical load of 10-20 kg/N/ha/ye, due to typical reliance on dwarf shrub heath, however these habitats are rare within the Colne and Blackwater estuaries and this species is more likely to rely on salt marsh within these habitats. As stated for avocet the kg N/ha during construction would increase to 0.1 during construction, below the threshold for hen harrier. Therefore, the conservation objectives would not be undermined in relation to hen harrier for the Black water Estuary SPA/ Ramsar site and the Colne Estuary SPA/ Ramsar site. For other aspects of air quality, the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone- Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 15: MUTE SWAN

DISTRIBUTION

11.6.413 Mute swan were recorded at location 1 during intertidal non- breeding season bird surveys (SLR 2022) (near Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI) on nine occasions, with a peak count of four in January 2022. All observations were made inland, within Holland Haven Marshes SSSI, near the pumping station and fields further inland. At location 2 (landfall) mute swan were recorded on one occasion, where two individuals were observed roosting inland.

11.6.414 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, mute swan was recorded on five occasions within 400 m of the Order Limits in Route Sections 1, 3 and 4, with one or two mute swan recorded each time.

11.6.415 From the North Falls survey data (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), mute swan has been confirmed as present within compartment A (Little Clacton), with a peak count of two in year one 2020/21, observed in five surveys, and a peak count of one in January and February in year two 2021/22, observed in 2/14 surveys.

11.6.416 During the North Falls surveys, this species was also recorded in compartment B (Holland Brook) through the non-breeding season, peak counts of six in year one 2020/21(species observed in five surveys in 2020/21) and 12 in October in year two 2021/22, observed in 12/14 surveys.

11.6.417 Mute swan has also been confirmed as present within compartment C (Great Holland), peak counts of eight in year one 2020/21, in 11 surveys, and six in February in year two 2021/22, in 4/14 surveys. Mute swan was confirmed within compartment D (Holland Haven Marshes SSSI), peak counts of seven in year one 2020/21, species observed in six surveys in 2020/21, and for in October in year two 2021/22, observed in 1/14 surveys; and also in compartment E (Frinton Golf Club) during the non-breeding season, with a peak count of two in March in year two 2021/22, observed in 1/14 surveys.

11.6.418 Mute swan has been confirmed as present within compartment A (Little Clacton), peak count of two; compartment B (Holland Brook), peak count of five; compartment C (Great Holland), peak count of two; and compartment D (Holland Haven Marshes SSSI) peak count of two, all between April and July 2021. Within the North Falls cable route, mute swan was identified in all compartments except H and I, with a peak count of 12 in compartment B.

11.6.419 Within the summary report that consolidates all non- breeding season bird records, mute swan were observed within the Order Limits, excluding the Beach Works TCC and Manor Way access, there were counts of four and one in Route Sections 5 and 4, in December 2021 and January 2022 respectively. A total of 28 observations of mute swan were made within the 400 m buffer (10 in Route Section 1, excluding the Beach Works TCC and Manor Way access, eight in Route Section 3, four in Route Section 4 and 5 and two in Route Section 6). The peak count was 12 individuals within Route Section 5 recorded in February 2022. A total of seven observations of mute swan were recorded within the 400 m buffer from the Beach Works TCC and Manor Way Access, a peak count of seven mute swans was recorded in November 2020, single individuals were most frequently observed (three occasions). The other three observations were of two or three individuals. All observations of mute swan were on land, outside the intertidal area (SLR 2023). All observations of non- breeding mute swan within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 4, 5 and 6 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.420 Mute swan are designated as a non-breeding bird species in the following citations for designated sites:

- Abberton Reservoir SPA

11.6.421 As described in 11.6.86, WeBS data was compared to the citation population figures for the different designated sites.

11.6.422 Abberton Reservoir SPA the citation population was 500, and the most recent WeBS count (17/18-21/22) was 419, therefore the population is not in favourable conservation status and the objective will be to restore the population. A peak count of 12 mute swans were recorded during surveys for VE/North Falls, this is 2.4% of the SPA population at the time of designation. Mute swan is a sedentary species (Minton, 1971), much more so than the other species, although occasional long-distance movements have been recorded. The birds recorded during the survey were over 20 km from Abberton Reservoir, which makes it unlikely that the birds recorded are part of the Abberton Reservoir non-breeding population (Minton 1971).

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.423 Refer to 11.6.88 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.424 The locations where mute swan were recorded and where temporary or permanent habitat loss could occur are: Beach Works TCC and Manor Way access, landfall compound zone, Route Section 3 where the haul road goes close to lakes, near Thorpe-le-Soken BNG: TM 19314 22692, TCC 4, TCC6 and TCC8.

11.6.425 Mute swan are likely to only be located near watercourses, these will be crossed by HDD and therefore will remain intact and available for use by this species.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.426 There will be no impact on the conservation objectives of Abberton Reservoir SPA in relation to mute swan and habitat loss. The construction of the onshore cable route will not affect waterbodies and mute swan are sedentary, therefore the population recorded during surveys are unlikely to be linked to Abberton Reservoir. **Therefore, habitat loss during construction will not have an adverse effect on the integrity of Abberton Water SPA for the Project alone - Scenario 1, in relation to mute swan.**

OPERATION

11.6.427 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.428 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.429 Mute swan have not had an assessment on sensitivity to disturbance Cutts *et al.*, 2013 and do not have a disturbance classification. However, mute swans are considered to have a low sensitivity to disturbance, as they will frequently remain in places of human disturbance (e.g. parks).

11.6.430 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.431 Due to its disposition, mute swan are unlikely to be displaced from the habitat near Beach Works TCC and Manor Way access, landfall compound zone, Route Section 3 where the haul road goes close to lakes, near Thorpe-le-Soken BNG: TM 19314 22692, TCC 4, TCC6 and TCC8. and aquatic habitat inland, throughout the duration of construction, based on noise and visual disturbance.

11.6.432 During decommissioning there will be no requirement for activity on the coastal intertidal area, Onshore ECC or within the SSSI, decommissioning is not discussed further.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.433 As mute swan using the habitat within the ECC would not be part of the conservation objective of Abberton Reservoir SPA. Effects can be ruled out as disturbance will not impact mute swan associated with Abberton Reservoir SPA, not undermining the conservation objectives and therefore, **there will be no adverse effect on the Abberton Reservoir SPA in relation to disturbance of mute swan during construction or decommissioning.**

OPERATION

11.6.434 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.435 As mute swan present nearby to the Order Limits are not associated with Abberton Reservoir SPA there is no pathway to impact the SPA during the operation of the VE and NF Projects and it will not be possible to undermine conservation objectives. **There will be no adverse effect on the integrity of the Abberton Reservoir SPA/ Ramsar site vis disturbance of mute swan during operation.**

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.436 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.14711.6.139. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE Project alone - (Scenario 1) alone.**

FEATURE 16: CORMORANT

DISTRIBUTION

11.6.437 During intertidal surveys in the non- breeding season (SLR 2022), cormorant were recorded at landfall location 1 (near Beach Works TCC on Manor Way and Holland Haven Marshes SSSI) in 56% of the survey counts, with a peak count of 28 in January 2022. A total of 70 observations of cormorants were recorded at location 1, 42 of these were observed offshore, three within intertidal zones, and 25 on land within Holland Haven Marshes SSSI. Cormorants were most frequently observed flying (28.57%), loafing (25.71%) and roosting (17.14%).

11.6.438 During the same surveys, cormorant were recorded in 39% of the survey counts at location 2 (landfall), with a peak count of 18 in December 2022. Cormorant were most frequently observed offshore, with some observations inland near the waterbody located close to location 1 within Holland Haven Marshes SSSI. There were four occasions cormorant were recorded, with the peak count being four and the smallest being one individual. The most common behaviour seen was flying (67.39%).

11.6.439 During the 2022/2023 surveys of the Order Limits (MacArthur Green 2023) cormorant were observed within Route Section 1, 3, 4, and 7 within 400 m from the Order Limits boundary, on 12 occasions. A peak count of 31 was recorded within section 1.

11.6.440 From bird surveys undertaken for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), cormorant have been confirmed as present within compartment A (Little Clacton), with a peak count of two in November in year two 2021/22, observed in 3/14 surveys. This species was also recorded in compartment B (Holland Brook) with a peak count of five in year one 2020/21 (species observed in two surveys in 2020/21), and seven in January in year two 2021/22, observed in 11/14 surveys. Cormorant has been confirmed as present within compartment C (Great Holland) with a peak count of one in year one 2020/21 (species observed in one survey in 2020/21), and four in December in year two 2021/22, observed in 7/14 surveys. Presence was also confirmed in compartment D (Holland Haven Marshes SSSI) within the landfall throughout the winter, with a peak count of 96 in year one 2020/21 (species observed in eight surveys in 2020/21), and 232 in November in year two 2021/22, observed in 14/14 surveys; and within compartment E (Frinton Golf Club) with a peak count of one in year one 2020/21 (species observed in 1 survey in 2020/21), and 52 in November in year two 2021/22, observed in 9/14 surveys.

11.6.441 During the breeding bird survey 2021 no breeding colonies were present within the survey area. Between April and July 2021 cormorant has been confirmed as present within compartment A (Little Clacton) on land, with a peak count of one; compartment B (Holland Brook), with a peak count of three; compartment C (Great Holland) with a peak count of two; compartment D (Holland Haven Marshes SSSI) with a peak count of one; and also in compartment E (Frinton Golf Club) with a peak count of six.

11.6.442 Within the summary report (SLR 2023) that consolidates all non- breeding season bird records within 400 m of the Order Limits, a total of 12 observations of cormorant were made within the Order Limits across Route Sections 1, 3, 4, and 7. There was a peak count of 17 recorded in December 2022, but 83% of observations recorded a count of one to four birds. The majority of observations were on inland, with only one intertidal observation.

11.6.443 A total of 61 observations were recorded within the 400 m buffer of the Order Limits, concentrated in Route Section 1 excluding the Beach Works TCC and Manor Way access (70% of observations), but also being recorded in Route Sections 3, 4, 5, and 7. 54% of observations were recorded on land, 44% were offshore observations, and 2% were intertidal observations. A peak count of 31 was recorded in December 2022 on land, other observations ranged from one to nine. Observations within the 400 m buffer were concentrated in January, February, and March 2022 (69% of observations). A total of 68 observations of cormorant were recorded within the Beach Works TCC and Manor Way access 400 m buffer, 43 observations were of more than one bird, with a peak count of 18 individuals. The majority of observations were recorded in December 2021 and January, February, and March 2022, and three observations in January 2021. 54% of observations were recorded on land, 37% were offshore and 9% were intertidal observations.

11.6.444 All observations of non-breeding cormorant within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 54-57 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.445 Cormorant are a qualifying interest breeding species within the Abberton Reservoir SPA. The citation includes 360 pairs, supplementary information (English Nature 1991) highlights that the population has declined and the latest five year mean peak is 161 pairs. The conservation status is therefore unfavourable and the conservation objective is to restore.

11.6.446 The inclusion of cormorant on the citation is due to an inland breeding colony located at Abberton Reservoir. A published study from Holland (Paillisson ., 2004) found that the average maximum flight range from the colony was 12.4 ± 4.0 km with a minimum of 1.3 km and a maximum of 27.6 km. This data is from a coastal colony and the birds were foraging at sea. Another study, this time of the birds at Abberton Reservoir (an inland colony), confirmed the presence of sea fish and marine crustaceans, as well as freshwater and migratory fish, in the diet during the breeding season (Carss and Ekins 2002). The birds must therefore travel from the Reservoir to the sea to forage. Marine and migratory fish made up most of the diet, and the authors concluded that the colony here derives most of its food from nearby estuaries and the coast. Taking these two papers together suggests that the VE landfall is within the foraging range of the birds which breed at Abberton Reservoir. However, the birds are more likely to forage in the Colne and Blackwater estuaries which are closer to Abberton Reservoir. This is reflected in the very low numbers of cormorant recorded at the VE landfall locations during the breeding seasons.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.447 As set out above, the habitat of foraging breeding cormorant from Abberton Reservoir is the sea and to a lesser extent, Abberton Reservoir (and other freshwater habitats). **Therefore, this colony would not be affected by terrestrial habitat loss as a result of VE, either temporary or permanent.**

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY UNMITIGATED

11.6.448 Given that breeding cormorant at Abberton Reservoir are not reliant on habitat that will be lost temporarily or permanently, there is no possibility of undermining the conservation objectives of Abberton Reservoir SPA/ Ramsar site. The habitat loss during construction of the onshore cable route has no potential to impact cormorant, the conservation objectives of the identified designates sites would not be undermined by habitat loss, and **there would be no adverse effect on the integrity Abberton Reservoir SPA/Ramsar site for the Project alone - Scenario 1 in relation to breeding cormorant.**

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.449 It is possible that construction works at the coast disturb foraging cormorant during the breeding season at sea, however, such disturbance would be short-lived, this species is relatively tolerant of disturbance, the area of available alternative habitat is obviously large, and the survey results confirm that the sea at the landfall location is not a key foraging area for this species during the breeding season, with only low numbers recorded. Therefore, any disturbance here during the breeding season could not affect the reproductive success of the cormorant population at Abberton Reservoir SPA.

11.6.450 A study which included marking (ringing) birds at Abberton Reservoir confirms that some birds which breed at the colony move away from there when not breeding, mainly to other areas in south-east England and especially around the coast of East Anglia, Essex, and Kent (Natural England ENRR360). During the surveys for VE/North Falls, higher numbers were recorded during the winter which, combined with the research, indicates that some of these birds are likely to originate from the Abberton Reservoir SPA. As discussed for other species, disturbance could affect over-winter survival and potentially the size of the breeding colony in the following year. Given the high number of cormorant recorded during the surveys relative to the size of the breeding colony at Abberton Reservoir, and that this colony is in unfavourable condition (45% decline since designation) any reduction in overwinter survival could undermine the Conservation Objective to restore the population.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.451 As cormorant from Abberton Reservoir SPA/ Ramsar site have been identified through studies as using habitat in the vicinity of the VE Project, disturbance has the potential to limit foraging and therefore has the potential to impact survival of cormorant within the vicinity. **This would undermine conservation objective four, the restoration of the population for the Abberton Reservoir SPA with cormorant where it is in unfavourable condition leading to an adverse effect on the integrity of Abberton Reservoir SPA.**

MITIGATION

11.6.452 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.453 With mitigation, the conservation objectives of Abberton Reservoir SPA with breeding cormorant in the citation will not be undermined in relation to disturbance. **Therefore, with the mitigation outlined, no adverse effect on site integrity for the Abberton Reservoir SPA in relation to breeding cormorant during construction and decommissioning, for the Project alone - Scenario 1 are predicted.**

OPERATION

11.6.454 As for brent goose.

PATHWAY 3: DECREASE IN AIR QUALITY

11.6.455 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE Project alone - (Scenario 1) alone.**

FEATURE 17: SANDERLING

DISTRIBUTION

11.6.456 Intertidal surveys in the non- breeding season (SLR 2022) recorded one individual sanderling at landfall location 1 (near the Beach Works TCC on Manor Way and Holland Haven Marshes SSSI) in 1.19% of the survey counts, with a peak count of 1 in January 2022. The sanderling was observed to be foraging and flying during the recording.

11.6.457 Sanderling were not recorded in the 222/23 non- breeding survey of the Order Limits (MacArthur Green 2023).

11.6.458 At location 2 (landfall) sanderling were recorded on two occasions, with a peak count of four in October 2021, both of these observations were recorded within the intertidal zone. One observation recorded the flock foraging and flying; while the other observation recorded the flock foraging.

11.6.459 During surveys for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) sanderling has been confirmed as present within compartment D (Holland Haven Marshes SSSI), with a peak count of one in year two 2021/22, observed in 2/14 surveys. This species was also recorded in compartment E (Frinton Golf Club) during the non-breeding season, with a peak count of four in August in year two 2021/22, observed in 1/14 surveys.

11.6.460 Within the summary report that consolidates all non- breeding season bird records, a single observation of two sanderlings foraging was recorded within the Order Limits within Route Section 1 excluding the Beach Works TCC and Manor Way access, on land in January 2022. A further two records of foraging sanderling were reported in the 400 m buffer, in the intertidal and offshore areas of Route Section 1. Flock size was four and one, recorded in October and January 2022 respectively. Two observations of individual sanderlings on land within a 400 m buffer of the Beach Works TCC and the Manor Way access were recorded in October and November 2021. All observations of non- breeding sanderling within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 46 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.461 Sanderling are a qualifying interest feature of the Colne Estuary SPA. The citation population was 219 and the most recent mean peak count from BTO WeBS data (2017/18-21/22) was 205. Sanderling are in an unfavourable conservation status and the conservation objective will be to restore the population.

11.6.462 The peak count of four individuals is equivalent to 1.82% of the SPA citation population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.463 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.464 Specifically foraging habitat will be temporary lost for the duration of the works. Holland Haven Marshes SSSI will be crossed by HDD to preserve the habitats present, ensuring no permanent infrastructure is within the SSSI boundary.

11.6.465 During construction temporary habitat loss would displace sanderling from habitat these birds have been found in previously, primarily intertidal habitat.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.466 Based on the numbers recorded relative to the current population of sanderling at the Colne Estuary (1.82%), and the assumption that the sanderling recorded during the surveys form part of this population, there is potential for an impact that caused a reduction in over winter survival to undermine the conservation objectives of the Colne Estuary SPA. However, sanderling forage along the shoreline between high and low tide, usually on sandy beaches. The area of suitable foraging habitat affected through temporary habitat loss, is small compared to that available and it will remain as suitable habitat after construction. The temporary habitat loss on its own could not affect over-winter survival of this species. As with other species, effects are more likely from disturbance associated with construction which is discussed below. **There will be no adverse effect on the integrity of the Colne estuary SPA, in relation to habitat loss and sanderling during construction for the Project alone - Scenario 1.**

OPERATION

11.6.467 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.468 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.469 Sanderling are classified as having a low sensitivity to disturbance and are extremely tolerant, with habituation, to disturbance (Cutts ., 2013). Noise up to 75 dB at the bird are considered acceptable and sanderling are tolerant of people allowing approach to 6-50 m.

11.6.470 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.471 Habitat up to 150 m from the source of noise could be impacted. This could disturb sanderling from foraging, if this occurs during cold weather when birds are thermodynamically stressed, there is a greater risk of mortality.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.472 Given the low sensitivity of sanderling to disturbance and the amount of available habitat, a reduction in over winter survival as a result of VE is unlikely. However, the population at the Colne Estuary is in unfavourable condition and up to 1.82% (equivalent) of this population were recorded during the surveys. Therefore, there is a residual risk that disturbance of this species could undermine conservation objective 4: restoration of the population of sanderling. **This has the potential for an adverse effect on the integrity of the Colne Estuary SPA.**

MITIGATION

11.6.473 Refer to 11.6.12811.6.120 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.474 With mitigation, the conservation objectives will not be undermined in relation to non-breeding sanderling. For the Colne Estuary SPA, there would be no adverse effect on integrity in relation to sanderling as an interest feature due to disturbance when mitigation is in place, for the Project alone - Scenario 1.

OPERATION

11.6.475 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.476 Scheduled maintenance would occur once annually, this will result in minor disturbance. Inspection would be comparable to walkers accessing the habitat and current farming activities. If the visit occurred during a spell of freezing weather, there is the potential for a negative impact, disturbing foraging sanderling in the immediate landfall areas (intertidal) when they are most energetically fatigued. This could impact survival of non-breeding sanderling if present.

11.6.477 Unscheduled maintenance could result in considerable amount of disturbance, and due to nature, would not be possible to seasonally schedule. Disturbance could impact sanderling in the non- breeding season within the immediate landfall area. This accounts for less than 0.7% of the onshore cable route, the chances of an unscheduled maintenance event occurring in this small proportion of the route is relatively low. Although climate change, associated sea level rise and adverse weather conditions will make the intertidal and immediate land more unpredictable, this will be incorporated into the calculations for the design and location of onshore infrastructure.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.478 As scheduled maintenance is only one visit annually, this disturbance is very limited, the only pathway to undermine conservation objectives is if birds were disturbed when highly stressed, i.e. in cold weather. Additional energy expenditure and displacement from foraging resources could cause changes in survival for those birds involved. Impacting Conservation Objective 4: population, due to the numbers seen in this vicinity.

11.6.479 The same can be said for unscheduled maintenance, although this would last a considerably longer time, be harder to schedule and create much more disturbance. The chance of such maintenance being required at the immediate inshore locations is relatively low. Leading to a potential adverse effect on integrity of the Colne Estuary SPA for both scheduled and unscheduled maintenance.

MITIGATION

11.6.480 Scheduled maintenance will only occur in weather above freezing, to ensure that any birds that are disturbed are not thermodynamically stressed, refer 11.6.137

11.6.481 Unscheduled maintenance is harder to mitigate, timings are harder to implement due to the nature of the requirement. Screening of unscheduled maintenance, if in the vicinity of Holland Haven Marshes SSSI as detailed for construction, refer to 11.6.128.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.482 With the low sensitivity of sanderling to disturbance, mitigation outlined for scheduled maintenance and the low chances of unscheduled maintenance being undertaken in the key habitats used by sanderling during the winter, there would be no adverse effect on site integrity, through undermining the conservation objectives of the identified sites in relation to non- breeding sanderling, due to disturbance and potential impacts on survival.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.483 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE the Project alone -Scenario 1 alone.**

FEATURE 18: COOT

DISTRIBUTION

11.6.484 Coot was not recorded in the intertidal survey (SLR 2022).

11.6.485 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits coot were recorded on 12 occasions, within Route Section 3 and 4, with a peak count of 12.

11.6.486 During surveys of the North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) landfall coot were recorded within Little Clacton compartment A and Holland Brook compartment B, during the non-breeding surveys in year one, with a peak count of two. During the breeding season surveys, coot were observed in the same compartments with a peak count of two. Coot were also recorded in the North Falls corridor, specifically with a peak count in compartment F, of 98. This is outside the Onshore ECC and this peak count is not used in the assessment.

11.6.487 Within the summary report that consolidates all non- breeding season bird records, coot observations were concentrated within the 400 m buffer of the Order Limits within Route Section 3, although there were also records from the 400 m buffer within Route Sections 4 and 5. Within Route Section 3, counts ranged between 1 and 27 individuals. Only one observation of two individuals was made within Route Section 3a, and seven observations ranging between 1 and 4 individuals were made within Route Section 4. One observation of two individuals was made within Route Section 5. A peak count of 28 individuals was recorded in February 2022 within Route Section 3. Observations were concentrated in January and February (45.16%) with observations also made in October, November, and March. All observations of non-breeding black-tailed godwit within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 24, 25 and 26 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.488 Coot are listed as a qualifying feature of Abberton Reservoir SPA during the winter only, the citation population is 11,500, the recent WeBS count (2017/18-21/22) was 7,372 for Abberton Reservoir. The conservation status is unfavourable and the objective will be to restore the population.

11.6.489 The coot population is partially migratory with resident birds (26,000 pairs/52,000 adults in Britain) (BTO) joined in winter by migrants from the continent making a total wintering population in Britain of 200,000 birds (Frost *et al.*, 2019). The winter population of coot at Abberton Reservoir will therefore be made up of birds which breed over a wide area including the continent.

11.6.490 The peak count of three recorded near the Project was 1.67% of the SPA population as stated on the citation.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.491 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.492 As coot have been located predominantly near waterbodies where existing access will be used by the Project during construction temporary habitat loss would be located away from areas where coot have been recorded.

IMPLICATION ON CONSERVATION OBJECTIVES

11.6.493 Coot were observed away from areas that will be impacted by temporary or permanent habitat loss, therefore the conservation objectives for Abberton Reservoir would not be undermined due to habitat loss during construction.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.494 There will be no impact on the integrity of Abberton Reservoir SPA in relation to coot and habitat loss during construction for the Project alone - Scenario 1.

OPERATION

11.6.495 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.496 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.497 No information on coot sensitivity was identified.

11.6.498 Noise assessment, refer Figure 11.23 and Table 11.49.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.499 The locations coot were identified were close to existing access tracks, construction traffic will not use these, they are operational access routes only. **There would be no adverse effect on the integrity Abberton Reservoir SPA by disturbance of coot during the Project alone - Scenario 1.**

OPERATION

11.6.500 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.501 Scheduled maintenance would occur once annually and would be located outside areas where coot have been observed.

11.6.502 Unscheduled maintenance would be located significantly outside of habitat where coot have been identified.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.503 The location coot were observed are associated with existing access tracks, which will be used as an operational access route and waterbodies. Waterbodies will not be impacted by any scheduled or unscheduled maintenance and the tracks operational access route will be used infrequently by vehicles therefore there would be no pathway to undermine the conservation objective of Abberton Reservoir SPA and there would be no adverse effect on the integrity of Abberton Reservoir SPA in relation to disturbance of coot during operation of VE and NF (Scenario 1) alone.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.504 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.49. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for the Project alone - Scenario 1.**

FEATURE 19: GADWALL

DISTRIBUTION

11.6.505 During the intertidal surveys (SLR 2022), gadwall were recorded at landfall location 1 (Beach Work TCC, Manor Way access and Holland Haven Marshes SSSI) on eight occasions, with a peak count of 10 in September 2021. All observations were on land within Holland Haven Marshes SSSI and foraging behaviours were most frequently observed (96.9% of observations). Gadwall was not recorded at location 2 (landfall) during the landfall non-breeding bird surveys 2021/22.

11.6.506 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, gadwall were recorded on 12 occasions, within section 3 and 4, with a peak count of 31.

11.6.507 From North Falls bird surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), gadwall has been confirmed as present within compartment A (Little Clacton) on land, with a peak count of four in February in year one 2020/21, observed in one survey in 2022/21. This species was also recorded in compartment B (Holland Brook), peak count seven in February in year one 2020/21, observed in one survey in 2022/21, and a peak count of 18 in March in year two 2021/22, observed in 2/14 surveys. Gadwall has also been confirmed as present within compartment D (Holland Haven Marshes SSSI), peak count four in February in year one 2020/21, observed in three surveys in 2020/21, and seven in March in year two 2021/22, observed in 2/14 surveys.

11.6.508 Gadwall were recorded within compartment D (Holland Haven Marshes SSSI), peak count of two during the breeding bird survey between April and July 2021. No signs of breeding were noted for this species.

11.6.509 Within the summary report that consolidates all non- breeding season bird records, gadwall observations were concentrated within the 400 m buffer of the Order Limits (excluding Beach Works TCC and Manor Way Access), within Route Section 3, although observations were also made within the 400 m buffer in Route Sections 1 (a single observation of one individual in January 22), Route Section 4. Counts ranged between 1 and the peak count of 44, with most observations taking place within the core winter months of December, January, and February. Within a 400 m buffer from the Beach Works TCC and Manor Way access, gadwall were recorded on 12 occasions. Counts ranged from 1 to the peak count of 10 individuals with observations made in September, December, February, and March 2021, and March 2022. All observations were on land. All observations of non- breeding gadwall within 400 m of the entire Order Limits are presented in Appendix A Drawing 3, sheet 12 and 14 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.510 Gadwall are listed as a qualifying feature in the non-breeding season for the following designated sites:

- Abberton Reservoir SPA
- Abberton Reservoir Ramsar site

11.6.511 The wintering population at these sites comprises primarily birds which breed in eastern Europe and Iceland and possibly some which breed in Britain. There are only 2,225 breeding pairs in Britain whereas the wintering population is 31,000 birds (Frost *et al*., 2019).

Table 11.59 Conservation status analysis of gadwall

Designated Site	Citation Population	BTO Webs Count 15/16-19/20 for Relevant Area	Difference	Favourable Conservation Status Y/N	CO Restore or Maintain	Survey Peak Count (% of Citation Population)
Abberton Reservoir SPA	415	832	+417	Y	Maintain	10.6
Abberton Reservoir Ramsar site	550	832	+282	Y	Maintain	8

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.512 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.513 Gadwall are mostly restricted to larger waterbodies which will not be directly affected during construction works, either temporarily or permanently.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.514 A connection between the gadwall observed during the surveys and the identified designated sites cannot be ruled out, as gadwall may move between them, no foraging distance in winter is provided for gadwall in the standard literature on SPA connectivity (SNH 2016). There will still be suitable habitat and localities away from TCC and haul roads available for foraging gadwall and areas where this species was observed will not be impacted by habitat loss, specifically. Locations where gadwall have been observed close to activities near the Order Limits are: Thorpe-le-Soken BNG: TM 19314 22692 and Holland Haven Marshes SSSI. The construction of the Onshore ECC? is unlikely to impact gadwall, as this species is predominately located in Holland Haven Marshes SSSI, which will be crossed by HDD. The impact of habitat loss alone (excluding disturbance, discussed later) would not have an adverse effect on integrity of identified designated sites, due to no suitable habitat being affected by the construction works and therefore no adverse effect on the integrity of identified designated sites in relation to habitat loss associated with gadwall during constriction, for the Project alone - Scenario 1.

OPERATION

11.6.515 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.516 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.517 The recommended buffer for gadwall from construction activity is 200 m (Wallis ., 2019).

11.6.518 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.519 Gadwall could potentially be displaced from habitat near Thorpe-le-Soken BNG: TM 19314 22692 as the existing track will have more traffic during construction, however, vehicles have less of a visual disturbing effect than people on foot (Hill ., 1997). Disturbance from Holland Haven Marshes SSSI is a potential risk, this would likely be noise based due to the proximity of the landfall compound and the Beach Works TCC.

IMPACTS FOR CONSERVATION OBJECTIVES UNMITIGATED AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.520 Gadwall using the habitat within the Holland Haven Marshes SSSI area could be part of the qualifying population of the identified designated sites. There is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Disturbance during construction has the potential to affect overwintering survival of gadwall , though reduced foraging habitat availability and increased expenditure of energy caused by disturbance, which could impact populations in the long term, potentially undermining Conservation Objective 4 for the SPAs: maintain or restore the population of gadwall, considering also that the number of gadwall recorded during the survey was relatively high when compared to the population within the SPAs. **Therefore, there is potential for an adverse effect on the integrity of Abberton Reservoir SPA and Ramsar site, to the effect on gadwall of the Project alone - Scenario 1 unmitigated.**

MITIGATION

11.6.521 The CoCP (ES Volume 9, Report 21: Code of Construction Practice) includes measures to reduce disturbance to important populations of non-breeding birds along the onshore ECC and at the OnSS, including:

11.6.522 Where practical, in areas where disturbance to significant numbers of non-breeding waterbirds is likely, measures such as fencing/ hoarding would be used during the winter months to provide visual and acoustic screening of active working areas. The requirement for such measures would be determined by the ECW, considering the nature and timing of the works and relevant bird data, including previous survey data and observations made during the construction period.

IMPACTS FOR CONSERVATION OBJECTIVES EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.523 With the mitigation outlined above, no adverse effect on site integrity through undermining the conservation objectives of the identified sites in relation to non-breeding gadwall during construction and decommissioning.

OPERATION

11.6.524 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.525 Impacts would be similar to those identified for Brent geese, refer to 11.6.216 and 11.6.217.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.526 The impacts on gadwall will be the same as for Brent goose, refer to 11.6.218 (risk of disturbance during coldest weather) and 11.6.219 (unscheduled maintenance within intertidal and immediate landfall areas).

MITIGATION

11.6.527 The mitigation for gadwall will be the same as for Brent goose, refer to 11.6.220 (timing scheduled maintenance to avoid periods of cold weather) and 11.6.221 (screening of unscheduled maintenance).

EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.528 The effects on site integrity will be the same for gadwall as for brent goose, refer to 11.6.222 (no adverse effect on integrity for scheduled maintenance) and 11.6.223 (risk of likely significant effect for unscheduled maintenance, if located in the intertidal or immediate landfall areas).

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.529 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.148.

FEATURE 20: GREAT CRESTED GREBE

DISTRIBUTION

11.6.530 During the intertidal surveys (SLR 2022), great crested grebe were recorded at landfall location 1 (near Beach Works TCC and Holland Haven Marshes SSSI) in 3.5% of the survey counts, with a peak count of two in January 2022. Observations ranged from one to two individuals. All observations were offshore, foraging was recorded for 66.76% of the time observed, flying as recorded for the other 33.33%. Great crested grebe was not recorded at location 2 (near landfall) during the landfall non-breeding bird surveys 2021/22.

11.6.531 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, great crested grebe were recorded within 400 m of Route Section 3 of the Order Limits, on three occasions.

11.6.532 During the surveys for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), great crested grebe has been confirmed as present within compartment D (Holland Haven Marshes SSSI), peak count two in year one 2020/21, species observed in one survey, and three in December in year two 2021/22, observed in 2/14 surveys. Great crested grebe were not recorded during the breeding bird survey 2021, between April and July 2021.

11.6.533 Within the summary report that consolidates all non- breeding season bird records, great crested grebe were observed within 400 m buffer seven times, within Route Section 1 on one occasion and Route Section 3 on all other occasions. The count ranged between one and three individuals. All observations of non- breeding great crested grebe within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 27 and 28 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.534 Great crested grebe are a non- breeding qualifying interest species within Abberton Reservoir SPA, the citation population was 180, the most recent mean peak from WeBS data (2017/18-21/22) was 1,737. Therefore, the conservation objectives will be to maintain the population. Peak count of three observed within Route Section 3 is equivalent of 1.67% of the citation population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.535 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.536 Great crested grebe were primarily recorded at the waterbodies around Thorpe-le-Soken BNG: TM 19314 22692. At this location construction activity will occur to the south of the waterbodies there is no permanent land loss near the waterbodies and just increased use of existing access tracks near the waterbodies.

11.6.537 During construction, temporary habitat loss would not displace great crested grebe from habitat these birds have been found in previously, as waterbodies will not be affected.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.538 The numbers of great crested grebe (between one and three individuals), the infrequency of observations and the distance from Abberton Reservoir, the Project not impacting habitat that this species was found within during the surveys and the very large increase (almost ten-fold) in this species within the SPA since the site was designated mean that habitat loss could not to undermine the conservation objectives for great crested grebe at Abberton Reservoir SPA.

11.6.539 No adverse effect on the Abberton Reservoir SPA will occur in relation to habitat loss associated with great crested grebe, during construction for the Project alone - Scenario 1.

OPERATION

11.6.540 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.541 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.542 Great crested grebe are considered to have a Flight Initiated Distance (FID) of 70 m from vehicles (McLeod *et al.*, 2013)

11.6.543 Noise assessment, refer to Figure 11.23 and Table 11.49.

11.6.544 Disturbance of habitat up to 70 m from the source of disturbance could initiate flight in this species, the Order Limits is located adjacent to the southern edge of the most westerly waterbody at Thorpe- le- Soken where great crested grebe were recorded most frequently. This is within 70m of these waterbodies. VE construction would increase activity to the south of these waterbodies the amount of vehicles on these tracks and this could disturb great crested grebe from foraging. If this occurs during cold weather when birds are thermodynamically stressed and there is a greater risk of mortality.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECT ON SITE INTEGRITY - UNMITIGATED

11.6.545 The numbers of great crested grebe (one - three individuals), the infrequency of observations and the distance from Abberton Reservoir, and the very large increase (almost ten-fold) in this species within the SPA since the site was designated mean that construction related disturbance could not to undermine the conservation objectives for great crested grebe at Abberton Reservoir SPA.

11.6.546 There would be **no adverse effect on integrity of Abberton Reservoir due to disturbance of great crested grebe during the construction and decommissioning, when considering the Project alone - Scenario 1.**

OPERATION

11.6.547 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.548 Scheduled maintenance would occur once annually, this will result in minor disturbance. Inspection would be comparable to walkers accessing the habitat or a single vehicle accessing the operational access route between the two lakes. If the visit occurred during a spell of freezing weather, there is the potential for a negative impact, disturbing foraging great crested grebe in the immediate landfall areas when they are most energetically fatigued. However, the track is in existence and vehicles are likely to use this track in cold weather currently. Therefore, the risk is considered deminimus.

11.6.549 Unscheduled maintenance could result in considerable amount of disturbance, and due to the nature of such works, would not be possible to seasonally schedule. Disturbance at the main waterbody for great crested grebe records (Route Section 3, Thorpe-le -Soken) would consist of an increase in vehicular traffic in the event of unscheduled maintenance at this location along the ECC only.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.550 As scheduled maintenance is only one visit annually, this disturbance is very limited, the only pathway to undermine conservation objectives is if birds were disturbed when highly stressed, i.e. in cold weather. Additional energy expenditure and displacement from foraging resources could cause changes in survival for those birds involved. Impacting Conservation Objective 4: population, due to the numbers seem in this vicinity.

11.6.551 The same can be said for unscheduled maintenance, although this would last a considerably longer time, be harder to scheduled and create much more disturbance. The chance of such maintenance being required at the Thorpe-le-Soken location is relatively low.

11.6.552 The numbers of great crested grebe (one - three individuals), the infrequency of observations and the distance from Abberton Reservoir, and the very large increase (almost ten-fold) in this species within the SPA since the site was designated mean, the conservation objectives of the Abberton Reservoir SPA would not be undermined by disturbance during operation and **there would be no adverse effect on site integrity, in relation to non-breeding great crested grebe, for the Project alone- Scenario 1.**

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.553 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.148. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. Therefore, **the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for the Project alone - Scenario 1.**

FEATURE 21: POCHARD

DISTRIBUTION

11.6.554 During the intertidal survey (SLR 2022) pochard were not recorded at location 1 (near Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI) or location 2 (landfall) during the landfall non-breeding bird surveys 2021/22.

11.6.555 During the 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, pochard were recorded within 400 m of Route Section 3 on one occasion, where a count of two was recorded.

11.6.556 From the surveys associated with North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), Pochard were not recorded in either year one 2020/21 or year two 2021/22 non-breeding seasons. Pochard were also not recorded during the breeding bird survey 2021, between April and July 2021.

11.6.557 Within the summary report that consolidates all non- breeding season bird records, pochard were observed within Route Section 3 on two occasions, both observations were of two individuals (SLR 2023). All observations of non- breeding pochard within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 20 in Part 6, Volume 4, Annex 4.6.

11.6.558 Pochard are a migratory species within the Abberton Reservoir SPA designation. Due to the lack of evidence that this species uses habitat in the vicinity of the Project, **an adverse effect on the integrity of any SPA with this species as a qualifying feature can be excluded.**

FEATURE 22: SHOVELER

DISTRIBUTION

11.6.559 During surveys of the intertidal area (SLR 2022) shoveler were recorded at location 1 (near Beach Works TCC, Manor Way access and Holland Haven Marshes SSSI) on 60 occasions with a maximum flock size of 22 (mean = 8.98). The majority of observations (93.4%) were on land within associated with waterbodies in Holland Haven Marshes SSSI. Foraging, or foraging and loafing attributed 38% and 39% respectively. A total of six observations of shoveler were made at location 2 (landfall), flock size ranged from three to eight (mean = 5.16). The majority of observations (89%) were on land with foraging the most frequently observed activity. The peak count at location 1 of 22 shoveler is equivalent to 0.113% of the UK non-breeding population.

11.6.560 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, shoveler was recorded on one occasion within 400 m of the Order Limits in Route Section 3, with a count of four observed.

11.6.561 From the North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) the most important onshore area for shoveler is Holland Marshes in Compartment D with peak observations of 38 in year one and 29 in year two. No breeding locations were confirmed but adults were observed in Compartment D during April and May.

11.6.562 Within the summary report that consolidates all non-breeding season bird records, there were three observations of shoveler within the 400 m buffer of the Order Limits, excluding the Beach Works TCC and Manor Way, two were located in Route Section 3 (two and four individuals, in February and October respectively) and one observation of three individuals in Route Section 1 in March. Within the 400 m buffer of the Beach Works TCC and Manor Way, there were 91 observations of shoveler, A peak count of 33 individuals was recorded in February 2021. All observations of non- breeding shoveler within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 21, 22 and 23 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.563 Shoveler are designated as a non-breeding species in the following citations:

- Abberton Reservoir SPA
- Abberton Reservoir Ramsar site

11.6.564 Abberton Reservoir SPA citation population was 480 and 377 for the Ramsar site. The most recent WeBS count (2017/18-21/22) was 1,386, therefore the population has a favourable conservation status under both designations.

11.6.565 The peak count of 33 individuals recorded at Holland Haven Marshes is equivalent to 6.88% of the SPA, 8.75% of the Ramsar site population and 2.38% of the most recent WeBS count.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.566 Refer to 11.6.89 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.567 Shoveler were frequently recorded foraging within Holland Haven Marshes SSSI, and habitat north of the Manor Way. Specifically, the waterbodies within these locations were considered likely to support a greater number of individuals. The other location Shoveler were found was the waterbody near an existing access track, that will form an operational access route, used during operation and maintenance only (not construction) within Route Section 3, at Thorpe-Le- Soken. During construction there will be temporary habitat loss to the south of the most western waterbody, but no permanent habitat loss.

11.6.568 Holland Haven Marshes SSSI was an important habitat for shoveler, with the peak count across all surveys observed (33 individuals). This is in proximity to the Beach Works TCC and Manor Way access (south) and the Landfall (northeast). Holland Haven Marshes SSSI will be navigated crossed via HDD, there will be no land take within this area.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.569 A connection between the birds observed during the survey and Abberton Reservoir cannot be ruled out, as shoveler may travel between Abberton Reservoir and habitat near the Project. No foraging distance in winter is provided for shoveler in the standard literature on SPA connectivity (SNH 2016). There will still be habitat near the intertidal area available for foraging shoveler. Similar habitat will be available outside of the relatively small construction areas.

11.6.570 The construction of the onshore cable route will not remove habitat directly used by foraging shoveler. Therefore, the impact of habitat loss alone (excluding disturbance, discussed later) will not undermine the conservation objectives of the designated sites and therefore no adverse effect on integrity of Abberton Reservoir SPA, in relation to habitat loss impacting non- breeding shoveler during construction, for the Project alone - Scenario 1.

OPERATION

11.6.571 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 – DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.572 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.573 Shoveler are reported to have a Flight Initiated Distance (FID) of 114.2 m from motorised watercraft (Mori ., 2001), this is considered to be similar for construction traffic. Thresholds for noise are thought to be similar to teal.

11.6.574 Noise assessment: refer to Figure 11.23 and Table 11.49. For shoveler, noise over 70 dB will cause disturbance, up to 100 m from the landfall HDD compound during establishment, mobilisation, and demobilisation, removal and excavation of joint bays, any open trenching works and roof and backfill over TJBs and TCC access road removal. Visual disturbance will also incorporate at least a 100 m buffer around work and transport activities. The temporary habitat loss will be substantial, at least 100 m around the haul road adjacent to the intertidal area, 100 m from the TCC, impacting parts of Holland Haven Marshes SSSI and directly to the south of the waterbodies near Thorpe-le-Soken (Route Section 3).

11.6.575 Shoveler are likely to be displaced from habitat around the waterbodies at Thorpe-le-Soken and Holland Haven Marshes SSSI, specifically near the pumping station throughout the duration of construction, based on noise and visual disturbance occurring at the Beach Works TCC and the ECC corridor in Route Section 3 near the waterbodies. The landfall HDD compound is sufficiently far from the location of the concentration of most shoveler sightings. Disturbance from Holland Haven Marshes SSSI and the waterbodies at Thorpe-le-Soken is likely to an extent, due to the distance from Beach Works TCC, Manor Way access and construction within Route Section 3 respectively, based on the buffer recommended for shoveler. The loudest noises associated with construction may cause temporary disturbance further than 100m, due to the startling element.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.576 As shoveler using the habitat within Holland Haven Marshes SSSI and nearby could be part of the population associated with Abberton Reservoir and there is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Disturbance during construction has the potential to affect over-winter survival of shoveler, though reduced foraging, and increased expenditure of energy, which could impact populations in the long term. However, given the very large increase in the population of this species, and the relatively small numbers recorded during the survey, there is no scope for disturbance associated with construction of VE to undermine the conservation objective to maintain the population at Abberton Reservoir, or any of the other conservation objectives for this species, **therefore there would be no adverse effect on Abberton Reservoir SPA or Ramsar site in relation to disturbance from construction or decommissioning of the Project alone- Scenario 1.**

MITIGATION

11.6.577 No mitigation is required however this species will benefit from the mitigation required to prevent disturbance to other species.

IMPACTS FOR CONSERVATION OBJECTIVES EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.578 There will be no pathway to undermine the conservation objectives and no adverse effect on site integrity of the identified sites in relation to non-breeding shoveler during construction and decommissioning through disturbance generated by the Project alone - Scenario 1.

OPERATION

11.6.579 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.580 Impacts would be the same as for Brent geese, refer to 11.6.216 and 11.6.217.

IMPACTS ON CONSERVATION OBJECTIVES

11.6.581 As for construction.

MITIGATION

11.6.582 As for construction.

EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.583 As for construction.

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.584 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.148. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 23: TUFTED DUCK

DISTRIBUTION

11.6.585 Intertidal surveys (SLR 2022) recorded tufted duck at landfall location 1 (Beach Works TCC and Manor Way Access near Holland Haven Marshes SSSI) in 1.19% of the survey counts, with a peak count of one in January 2022. Tufted duck was observed to be foraging and flying during the recording. Tufted duck was not recorded at location 2 (landfall).

11.6.586 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, tufted duck was recorded on eight occasions within Route Section 3, with a peak count of 66.

11.6.587 During surveys for North Falls (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), tufted duck has been confirmed as present within compartment B (Holland Brook), peak count of three between April and July 2021, and compartment C (Great Holland), peak count of 1 between April and July 2021. Tufted duck was confirmed in compartment A (Little Clacton), peak count of four in March in year one 2020/21, observed in two surveys; compartment B (Holland Brook), peak count of seven in February in year two 2021/22, observed in 3/14 surveys; and compartment C (Great Holland), peak count of three in January in year two 2021/22, observed in 1/14 surveys.

11.6.588 Within the summary report that consolidates all non- breeding season bird records, there were 26 observations of tufted duck within 400 m of the Order Limits. Of these observations the peak count was 66 and located in Route Section 3. The majority of observations were located in Route Section 3 (88%), with only two observations, of three and one tufted duck in January and February 2022 in the buffer of Route Section 1 and one observation of two individuals in March 2022 in the buffer near Route Section 5. Observations appear to be concentrated in the latter part of the winter months, with records from February and March across the years accounting for 54% of observations. There were no observations of tufted duck associated with Holland Haven Marshes SSSI. All observations of non- breeding tufted duck within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 10 and 11 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.589 Tufted duck are a qualifying interest feature of the Abberton Reservoir SPA. The citation population was 3,500 for the SPA, with a mean peak of 4,443 for the most recent 5-year average WeBS count (2017/18-21/22) tufted duck are in favourable conservation status and therefore the conservation objective is to maintain the population.

11.6.590 The peak count of individuals recorded, was 66 within Route Section 3 (Thorpe-le-Soken waterbodies) equivalent to 1.89% of the SPA population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.591 Refer to 11.6.89 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.592 All tufted duck observations were found on or close to waterbodies, all of these will be retained during construction and crossed by HDD or avoided. There will be no loss of habitat, permanent or temporary at the locations where tufted duck have been observed.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.593 No loss of waterbodies within the project mean there is no scope to undermine the conservation objectives of the Abberton Reservoir SPA.

11.6.594 There will be no adverse effect on the integrity of Abberton Reservoir SPA in relation to non- breeding tufted duck and habitat loss, for the Project alone - Scenario 1.

OPERATION

11.6.595 During operation of the Project there will be no further land take, therefore, habitat loss during operation does not require assessment within the RIAA.

PATHWAY 2 - DISTURBANCE OF BIRDS OUTSIDE THE SPA

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.596 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.597 Tufted duck do not have a sensitivity classification in Cutts . (2013), FID is quoted as between 8 and 30 m (NatureScot Report 1283).

11.6.598 The key location where multiple registrations of tufted duck were recorded that could be disturbed by construction work are the waterbodies at Thorpe-Le-Soken within Route Section 3 where works will occur to the south of the waterbodies. To a lesser extent tufted duck were also recorded within Route Section 5, at a reservoir near New Hall. Visual disturbance could impact this species here.

11.6.599 Habitat up to 150 m from the source of noise could be impacted. This could disturb tufted duck from foraging, if this occurs during cold weather when birds are thermodynamically stressed, there is a greater risk of mortality.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.600 Tufted duck using the habitat within Thorpe-le-Soken could be part of the qualifying population of the identified designated site. There is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Disturbance during construction has the potential to affect overwintering survival of tufted duck , though reduced foraging habitat availability and increased expenditure of energy caused by disturbance, which could impact populations in the long term, potentially undermining Conservation Objective 4 for the SPAs: maintain the population of tufted duck, considering also that the peak count of tufted duck recorded during the survey was relatively high when compared to the population within the SPAs. **Therefore, there is potential for an adverse effect on the integrity of Abberton Reservoir SPA, due to the disturbance effect on tufted duck of the Project alone - Scenario 1 unmitigated.**

MITIGATION

11.6.601 Refer to 11.6.519. With mitigation in place, there would be no adverse effect on integrity in relation to non- breeding tufted duck and disturbance once mitigated, for the Project alone - Scenario 1.

OPERATION

11.6.602 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.603 Scheduled maintenance would occur once annually, this will result in minor disturbance. Inspection would be comparable to walkers accessing the habitat. If the visit occurred during a spell of freezing weather, there is the potential for a negative impact, disturbing foraging tufted duck particularly in the Thorpe- Le-Soken area (Route Section 3) when they are most energetically fatigued. This could impact survival of tufted duck.

11.6.604 Unscheduled maintenance could result in considerable amount of disturbance, and due to nature, would not be possible to seasonally schedule. Disturbance could impact tufted duck in the non- breeding season if it occurred when the species was present. This accounts for approximately 2% of the onshore cable route, the chances of an unscheduled maintenance event occurring in this small proportion of the route is relatively low.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.605 As scheduled maintenance is only one visit annually, this disturbance risk is very limited, specifically considering the number of tufted duck and that waterbodies will not be affected by the Project.

11.6.606 The same can be said for unscheduled maintenance, although this would last a considerably longer time, be harder to scheduled and create much more disturbance. The chance of such maintenance being required at the immediate inshore locations is relatively low,

11.6.607 It is concluded that there is no pathway to undermine the conservation objective of Abberton Reservoir SPA through disturbance during scheduled maintenance, due to the small proportion of the population observed with the Project area.

11.6.608 For scheduled maintenance, there would be no adverse effect on site integrity, through undermining the conservation objectives of the identified sites in relation to non- breeding tufted duck, due to disturbance and potential impacts on survival.

11.6.609 For unscheduled maintenance with screening and considering the low likelihood of such maintenance being required, there is no pathway to undermine the conservation objectives of Abberton Reservoir SPA, in relation to non-breeding tufted duck, **therefore there would be no adverse effect on the integrity of Abberton Reservoir SPA.**

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.610 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. **Therefore, the conservation objectives would not be undermined by any changes associated with the Project alone - Scenario 1 and air quality. There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 24: WATERBIRD ASSEMBLAGE

11.6.611 Of the identified designated sites within 15 km of the Project, several have waterbird assemblages during the non-breeding season that are a qualifying interest feature. These are:

- Stour and Orwell Estuaries SPA (over 20,000 waterfowl; specifically: great crested grebe, cormorant, brent goose, shelduck, wigeon, gadwall, northern pintail, goldeneye, ringed plover, grey plover, lapwing, knot, dunlin, black-tailed godwit, curlew, redshank, and turnstone);
- Stour and Orwell Estuaries Ramsar site (51,285 waterfowl);

- Colne Estuary SPA (over 20,000 waterfowl specifically: cormorant, mute swan, shelduck, goldeneye, ringed plover, grey plover, sanderling, dunlin, black tailed godwit and curlew);
- Abberton Reservoir SPA (over 20,000 waterfowl specifically: cormorant, mute swan, shelduck, goldeneye, ringed plover, grey plover, sanderling, dunlin, black tailed godwit, and curlew);
- Abberton Reservoir Ramsar site (23,787 waterfowl);
- Blackwater Estuary SPA (over 20,000 waterfowl specifically: brent geese, grey plover, dunlin, and black-tailed godwit); and
- Blackwater Estuary Ramsar site (105,061 waterfowl).

CONSERVATION STATUS

11.6.612 The BTO WeBS trends were used to assess the status of the waterfowl assemblages, refer to Table 11.60. The alert system uses the 2016/17 as the comparison year, this is somewhat historic, but gives a guide to current status.

Table 11.60 Waterfowl assemblage conservation status

Designated Site	Webs Alert (% Change Since Baseline)	Favourable Conservation Status Y/N	CO Restore or Maintain
Stour and Orwell Estuaries SPA/ Ramsar site	-28	N	Restore
Colne Estuary SPA/ Ramsar site	-18	N	Restore
Abberton Reservoir SPA/ Ramsar site	5	Y	Maintain
Blackwater Estuary SPA/ Ramsar site	51	Y	Maintain

IMPACT ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.613 For those designated sites in favourable condition, from the assessment of features already undertaken, VE could not undermine the conservation objective for waterfowl or have an adverse effect on the sire integrity for Abberton Reservoir SPA/ Ramsar site or Blackwater estuary SPA/Ramsar site. Therefore, Abberton Reservoir SPA/Ramsar site and Blackwater Estuary SPA/Ramsar site are not discussed further.

11.6.614 For The Stour and Orwell Estuaries SPA/Ramsar site and the Colne Estuary SPA/Ramsar site, due to the conservation status being unfavourable and the conservation objectives being to restore, VE could undermine the conservation objectives, and have an adverse effect on the integrity of the sites. The pathway and timing are, during construction and maintenance, via the disturbance pathway as discussed for the individual features.

Mitigation

11.6.615 Appropriate mitigation will be required during construction, refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW)

11.6.616 During operation scheduled maintenance should only occur in weather above freezing, to ensure that any birds that are disturbed are not thermodynamically stressed, refer to 11.6.189.

11.6.617 Unscheduled maintenance is harder to mitigate, timings are harder to implement due to the nature of the requirement. Implementation of screening of any maintenance near the coastal grassland or wetland habitat would limit disturbance to an extent.

IMPACT ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.618 With mitigation in place conservation objective four for waterfowl assemblage would not be undermined for Stour and Orwell Estuary and Colne estuary SPA or Ramsar site. **Therefore, the Project alone - Scenario 1 during construction, decommissioning, and operation, with mitigation would have no adverse effect on the integrity of the designated sites identified via the disturbance of waterfowl outside the SPA or Ramsar site boundary during the non-breeding season.**

11.6.619 The majority of the waterfowl species that make up these assemblages have previously been assessed as individual features. However, there are some species that make up the assemblages which have not, individual assessments are undertaken for the following species:

- Curlew (Stour and Orwell Estuaries SPA/Ramsar site)
- Lapwing (Stour and Orwell Estuaries SPA/Ramsar site
- Wigeon (Stour and Orwell Estuaries SPA/Ramsar site)
- Turnstone (Stour and Orwell Estuaries SPA/Ramsar site)

FEATURE 25: WATERBIRD ASSEMBLAGE - CURLEW

DISTRIBUTION

11.6.620 During the intertidal surveys (SLR 2022), curlew were recorded at landfall location 1 (Beach Works TCC, Manor Way access, near Holland Haven Marshes SSSI) in 50% of the survey counts, with a peak count of 47 in January 2022. Observations ranged from a small number of individuals (four) to 47. Two records were offshore, the other observations were on land. Curlew were most frequently observed foraging (71% of observations). At location 2 (landfall), curlew were recorded on eleven occasions, 90% of observations were on land, with the remaining 10% observed offshore. The flock size ranged from one to 66 (peak recorded in March 2022). Foraging was the most frequently observed behaviour, 58% of observations were foraging individuals, while birds in flight were recorded 35% of the time.

11.6.621 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, curlew were recorded with Route Sections 1 and 3 on nine occasions, with a peak count of 25 with Route Section 1.

11.6.622 During the North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys), curlew was present within compartment A (Little Clacton) on land, with a peak count of 20 in late March in year two 2021/22. This species was also recorded in compartment B (Holland Brook) sporadically through the non-breeding season, with a peak count of 39 in year two 2021/22, observed in 5/14 surveys. Curlew was within compartment D (Holland Haven Marshes SSSI) within the landfall throughout the winter, with a peak count of 53 in year one 2020/21, and 54 in year two 2021/22, observed in 9/14 surveys; and also in compartment E (Frinton Golf Club) during the non-breeding season, with a peak count of six in year one 2020/21, and four in year two 2021/22, observed in 2/14 surveys.

11.6.623 During breeding surveys for North Falls, small numbers of curlew were recorded within wetland areas at Holland Haven Marshes (mainly compartment D) in April and May 2021, a peak count of seven was recorded between April and July 2021. These were non-breeding individuals. Curlew were also recorded in compartment A, with a peak count of three, and compartment B, peak count of 22, between April and July 2021. These birds were also classed as non- breeding.

11.6.624 Within the summary report that consolidates all non- breeding season bird records a total of 26 observations of curlew within the Order Limits. The majority of these, 92.3%, were within Route Section 1 with two observations of individuals within Route Section 3 in November 2021 and December 2022. The peak count of observations in Route Section 1 was 44, with 29.2% of observations being greater than 20 individuals. The majority of curlew within the refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys were observed on land, with one intertidal observation. Observations were spread across all survey months.

11.6.625 Within the 400 m buffer of the Order Limits excluding Beach Works TCC and Manor Way access, there was a total of 85 observations of curlew, across Route Section 1 (72.9% of observations in the 400 m buffer), Route Section 3 (15.3% of observations in the 400 m buffer), Route Section 4 (10.6% of observations within the 400 m buffer). The peak count of curlew within the 400 m buffer was 84 and 44.7% of observations had a count of 10 or greater. Observations were split across most survey months with a concentration of observations in January, February, and March over the multiple years of survey (61.2% of observations).

11.6.626 A total of 30 curlew observations were recorded within the Beach Works TCC and Manor Way Access 400 m buffer. Counts ranged from one to 54, with 50% of records being greater than 10. One observation was offshore, and the rest were on land. Observations were recorded in all survey months, apart from October, with 66.6% of observations in January or February.

11.6.627 All observations of non- breeding curlew within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 38 and 40 in Part 6, Volume 4, Annex 4.6.

CONSERVATION STATUS

11.6.628 Curlew are a non-breeding assemblage species of the Stour and Orwell Estuaries SPA/ Ramsar site and quoted within the citation of the Ramsar site at a population of 1,824 individuals and for the SPA a population of 2,153 individuals, the most recent WeBS count 2017/18-/2021/22 was 1,173 from the Stour Estuary and 478 from the Orwell Estuary total of 1,651, less than the Ramsar citation. Therefore, curlew are in unfavourable conservation status within both designations and the conservation objective will be to restore the population.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.629 Habitat loss will not impact any onshore, coastal, or intertidal designated site relevant to this RIAA, and the majority will be temporary only during construction (TCC, drill pits, temporary haul roads), with only the footprint of TJBs, junction boxes and the OnSS comprising permanent habitat loss, with TJB and junction boxes only located at the landfall. There will be no permanent intertidal habitat loss.

11.6.630 Refer to 11.6.89 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.631 Curlew do use inland habitat, however this is most frequently up to 2 km inland (Mander ., 2022).

11.6.632 Onshore with the landfall area Holland Haven Marshes and Holland Brook (both areas part of the SSSI) are important habitat for curlew, the Peak count of 66 was observed at location 2 (northern location, near landfall) but were in flight. During construction temporary habitat loss would be located near the haul road and within /adjacent to the intertidal area, areas where curlew are likely to be present.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.633 Temporary habitat loss during construction has the potential to undermine conservation objective four, restoring the population of qualifying features for the Stour and Orwell SPA/ Ramsar site. If the curlew that were recorded during the surveys form part of the wintering population of the SPA/ Ramsar site, which is assumed. However, this will be temporary (maximum two seasons) and similar habitat will be available outside of the relatively small construction areas; intertidal habitat will remain available at low tide and habitat within Holland Haven Marshes SSSI will also still be available.

EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.634 The construction of the onshore cable route will temporarily remove habitat directly used by foraging curlew for up to two seasons, from intertidal habitat, associated with the beach haul road along the coast and the landfall compound zone. However, the majority of the inland habitat will still be available, as Holland Haven Marshes SSSI will be crossed by HDD, this and the majority of the surrounding fields will not be part of the construction area except for the landfall compound zone. Curlew were more frequently recorded within this inland habitat, with the highest density of 2.5 birds/ 0.005ha recorded in the inland localities. The area which will form the haul road and/ or TCC, that overlapped with curlew sightings was approximately 0.5 ha, compared with approximately 20 ha of inland habitat that will not form the haul road or TCC, that curlew were observed using. This is where the majority of curlew were recorded. The impact of habitat loss alone (excluding disturbance, discussed later) on curlew will not undermine the conservation objective to restore the waterfowl populations of the Stour and Orwell SPA/Ramsar site and therefore **the Project alone - Scenario 1 will not have an adverse effect on integrity of identified designated sites through habitat loss.**

PATHWAY 2 - DISTURBANCE

11.6.635 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.636 Curlew are classified as a bird of moderate sensitivity, Cutts . (2013), birds are particularly wary of visual disturbance, within 120-300 m recorded as an FID for a lone walker on mudflat. Birds within 300 m require consideration for visual disturbance and standard precautionary approach of 72 dB at the bird for noise disturbance.

11.6.637 Noise assessment, refer to Figure 11.23 and Table 11.49. For curlew noise over 70 dB will cause disturbance, up to 100 m from the landfall TCC, these include: establishing and removal of the landfall compound, HDD rig mobilisation, excavation of TJB, open trenching excavation, backfill and reinstatement, roof and backfill of TJBs and TCC plus access road removal. Visual disturbance will also incorporate at least 100 m, potentially up to 300 m buffer around work and transport activities. The temporary habitat loss will be substantial, at least 100 m, worse case 300 m around any temporary haul road near curlew observations, but specifically adjacent to the intertidal area and at least 100 m from the TCC locations near curlew observations, potentially 300 m if not screened.

11.6.638 Curlew are likely to be displaced from the intertidal area, parts of Holland Haven Marshes SSSI and fields surrounding the landfall TCC near the coast throughout the duration of construction, based on noise and visual disturbance. Disturbance from Holland Brook and the north western part of Holland Haven Marshes SSSI, due to the distance from TCC and haul roads is less likely, based on the buffer recommended for curlew. At locations further inland, where curlew have been observed the construction work is either distant from the observations or restricted to traffic along existing access tracks used during construction. As vehicles initiate less of a flight response compared to people, disturbance at these locations is likely to be less. The exception for then inland records of curlew is around Great Holland, where curlew have been observed within the Order Limits on several occasions. If construction occurs during the non-breeding season in these locations, disturbance of curlew at these locations is also possible.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.639 As curlew use the habitat within parts of Holland Haven Marshes SSSI and further inland near Great Holland, areas within the Order Limits, specifically near the landfall compound zone and Beach Works TCC could contain part of the assemblage qualification of the identified designated site. Additionally, there is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Disturbance during construction has the potential to impact mortality of qualifying features, through reduced foraging and increased expenditure of energy, which could impact populations in the long term, impacting on Conservation Objective 4: restore the population of the waterfowl assemblage of the Stour and Orwell Estuary SPA/Ramsar site. **This would lead to an adverse effect on integrity for the Stour and Orwell Estuary SPA/Ramsar site in relation to curlew and unmitigated disturbance during construction and decommissioning for the Project alone - Scenario 1.**

MITIGATION

11.6.640 Refer to 11.6.128 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.641 With the mitigation outlined above, the conservation objectives of **the designated sites will not be undermined and no adverse effect on site integrity of the identified sites in relation to disturbance of curlew during construction and decommissioning are predicted for the Project alone - Scenario 1.**

OPERATION

11.6.642 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.643 Disturbance has the potential to limit foraging and therefore has the potential to impact survival of curlew within 100-300 m of maintenance, depending on the amount of noise and visual disturbance. This would undermine conservation objective four, the population of each qualifying interest feature for the identified designated sites.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.644 The impacts curlew are similar to other waterfowl, refer to 11.6.187 (risk of disturbance during coldest weather and unscheduled maintenance within intertidal and immediate landfall areas). Impacting conservation objective 4: population and leading to **a potential adverse effect on the integrity of the Stour and Orwell Estuary SPA/Ramsar site in relation to curlew and unmitigated disturbance during operation for the Project alone - Scenario 1.**

MITIGATION

11.6.645 The mitigation for curlew will be the same as for Brent goose, refer to 11.6.220 (timing scheduled maintenance to avoid periods of cold weather) and 11.6.221 (screening of unscheduled maintenance).

IMPACTS ON CONSERVATION OBJECTIVES EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.646 The effects on site integrity will be the same for curlew as for brent goose, refer to 11.6.222 (no adverse effect on integrity for scheduled maintenance) and 11.6.223 (low chance and screening, no adverse effect on integrity).

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.647 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.147. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. **There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 26: WATERBIRD ASSEMBLAGE - LAPWING

DISTRIBUTION

11.6.648 During the intertidal survey (SLR 2022), lapwing were observed from location 1 (Beach Works TCC, Manr Way access near Holland Haven Marshes SSSI) on 89 occasions, sightings ranged from one individual to a peak count of 325 (mean 52.47). All observations were on land, spread out within Holland Haven Marshes SSSI and farmland nearby. Birds were observed loafing, foraging, and roosting. Lapwing was observed on five occasions from location 2 (landfall) flock size ranged from one to 65, observations were located to the south in similar location to those observed form location 1.

11.6.649 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, lapwing were recorded within or within 400 m of the Order Limits in sections 1, 2, 3, 4, 6, and 7.

11.6.650 From the surveys to inform North Falls landfall, lapwing were observed in:

- Compartment B, Holland Brook, peak count 66 in year 2, (beyond 400 m form the Order Limits - not included in this report);
- Compartment C, Great Holland in both years, peak count of 890;
- Compartment D, Holland Marshes in both years, peak count 137; and
- Compartment E, Frinton golf club in both years peak count 250.

11.6.651 Within the NF OWF (refer to Volume 6, Part 6, Annex 4.25 for details of NF OWF surveys) cable route corridor lapwing were recorded in all compartments except H and I. with a peak count of 1,315 in compartment E. The largest flocks, and highest frequency of observations, were recorded near Hamford Water SPA around Quay Farm, Beaumont Hall, and Barker's Farm. Lapwing may also use arable habitat within the ECC onshore corridor.

11.6.652 Breeding lapwing were identified in compartments B with a peak count of 12, C, peak count six and D, peak count eight, with post fledging flocks up to 12 birds record in July in compartment B (Holland Brook), refer to Figure 11.16. Three breeding pairs were identified within the SSSI and on arable habitat. Two pairs were within the PEIR assessment area.

11.6.653 Within the summary report (SLR 2023) that consolidates all non- breeding season bird records, there was a total of five observations within the Order Limits (Route Sections 1, 4, 6 and 7), all of which were recorded on land. Counts ranged from 12 to a peak count of 87 in December 2022. Observations within the Order Limits were recorded across the months of March, November, December, and January.

11.6.654 There was a total of 48 observations within the 400 m buffer from the Order Limits, 46% of which in Route Section 1, 29% in Route Section 3, 8% in Route Section 4, 6% in Route Section 6 and 7, and 2% in Route Sections 2 and 4a. Counts ranged from one to the peak count of 890 (Route Section 1).

11.6.655 A total of 87 observations were recorded within the 400 m buffer of Beach Works TCC and Manor Way access, all of which were recorded on land. Counts ranged from one up to a peak count of 150, which was recorded on three occasions on 23 September 2021. 75% of observations had a count between one to 49, 15% had a count between 50 to 99, and 10% had a count between 100 and 150. All observations of non- breeding lapwing within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 30-33 in Part 6, Volume 4, Annex 4.6.

618000 619000 620000 621000 622000 623000

220000 219000 218000 217000 216000

A B C D E

Great Holland

Holland-on-Sea

Holland Haven

Bursville Park

Legend:

- Search Area
- Survey Area
- Survey Compartment
- Holland Haven Marshes Site of Special Scientific Interest (SSSI)
- Holland Haven Local Nature Reserve

Target Species (2021)

- Avocet
- Barn Owl
- Cetti's Warbler
- Corn Bunting
- Grey Partridge
- Lapwing
- Marsh Harrier
- Redshank
- Yellow Wagtail
- Yellowhammer

Source: RHDHV, MacArthur Green

MacArthur Green

North Falls Onshore

Figure 2

Landfall Search Area: Target Species

0 250 500 Metres

MAP SCALE: 1:17,500 @ A3

N

Datum: OSGB 1936, Projection: British National Grid

Date: 26/08/2021

Map Author: LNF Checked: RD Approved: RD Status: Rev0

Document Path: S:\Projects\RHDHV\North Falls_NFA\03_Data\O_CF_Fig2_LSA_TargetSpecies_NFA.mxd

CONSERVATION STATUS

11.6.656 Lapwing are designated as part of the non- breeding assemblage for the Stour and Orwell Estuaries SPA/Ramsar site. Within WeBS alerts, the lapwing population had decreased by 44% from the first winter 1991/92 to the reference winter 2016/2017. The citation population for the SPA is 6,242 and the current WeBS count (2017/18-2021/22) is 2,677 for the Stour and Orwel combined. The peak count of 890 was 14.26% of the SPA population. Therefore, the conservation status is unfavourable, and the conservation objective will be to restore.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.657 Refer to 11.6.89 and 11.6.90 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.658 Lapwing use a vast area of inland arable habitat during the non-breeding season. The use is dependent on arable practices and management (manure spreading and sugar beet production) (Gillings ., 2007) and therefore the areas used change year to year. Within the east of England there is considerable arable habitat for lapwing to use and such habitat is extensive across the onshore ECC. The population size is limited by breeding success and not the availability of over-winter arable farmland habitat (Sheldon ., 2004) and therefore alternative farmland habitat outside the ECC is available.

11.6.659 Breeding lapwing were noted in compartment B, C, and D (NF OWF breeding survey 2021, refer to Figure 11.16, this is in the vicinity of Clacton Road Frinton and Walton, CO13 0JU, grid ref TM 21047 17687, TCC 1. Temporary habitat loss will occur substantially far (approximately 500m) from the vicinity of where lapwing have been recorded during the breeding season.

11.6.660 Onshore with the landfall area Holland Haven Marshes and Holland Brook (both areas part of the SSSI), the vicinity of Clacton Road Frinton and Walton, CO13 0JU, grid ref TM 20957 17953 near TCC1 were important habitats for lapwing in all seasons, with the peak count across all surveys observed (890 individuals non-breeding, 12 breeding season). Lapwing were also recorded in the vicinity of the Landfall Compound Zone During construction temporary habitat loss would be located at TCC1 and the Landfall Compound Zone, associated haul road and haul road within /adjacent to the intertidal area, all areas where lapwing are likely to be present. However, there will be no loss of habitat for this species within the SSSI, where many lapwing records were located.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.661 There will be arable and wetland habitat available, outside of the construction footprint for non-breeding lapwing and there will be no habitat loss at breeding locations.

11.6.662 The construction of the onshore cable route will remove habitat directly used by foraging non-breeding lapwing for up to two winter seasons, this habitat is associated with the haul road along the coast, TCC 1 and the Landfall Compound Zone locations, haul roads inland and open trenching. As there are other arable habitats available for foraging by non- breeding lapwing. The use by non- breeding lapwing is dependent on management and changes annually, therefore the way lapwing uses arable farmland changes, the areas of arable farmland lost to construction may or may not be used for lapwing at the time of construction. **Therefore, there will be no adverse effect on non- breeding lapwings in relation to habitat loss associated with the Project alone - Scenario 1 unmitigated.**

11.6.663 Breeding lapwing do use habitat nearby, but this will not be lost permanently or temporarily as part of the construction. **The impact of habitat loss alone (excluding disturbance, discussed later) will not have an adverse effect on integrity of the relevant designated sites for the Project alone - Scenario 1.**

PATHWAY 2 - DISTURBANCE

11.6.664 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.665 Lapwing are classified as a bird of moderate sensitivity, Cutts *et al*. (2013), birds within 300 m require consideration for visual disturbance and standard precautionary approach of 72 dB at the bird for noise disturbance.

11.6.666 Noise assessment, refer to Figure 11.23 and Table 11.49 Noise assessment at different distances data presented refers to A-weighted equivalent continuous noise level (LAeq) Bold figures ≥70LAeQ. For lapwing noise over 70 dB will cause disturbance, up to 100 m from the Landfall Compound. Visual disturbance will also incorporate at least 100 m, potentially up to 300 m buffer around work and transport activities. The disturbance loss will be substantial, at least 100 m, worse case 300 m around the haul road adjacent to the intertidal area and 100 m from the TCCs including the Landfall Compound and other haul road locations.

11.6.667 Disturbance from Holland Brook and Holland Haven Marshes SSSI, due to the distance from TCC and haul roads is less likely, based on the buffer recommended for lapwing. Displacement from other haul roads, TCC and trenching operations in arable fields along the ECC will also displace birds.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.668 Non-breeding birds will move between sites in response to the weather (Brown and Grice, 2005). Moreover, there is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Therefore, lapwing using the habitat within the Order Limits and within a 400 m buffer could be part of the non-breeding assemblage qualification of the Stour and Orwell SPA/ Ramsar site. Disturbance during construction has the potential to impact mortality of qualifying features during the non- breeding season, though reduced foraging, and increased expenditure of energy, which could impact populations in the long term, impacting impact on Conservation Objective 4: restoration of the population of the waterfowl assemblage at the Stour and Orwell Estuaries SPA. **Therefore, without mitigation there is a risk of an adverse effect on site integrity due to disturbance of non- breeding lapwing from the construction and decommissioning of the Project alone - Scenario 1.**

11.6.669 During the breeding season, disturbance at caused by TCC 1 within compartment C was suitably far from the location of breeding lapwing in 2021, (approximately 500m) however lapwing may nest in different locations in different years and therefore there is the potential that breeding lapwing could be disturbed and/or displaced by the Project, specifically near the Landfall compound or TCC1. **Therefore, without mitigation there could be adverse effect on site integrity due to disturbance of breeding lapwing from the construction and decommissioning of the Project alone - Scenario 1.**

MITIGATION

11.6.670 For non-breeding lapwing, refer to 11.6.126 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

11.6.671 Specific mitigation for breeding lapwing is required, this would include surveys for breeding pairs in the vicinity of the works pre- commencement and during operation, in the breeding season. Additional screening of the works would be required if pairs are nesting within 150 m.

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.672 With the mitigation outlined above, the conservation objectives of the identified sites will not be undermined in relation to non-breeding and breeding lapwing during construction and decommissioning, **therefore there will be no adverse effects on the integrity of the identified designated sites due to disturbance of non-breeding and breeding lapwing during construction or decommissioning for the Project alone - Scenario 1.**

OPERATION

11.6.673 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.674 Disturbance has the potential to limit foraging and therefore has the potential to impact survival of non- breeding lapwing within 100-300 m of maintenance, depending on the amount of noise and visual disturbance. This would undermine conservation objective four, the population of each qualifying interest feature for the identified designated sites. In addition, for lapwing, disturbance could impact breeding, if breeding success was to reduce and recruitment into the designated site populations would diminish.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.675 The impacts non- breeding lapwing are similar to other waterfowl, refer to 11.6.218 (risk of disturbance during coldest weather) and 11.6.219 (unscheduled maintenance within intertidal and immediate landfall areas). Impacting conservation objective 4: population. **Therefore, without mitigation there is a risk of an adverse effect on integrity of the relevant designated sites due to disturbance during operation of the Project alone - Scenario 1 for non-breeding lapwing.**

11.6.676 Impact on breeding lapwing could reduce breeding success and recruitment into the SPA population, this would undermine the conservation objectives. **Therefore, without mitigation there is a risk of an adverse effect on integrity of the relevant designated sites due to disturbance during operation of the Project alone - Scenario 1 for breeding lapwing.**

MITIGATION

11.6.677 Refer to 11.6.220 (timing scheduled maintenance to avoid periods of cold weather) and 11.6.221 (screening of unscheduled maintenance).

11.6.678 For breeding lapwing, if any checks are required with in compartments B, C or D, these should be undertaken in August-October, to avoid disturbing breeding lapwing (breed mid-March- July (RSPB)) and still avoid the coldest weather.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.679 With mitigation in place, disturbance will be diminished and will not impact the conservation objectives. **The effects on site integrity will be the same for lapwing as for avocet (no adverse effect on integrity for scheduled maintenance) and (diminished chance of unscheduled maintenance, no adverse effect on integrity),** however for lapwing, the area that could be impacted during unscheduled maintenance is larger, as this species uses arable land as well as wetland habitat.

PATHWAY 3 - DECREASE IN AIR QUALITY

11.6.680 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.148. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. **There will be no adverse effect on identified designated sites in relation to air quality during construction for VE and NF (Scenario 1) alone.**

FEATURE 27: WATERBIRD ASSEMBLAGE - TURNSTONE

DISTRIBUTION

11.6.681 Turnstone were observed 42 times from location 1 (near beach works TCC, Manor Way access and Holland Haven SSSI) during the intertidal surveys, flock size ranged from one to 14 individuals the majority of turnstone observations were in the intertidal area and foraging was the most frequently recorded behaviour. Although some observations were made in the field adjacent to the pumping station.

11.6.682 At location 2 (landfall) during the intertidal surveys turnstone were recorded on 16 occasions, flock size ranged from one to 10 and foraging was most frequently recorded. Observations were within the intertidal habitat and onshore along a ditch used at high tide for roosting.

11.6.683 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, turnstone were not recorded within the survey area.

11.6.684 Turnstone were observed as part of the North Falls survey data (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) during the non- breeding season, a peak count of eight was recorded and these observations were along the intertidal habitat.

11.6.685 Within the summary report that consolidates all non- breeding season bird records, six observations were made within the Order Limits excluding the Beach Works TCC and Manor Way access, all of which were recorded in Route Section 1. Counts consisted of one (two observations), two (one observation), and the peak count in this location- three birds (three observations). All observations were intertidal.

11.6.686 Within the 400 m buffer 14 observations of turnstone were made, with counts ranging from one to a peak count of 10. All observations were in Route Section 1, seven were intertidal, five were offshore and two were on land).

11.6.687 Within a 400 m buffer from the Beach Works TCC and Manor Way access, a total of 51 observations were recorded within the Holland Haven access and TCC 400 m buffer. Counts ranged from one to a peak count of 16 in March 2022, with six observations above a count of 10 (12%). 59% of all observations were offshore, 22% of were recorded on land, and 20% were intertidal observations.

CONSERVATION STATUS

11.6.688 Turnstone are designated as part of the non- breeding assemblage for the Stour and Orwell Estuaries SPA/ Ramsar site. Within WeBS alerts, the turnstone population had decreased by 22% from the first winter 1991/92 to the reference winter 2016/2017. Therefore, the conservation status is unfavourable, and the conservation objective will be to restore the population. The population with the designation citation is 690, with the most recent WeBS peak count of 664, the population is in unfavourable condition and the objective is to restore.

PATHWAY 1 - HABITAT LOSS

CONSTRUCTION AND DECOMMISSIONING ASSESSMENT OF EFFECTS ALONE

11.6.689 Refer to 11.6.89 for a description of temporary and permanent habitat loss. Permanent or temporary habitat loss will not impact any onshore, coastal, or intertidal designated sites relevant to the onshore section of this RIAA.

11.6.690 Turnstone use intertidal habitat and there will be temporary loss for a maximum of two seasons only when the cable is brought ashore and during the time the haul road is in use.

IMPLICATION ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.691 There will be intertidal habitat available outside the construction footprint for non- breeding turnstone, therefore the conservation objectives of the Stour and Orwell SPA/ Ramsar site will not be undermined.

11.6.692 The construction of the onshore cable route will remove habitat directly used by foraging non-breeding turnstone temporarily for up to two winter seasons, this habitat is associated with the haul road along the coast and any operations in the intertidal area. **The impact of habitat loss alone (excluding disturbance, discussed later) will not have an adverse effect on integrity of the relevant designated sites for the Project alone - Scenario 1.**

PATHWAY 2 - DISTURBANCE

11.6.693 Refer to paragraphs 11.6.101 to 11.6.114 for background of disturbance impacts.

11.6.694 Turnstone are classified as a bird of low sensitivity, Cutts *et al*. (2013), birds within 50 m require consideration for visual disturbance and standard precautionary approach of 72 dB at the bird for noise disturbance.

11.6.695 Noise assessment, refer to Figure 11.23 and Table 11.49. For turnstone noise over 70 dB will cause disturbance, up to 100 m from the TCC and intertidal trenching. Visual disturbance will also incorporate at least 50 m, buffer around work and transport activities. The temporary habitat loss will be minimal around the haul road adjacent to the intertidal area, as turnstone are likely to habituate to vehicle movements (Cutts ., 2013).

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.696 Non-breeding birds will move between sites in response to the weather (Brown and Grice, 2005). Moreover, there is no information on core foraging distances in the regular literature (SNH 2016), therefore designated sites cannot be ruled out based on distance. Therefore, turnstone using the intertidal and onshore habitat within the EEC could be part of the non-breeding assemblage qualification of the Stour and Orwell SPA/ Ramsar site. Disturbance during construction has the potential to impact mortality of qualifying features during the non- breeding season, though reduced foraging, and increased expenditure of energy, which could impact populations in the long term, impacting impact on Conservation Objective 4: restoration of the population of the waterfowl assemblage at the Stour and Orwell Estuaries SPA. **This has the potential to have an adverse effect on the integrity of the Stour and Orwell Estuaries SPA in relation to the disturbance of turnstone during the construction and decommissioning of the Project alone - Scenario 1.**

MITIGATION

11.6.697 For non- breeding turnstone the following mitigation will be required, refer to 11.6.12611.6.118 (piling taking place outside the winter period/ vibro-piling technology, fencing to provide visual and acoustic screening, suspending works during very cold periods, construction lighting at HDD locations would be at the lowest, safest permissible level and with light spill minimised and on site measures overseen by an ECoW).

IMPACTS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.698 With the mitigation outlined above, the conservation objectives of the identified sites will not be undermined in relation to non-breeding turnstone during construction and decommissioning, **therefore there will be no adverse effects on the integrity of the identified designated sites due to disturbance of non- breeding turnstone during construction or decommissioning for the Project alone - Scenario 1.**

OPERATION

11.6.699 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

11.6.700 Disturbance has the potential to limit foraging and therefore has the potential to impact survival of non-breeding turnstone within 50 m of maintenance, depending on the amount of noise and visual disturbance. This would undermine conservation objective four, the population of each qualifying interest feature for the identified designated sites.

IMPACTS ON CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - UNMITIGATED

11.6.701 The impacts on non- breeding turnstone are similar to other waterfowl, refer to 11.6.187 (risk of disturbance during coldest weather) and 11.6.51 (unscheduled maintenance within intertidal and immediate landfall areas). Impacting conservation objective 4: population. **This could have an adverse impact on the integrity of the Stour and Orwell Estuaries SPA in relation to the disturbance of turnstone during the operation of the Project alone - Scenario 1 unmitigated.**

MITIGATION

11.6.702 Refer to paragraphs 11.6.49 to 11.6.51 for detail on scheduled and unscheduled maintenance.

EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.703 The effects on site integrity will be the same for turnstone as for other waterfowl (**no adverse effect on integrity for scheduled maintenance and low chance and screening, no adverse effect on integrity).**

PATHWAY 3 – DECREASE IN AIR QUALITY

11.6.704 For air quality the assessment was the same as for avocet, as the threshold values are based on those for higher plants and are the same across species and designated sites, refer to 11.6.148. All facets of air quality identified are predicted through modelling and the air quality assessment chapter to be below the threshold specified on the APIS website. Therefore, the conservation objectives would not be undermined by any changes in associated with the Project alone - Scenario 1 and air quality. **There will be no adverse effect on identified designated sites in relation to air quality during construction for VE the Project alone - Scenario 1.**

FEATURE 28: WATERBIRD ASSEMBLAGE - WIGEON

DISTRIBUTION

11.6.705 Within the intertidal surveys (SLR 2022) wigeon were recorded at location 1 (Beach Works TCC, Manor Way access near Holland Haven Marshes SSSI) on 64 occasions with a maximum flock size of 140 (mean = 46.59). The majority of observations were on land associated with waterbodies near Holland Haven Marshes SSSI (89%). Foraging accounted for 47% of observations and loafing 18.75%. A total of 12 observations of wigeon were made at location 2 (landfall location), the peak flock size was 256 (mean = 98.08%), 58% of the observations were on land in a similar location to those observed at location 1. Flying accounted for 33% of observations, loafing 25%, and foraging, loafing and general maintenance behaviour accounting for 8.33% of observations. Loafing and flying were associated with observations offshore.

11.6.706 The 2022/23 non-breeding bird surveys (MacArthur Green 2023) for the Order Limits, did not record wigeon within 400 m of the Order Limits.

11.6.707 North Falls surveys (refer to Volume 6, Part 6, Annex 4.25 for details of North Falls surveys) identified the most important onshore area for wigeon is Holland Marshes in Compartment D with peak observations of 288 in year 1 and 370 in year 2. A peak count of 200 at Frinton Golf club during year 2 was recorded.

11.6.708 Within the summary report that consolidates all non- breeding season bird records, a total of six observations of wigeon were recorded in the 400 m buffer of the Order Limits, excluding Beach Access TCC and Manor Way access. Numbers ranged from 10 to a peak count of 200. All observations were in Route Section 1. Within a 400 m buffer of the Beach Works TCC and Manor Way access, a total of 91 observations of wigeon were recorded. The majority of these were located on land with only two offshore observations of 18 and 40 individuals. A peak count of 288 individuals was recorded in March 2021, and 19 observations were over 100 individuals (20.8%). All observations of non- breeding wigeon within 400 m of the Order Limits are presented in Appendix A Drawing 3, sheet 15 in Part 6, Volume 4, Annex 4.6.

11.6.709 The impacts for wigeon are considered the same as teal, and mitigation is to ensure that VE does not hinder the restoration of the waterfowl assemblage refer to Feature 9: Teal.

FEATURE 25: RAMSAR HABITATS, INVERTEBRATES & PLANTS

DISTRIBUTION

11.6.710 The Qualifying Plant and Invertebrate Features of the Ramsar sites are set out in Table 11.61.

Table 11.61 Qualifying Plant and Invertebrate Features of Ramsar sites

Designated Site	Plants	Invertebrates.
Stour and Orwell Estuaries Ramsar	The saltmarsh plants: *Puccinellia rupestris* *Spartina maritima* *Sarcocornia perennis* *Limonium humile* Ands the sea grasses: *Zostera angustifolia,* *Zostera noltei*	The flies: *Phaonia fusca,* *Haematopota grandis* The spiders: *Arctosa fulvolineata, Baryphyma duffeya*
Colne Estuary (Mid-Essex Coast Phase 2)	The saltmarsh plants: *Bupleurum tenuissimum* *Carex divisa* *Frankenia laevis* *Hordeum marinum* *Inula crithmoides* *Limonium binervosum* *Sarcocornia perennis* *Salicornia pusilla* *Spartina maritima* *Suaeda vera* And the sea grasses: *Zostera marina* *Zostera noltei*	The ground beetles: *Dyschirius extensus* *Polistichus connexus* The diving beetle: *Graptodytes bilineatus* The rove beetle: *Philonthus punctus* The moths: *Coleophora fuscicornis* *Ethmia terminella* *Aethes margarotana* *Cnaemidophorus rhododactyla* *Coleophora wockeella* *Neofriseria singula* Eupithecia extensaria *Idaea ochrata* *Malacosoma castrensis*

Designated Site	Plants	Invertebrates.
		Ancylis upupana *Eucosma catoptyrana* *Eucosma maritima* *Nyctegretis lineana* *Platyptilia calodactyla Platytes alpinella* *Stigmella samiatella* *Yponomeuta rorrella* The damselfly: *Lestes dryas* The mosquito: *Aedes flavescens* The crane-flies: *Erioptera bivittate* *Limonia danica* The soldier-fly: *Stratiomys longicornis* The horseflies: *Hybomitra expollicata* *Hybomitra ciureai* Haematopota bigoti The spiders: *Heliophanus auratus* *Trichoncus hackmani* *Arctosa fulvolineata*

Designated Site	Plants	Invertebrates.
		Euophrys browningo *Haplodrassus minor* . The fly *Campsicnemus magius* The ant *Myrmica speciodes* The caddisfly *Trichoptera cito* The weevil *Baris scolopacea*

11.6.711 In addition, the Colne Estuary (Mid-Essex Coast Phase 2) is designated for the extensive saltmarsh habitat it supports.

CONSERVATION STATUS

11.6.712 The plant species are all nationally scarce and the invertebrates are all Red data Book species. There is not enough information available to assess the current conservation condition of these species in the Ramsar sites.

PATHWAY1: PHYSICAL HABITAT LOSS

11.6.713 There will be no loss of saltmarsh and coastal and wetland habitats suitable for the Ramsar habitats and species, either inside or outside the Ramsar Site.

PATHWAY 2: CHANGES IN AIR QUALITY

11.6.714 The two Ramsar sites are at 3.10 km and 7.21 km, respectively, from the onshore ECC. Since the VE will not exceed the air quality targets for Fisher's Estuarine Moth at Hamford Water SAC, which is much closer, it can be concluded that there will be no adverse effects arising from air quality on the saltmarsh habitats, plants and invertebrates at the two Ramsar sites, or supporting populations located outside the site which are likely to be confined to designated sites.

PATHWAY 3: CHANGES IN WATER QUALITY

11.6.715 Similarly, given the distances involved, there is a very low risk that aquatic pollution affects any of the qualifying interest features of the two Ramsar sites. Moreover, the measures set out for the protection of the aquatic environment for Fisher's Estuarine Moth will ensure that there are no adverse effects on water quality within the Ramsar sites, or any other site likely to support the same species.

IMPLICATIONS FOR CONSERVATION OBJECTIVES AND EFFECTS ON SITE INTEGRITY - MITIGATED

11.6.716 With mitigation to protect water quality, the conservation objectives of the designated sites will not be undermined and no adverse effect on site integrity of the identified sites in relation to habitat loss, air quality and water quality.

SUMMARY

11.6.717 The following table provides a summary of the assessment above.

Table 11.62 A summary of assessment for AEoI alone for onshore ecology

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
Hamford Water SAC	0.71	Fisher's estuarine moth	Construction: habitat loss Operation scheduled / unscheduled maintenance: habitat loss	Preconstruction checks for Hog's fennel. Timing of maintenance checks to growing season within 1 km of the coast to be able to identify and relocate Hog's fennel if within these maintenance areas. Measures to control aquatic pollution.	No AEoI
Hamford Water SPA	0.71	Over winter: > Avocet > Black-tailed godwit > Dark-bellied brent goose	Construction temporary habitat loss: Potential to impact breeding avocet Construction: disturbance of	Checks for breeding Schedule 1 species (avocet). Piling at the landfall (if required) would	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		> Grey plover > Redshank > Ringed plover > Shelduck > Teal During the breeding season: *Little tern (considered offshore and screened out at stage 1)*	non- breeding waterfowl and breeding avocet. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl and avocet.	either take place outside the winter period (October to March) or would utilize less noisy, vibro-piling or push piling technology. Fencing/ hoarding would be used at landfall during the winter months to provide visual and acoustic screening of the landfall compound. Where practical, e.g. at HDD working areas and TCCs, similar measures would also be employed in other areas where disturbance to significant numbers of non-breeding	

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
				waterbirds is likely, measures such as fencing/ hoarding would be used during the winter months to provide an element of visual and acoustic screening of active working areas. The requirement for such measures would be determined by the ECOW. If necessary, works at the landfall would be suspended during periods of very cold weather ground was frozen (as measured at a nearby weather station). Refer to	

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
				Table 8.1 and Volume 6, Part 3, Chapter 4: Onshore Biodiversity and Nature Conservation for full wording.	
Hamford Water Ramsar site	0.71	Important wintering populations of: > Black-tailed godwit > Dark-bellied brent goose > Redshank > Ringed plover	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl	As Hamford water SPA	No AEoI
Stour and Orwell Estuaries SPA	3.10	Over winter: > Black-tailed godwit > Dark-bellied brent goose > Dunlin	Construction temporary habitat loss: Potential to impact breeding lapwing Construction: disturbance of	As for Hamford water with the addition of additional surveys for lapwing in compartment C and screening if required.	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		> Grey plover > Knot > Pintail > Redshank > Waterbird assemblage On passage: > Redshank During the breeding season: > Avocet	non- breeding waterfowl and breeding lapwing. Operation scheduled / unscheduled maintenance: disturbance of breeding and non-breeding waterfowl		
Stour and Orwell Estuaries Ramsar site	3.10	Important wintering populations of: > Black-tailed godwit > Dark-bellied brent goose > Dunlin > Grey plover > Knot	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl	As Stour and Orwell SPA Plus measures to control aquatic pollution.	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		> Pintail > Redshank Important passage populations of redshank. Also qualifies for: Wintering waterbird assemblage Nationally important higher plant species occurring on the site, *Puccinellia rupestris*, *Spartina maritima*, *Sarcocornia perennis*, *Limonium humile*, *Zostera angustifolia*, *Zostera noltei*. Nationally important	Water and Air Quality Effects on Invertebrates & Plants		

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		Invertebrate species occurring on the site, *Phaonia fusca*, *Haematopota grandis* (Meigen), *Arctosa fulvolineata*, *Baryphyma duffeya*.			
Colne Estuary (Mid-Essex Coast Phase 2) SPA	7.21	Over winter: > Dark-bellied brent goose > Hen harrier > Pochard > Redshank > Ringed plover > Waterbird assemblage During the breeding season: *Little tern (considered offshore and*	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl	As Hamford water SPA	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		screened out at stage 1)			
Colne Estuary (Mid-Essex Coast Phase 2) Ramsar site	7.21	Over winter: > Dark-bellied brent goose > Redshank > Waterbird assemblage > Wetland invertebrate assemblage > Wetland plant assemblage	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl Water and Air Quality Effects on Invertebrates & Plants	As Hamford water SPA	No AEoI
Abberton Reservoir SPA	11.4	Breeding: > Cormorant Non-breeding: > Coot > Gadwall > Goldeneye	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of	As Hamford water SPA	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		> Great crested grebe > Mute swan > Pochard > Shoveler > Teal > Tufted duck > Wigeon > Waterbird assemblage	non- breeding waterfowl		
Abberton Reservoir Ramsar site	11.4	Wintering: > Gadwall > Shoveler > Wigeon > Waterbird assemblage	Construction: disturbance of non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl	As Hamford water SPA	No AEoI
Blackwater Estuary (Mid-	13.91	Non-breeding:	Construction: disturbance of	As Hamford water SPA	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
Essex Coast Phase 4) SPA		> Black-tailed godwit > Dark-bellied Brent goose > Dunlin > Grey plover > Hen harrier > Waterbird assemblage Breeding: > Little tern (considered offshore and discussed in that section) > Pochard > Ringed plover	non- breeding waterfowl. Operation scheduled / unscheduled maintenance: disturbance of non- breeding waterfowl		
Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar site	13.91	Wintering: > Black-tailed godwit, > Dark-bellied brent goose	Construction: disturbance of non- breeding waterfowl. Operation scheduled /	As Hamford water SPA	No AEoI

Designated Site	Distance to Onshore ECC (Km)	Qualifying Features	Risks	Mitigation	Summary
		> Dunlin > Grey plover > Waterbird assemblage > Saltmarsh > Wetland invertebrate assemblage > Wetland plant assemblage	unscheduled maintenance: disturbance of non- breeding waterfowl		

12 ASSESSMENT OF ADVERSE EFFECT IN-COMBINATION

12.1.1 The screening outcome for potential LSEs on designated sites and features from VE in-combination is presented in Section 9, identifying the plans and projects to be considered within the RIAA. The assessment presented here draws on that presented within relevant topic specific chapters of the ES, tailored for the requirements of the RIAA, to inform the assessment of AEoI in-combination to the features and effects screened in. As mentioned above in Section 9.2, it is acknowledged that the potential contribution to an in-combination AEoI by VE could stem not only from those effects where potential LSE exists in relation to the project alone (and therefore screened in for the in-combination assessment as above in Section 9.1), but also potentially from effect of the project that is not significant when considered alone, but that may become more relevant in-combination.

12.1.2 In assessing the potential for in-combination effects associated with VE, 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 or full design envelope as currently presented. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans with consent and (if required) Contract for Difference (or similar) are more likely to contribute to in-combination impact with VE (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, and therefore there may be some attrition.

12.1.3 For this reason, all relevant projects/ plans considered in-combination alongside VE have been allocated into 'Tiers', reflecting their current stage within the planning and development process. 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, along with the plans and projects considered are described in Section 9. The plans and projects considered for each receptor are presented within the following tables:

- Benthic and Intertidal Ecology: Table 9.5;
- Marine Mammals: Table 9.6;
- Offshore and Intertidal Ornithology: Table 9.7;
- Migratory Fish: Table 9.8; and
- Onshore Ecology: Table 9.9.

12.1.4 For each plan/ project screened in within these tables, the in-combination maximum design scenario draws on the information presented in topic specific chapters of the ES. Consideration is given to the following points for each project:

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

12.1.5 It should be noted that operational projects such a Galloper and Greater Gabbard offshore wind farms form part of the environmental baseline as they were operational at the point when site-specific data was collected across the VE array areas and ECC. Therefore, they have not been considered within this in-combination assessment.

12.1.6 Following the identification of the plans and projects with the potential to result in an AEoI in-combination with VE, the assessment is made below. The information is presented according to the following receptor groupings as for the alone assessment:

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

12.1.7 Additionally, as established in Section 9.2, an in-combination assessment has been completed for all effect pathways identified. Where an effect was concluded to be inconsequential alone, VE has considered other plans and projects with the same effect to determine whether there may be a likely significant effect in-combination. In this case VE has concluded that there would not be an in-combination effect, as the nature of the inconsequential effect means that it would not act with other plans and projects to cause a conceivable effect (paragraph 3.16 (1) of PINS Advice Note 10 version 9 (Planning Inspectorate, 2022)) or real risk to the European site's conservation objectives.

12.2 BENTHIC AND INTERTIDAL ECOLOGY

12.2.1 The potential for LSE in-combination from VE with regard to subtidal and intertidal benthic is summarised in Section 9.2 with the Stage Two (AA) presented below.

12.2.2 Information to inform the AA alone for subtidal and benthic intertidal ecology is provided in Section 11 which assesses eight impacts, across two sites (Margate and Long Sands SAC and Essex Estuaries SAC) during construction, decommissioning, operation, and maintenance.

12.2.3 As outlined in Section 5.12 of Volume 6, Part 2, Chapter 5: 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 VE benthic subtidal study area as defined by the secondary ZoI, which has been defined based on the expected maximum distance that water from within the Order Limits 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 VE.

12.2.4 Table 9.5above 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:

- Offshore wind farms - both planned and consented;
- Aggregate and disposal areas; and
- Cable projects.

12.2.5 As highlighted within Section 5.12.5 of Volume 6, Part 2, Chapter 5: Benthic and Intertidal Ecology, and Section 9.1, certain impacts assessed for the project alone are not considered in the in-combination assessment due to:

- The highly localised nature of the impacts (i.e., they occur entirely within the VE ECC and array areas only);
- Management measures in place for VE will also be in place on other projects reducing the risk of impacts occurring; and/ or
- Where the potential magnitude of the impact from VE alone has been assessed as negligible and there is overall no significance.

12.2.6 The impacts excluded from the in-combination assessment for the above reasons are:

- Construction & decommissioning phase:
  - Increased risk of introduction or spread of marine INNS; and
  - Accidental pollution.
- O&M phase:
  - EMF effects;
  - Increased risk of introduction or spread of marine INNS;
  - Changes to physical processes;
  - Suspended sediment/ deposition; and
  - Accidental pollution.

12.2.7 The impacts that have been considered in the in-combination assessment are as follows:

- Construction and decommissioning phase:
  - Physical habitat loss/ disturbance;
  - Suspended sediment/ deposition.
- O&M phase:
  - Physical habitat loss/ disturbance.

12.2.8 With regard to the potential impacts highlighted above, the potential for a LSE in-combination was identified for the benthic habitats of the following sites:

- Margate and Long Sands SAC; and
- Essex Estuaries SAC.

CONSTURCTION AND DECOMISSIONING

12.2.9 The potential for an AEoI in-combination as a result of effects on benthic and intertidal ecology during construction and decommissioning relates to the sites listed above. As for the AA alone, the potential for AEoI during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

PHYSICAL HABITAT LOSS / DISTURBANCE

12.2.10 There is the potential for in-combination physical habitat loss/ disturbance as a result of both the construction and decommissioning activities associated with VE and the Tier 1, 2 and 3 projects identified in Table 9.5. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic ecology study area.

12.2.11 The plans or projects identified to contribute to an in-combination effect on the sites listed above, as a result of physical habitat loss/ disturbance are as follows:

- Tier 1
  - O&M phase of OWF East Anglia TWO;
  - Operation of aggregate production areas including Tarmac Marine Ltd (509/1, 509/2, 509/3), CEMEX UK Marine Ltd (510/2, 507/1, 507/2, 507/3, 507/4, 507/6), Hanson Aggregates Marine Ltd (528/2), Britannia Aggregates Ltd (508); and
  - Construction and O&M of NeuConnect Interconnector.
- Tier 2:
  - Construction and O&M of North Falls OWF;
  - Construction and O&M of Sea Link interconnector; and
  - Construction and O&M of Gridlink Interconnector.
- Tier 3:
  - Construction and O&M of Nautilus MPI interconnector; and
  - Construction and O&M of Lionlink.

TIER 1 PROJECTS

12.2.12 East Anglia TWO is a consented OWF which sits to the north of the VE northern array area and does not overlap or interact with any of the proposed VE array area or ECC. Additionally, the anticipated construction works for this project will conclude in 2027, and as a result, it is unlikely that construction activities associated with VE would overlap with the construction activities of East Anglia TWO, both temporally and physically. However, there is the potential for VE construction activities to overlap with any O&M activities associated with East Anglia TWO.

12.2.13 Any O&M activities for East Anglia TWO, for example inter-array cable maintenance activities and jack up operations, would be restricted to within the East Anglia TWO array area and does not directly overlap with the VE array areas or ECC. As a result, due to the short-term localised nature of any disturbance it is anticipated that impacts from both projects would not combine to have any significant effect.

12.2.14 Similarly, VE array areas and preferred OECR does not overlap with any of the aggregate sites highlighted above. The impacts from the construction and decommissioning of VE and from aggregate extraction activities are predicted to be of local spatial extent, short-term, intermittent, and reversible.

12.2.15 The consented NeuConnect Interconnector is proposed to cross with approximately 78 km of the VE benthic ecology study area, including going through Margate and Long Sands SAC, to the south of the VE ECC. Construction is expected to occur in 2027, so there will be one year of construction overlap with VE construction. O&M of NeuConnect Interconnector will also overlap with VE construction. The installation of the cable and any associated O&M activities are expected to be short term and localised to the site of the interconnector cable. Additionally, given the relatively limited overlap with the study area compared to the interconnector's overall GB extent (28%), no in-combination effects are predicted with the construction and decommissioning of VE.

TIER 2 PROJECTS

12.2.16 The EIA Scoping Report has been submitted for the North Falls OWF project (North Falls Offshore Wind Ltd, 2021). Whilst the project is not yet close to achieving consent the construction and O&M of this Tier 2 project has the potential to cause cumulative physical habitat loss/ disturbance with VE construction. In the scoping report submitted for the project, there is an indicative programme of offshore construction beginning in 2028.

12.2.17 There is no information in the public domain regarding the defined area for total physical habitat loss/ disturbance, however based on OWF's of a similar size it is known that both the construction and O&M activities will be short-term, intermittent and localised to the site. The North Falls scoping boundary covers 149.96 km2, however the area of overlap 0.8 km2 does not overlap with any designated sites for benthic and intertidal ecology features and therefore no in-combination impacts are expected to interact with any designated sites. Taking this into consideration, there are not predicted to be any significant in-combination impacts from the construction or operation of North Falls.

12.2.18 Sea Link is a proposed offshore HVDC link between Suffolk and Kent, the purpose of which is to take the power brought in by East Anglia ONE North, East Anglia TWO, and Sizewell from Suffolk down to Kent to distribute within the Thames Valley where it is needed. The project has currently submitted a scoping report which identifies a potential for LSE for temporary habitat loss / disturbance, however no detailed assessments have been undertaken for this effect to discuss AEoI or mitigated impacts and therefore it is not possible to make a detailed assessment of the significance of effect at this time. However, it is predicted that any physical habitat loss/ disturbance from the construction, O&M will be short term and localised to the site. It is not anticipated that any effects, once qualified, would result in a significant in-combination impact.

12.2.19 The Gridlink Interconnector is a proposed offshore HVDC link between Kingsnorth in the UK and Dunkerque in France. The project has submitted a scoping report and an ecological impact assessment, both of which conclude that there will be no potential effects resulting in physical habitat loss/ disturbance. Combined with the effects of other similar infrastructure projects, it is considered that there would be no significant impacts in-combination with other projects.

TIER 3 PROJECTS

12.2.20 Neither the Nautilus interconnector nor Lion link have submitted a scoping report currently, with no assessments of impacts being made at this time. However, based on other similar infrastructure projects, it is predicted that any physical habitat loss/ disturbance from the construction, O&M will be short term and localised to the site. It is not anticipated that any effects, once qualified, would result in a significant in-combination impact.

CONCLUSION ON THE POTENTIAL FOR AN IN-COMBINATION EFFECT AS A RESULT OF PHYSICAL HABITAT LOSS/ DISTURBANCE DURING CONSTRUCTION AND DECOMMISSIONING

12.2.21 In all cases, the potential for physical habitat disturbance/ loss will be short term, localised and intermittent. It is acknowledged that North Falls and the NeuConnect, Sea Link and Gridlink interconnectors construction and O&M phases overlap with VE construction, and are within the ZoI considered for the Margate and Long Sands SAC, however as acknowledged for the alone assessment (Section 11) there will be limited disturbance from VE, and due to the highly mobile nature of the feature Annex I Sandbanks the site and associated biotopes will naturally be exposed to high levels of physical disturbance, therefore this habitat will be highly tolerant of an effect of this nature.

12.2.22 With regards to the Essex Estuaries SAC, only the ZoI for the Gridlink Interconnector and VE overlaps with the site. However, it is considered based on the project's environmental assessments and the understanding gained from similar projects and thus there is no potential for in-combination temporary habitat disturbance or loss.

12.2.23 **Therefore, it is concluded that there is no potential for an AEoI to the conservation objectives of the features and sub-features of the Margate and Long Sands SAC and Essex Estuaries SAC in relation to temporary physical habitat disturbance/ loss from VE in-combination with other plans or projects and therefore, subject to natural change, the features will be maintained in the long term with respect to this effect.**

SUSPENDED SEDIMENT/ DEPOSITION

12.2.24 There is the potential for in-combination increases in suspended sediment/ deposition as a result of both the construction and decommissioning activities associated with VE and the Tier 1, 2 and 3 projects identified in Table 9.5. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic ecology study area.

12.2.25 The plans or projects identified to contribute to an in-combination effect on the sites listed above, as a result of temporary physical habitat loss/ disturbance are as follows:

- Tier 1
  - Operation of aggregate production areas including Tarmac Marine Ltd (509/1, 509/2, 509/3), CEMEX UK Marine Ltd (510/2, 507/1, 507/2, 507/3, 507/4, 507/6), Hanson Aggregates Marine Ltd (528/2), and Britannia Aggregates Ltd (508);

- Operation of sea disposal sites Inner Gabbard (TH052), Inner Gabbard East (TH056), Harwich Haven (TH027), Northey Island (TH058), Maldon Saltings 3 (TH064), TEOW Disposal Site 1 (TH153), TEOW Disposal Site 2 (TH254), TEOW Disposal Site 3 (TH155), Wrabness Beach (TH213), Copperas (TH216), Erwarton Track (217), EA One Route EC-2 (TH221), Wrabness Beach East (TH229); and Horsey (TH230); and
- Construction of NeuConnect Interconnector.

- Tier 2
  - Construction of OWF North Falls;
  - Construction and O&M of Sea Link interconnector; and
  - Construction and O&M of Gridlink Interconnector.
- Tier 3
  - Construction of Nautilus MPI; and
  - Construction and O&M of Lionlink.

TIER 1 PROJECTS

12.2.26 Aggregate Area 524 is within a distance of one spring tidal excursion ellipse from the VE southern array area and preferred OECR. Aggregate Areas 507/1/2/4/6, Area 508, Area 509/1/2/3, Area 510/1/2, Area 524 and Area 528/2 are also within the benthic study area from the preferred OECR. Accordingly, it is necessary to consider the potential for in-combination changes in SSC and bed levels.

12.2.27 It is understood that the target material at the sites is both sands and gravels, principally for use in the construction industry. The permitted annual licensed tonnage from aggregate sites in the Outer Thames region is 3.8 million tonnes although typical annual dredging amounts are usually around half of this figure (The Crown Estate, 2022).

12.2.28 As highlighted within the alone assessment, construction and decommissioning activities, such as cable installation and cable trenching are all predicted to result in sediment plumes and localised increases in SSC. There is the potential due to the proximity of some of these aggregate sites that sediment plumes generated from two different activities/ projects could meet and coalesce to form one larger plume. However, as highlighted within ES Volume 6, Part 2, Chapter 2: Marine Physical Processes, Chapter 5: Benthic and Intertidal Ecology, and associated sediment modelling that fine grained sediment plume will be subject to rapid dispersion to near background levels (tens of mg/l) within hundreds to a few thousands of metres at the point of release.

12.2.29 With the exception of Area 509/1, all aggregate areas are located over 1 km away. Any in-combination increase in either the spatial footprint or peak concentration of sediment plumes are therefore expected to be indistinguishable against background levels. Any associated changes in bed level/ deposition will also be immeasurable.

12.2.30 The only aggregate license area within 1 km of the project is Area 509/1 (Longsand) which is located circa 100 m to the south of the preferred OECR and dredged by Tarmac Marine Ltd. Given the very close proximity of the two activities, it is considered that both types of plume interaction described above could theoretically occur. However, it is noted that in line with UNCLOS (The United Nations Convention on the Law of the Sea) cable installation vessels typically request a 1 nautical mile (c. 1.85 km) vessel safety zone when installing or handling cables. Accordingly, whilst plume interaction may still occur, the potential for much higher concentration and more persistent plumes than that previously described in the project-alone assessments of SSC is considered to be small. Cumulative increases in bed level/ deposition could still theoretically occur. However, it is noted that this location is characterised by high current speeds which regularly re-work mobile material at the bed, resulting in a general north-easterly direction in net bedload transport in the vicinity of Area 509/1.

12.2.31 As noted above, there are also several disposal sites which have been screened in (Inner Gabbard (TH052), Inner Gabbard East (TH056), Harwich Haven (TH027), Northey Island (TH058), Maldon Saltings 3 (TH064), TEOW Disposal Site 1 (TH153), TEOW Disposal Site 2 (TH254), TEOW Disposal Site 3 (TH155), Wrabness Beach (TH213), Copperas (TH216), Erwarton Track (217), EA One Route EC-2 (TH221), Wrabness Beach East (TH229); and Horsey (TH230)). Should export cable installation be occurring at the same time as dredge disposal activities at these sites, there could theoretically be the potential for in-combination changes in SSC and deposition.

12.2.32 The Inner Gabbard East disposal ground (TH056) is considered to be a non-dispersive site; therefore, apart from the occurrence of natural erosion and deposition, it is likely that once the material has been placed there it will remain in place (HHA, 2019).

12.2.33 With the exception of Maldon Saltings 3 (TH064), Northey Island (TH058), and Wrabness Beach East (TH229), all other identified disposal sites are located at a distance greater than 5 km from the preferred OECR, in relation to the orientation of the tidal axis. At this distance apart, any in-combination increase in either the spatial footprint or peak concentration of sediment plumes is expected to be indistinguishable from that previously reported for the export cable installation on its own. Any associated in-combination changes in deposition will also be immeasurable. For the three remaining disposal sites, while there may be overlap with the Essex Estuaries SAC it is considered that due to the highly intermittent, short-term and localised nature of effects, there is no potential for an AEoI on the site in-combination.

12.2.34 The consented NeuConnect Interconnector is proposed to cross with approximately 78 km of the VE benthic ecology study area, including going through Margate and Long Sands SAC, to the south of the VE ECC. Construction is expected to occur in 2027, so there will be one year of construction overlap with VE construction. O&M of NeuConnect Interconnector will also overlap with VE construction. The installation of the NeuConnect Interconnector and any subsequent increases in SSC and sediment deposition that would have the potential to pose a significant smothering impact to benthic ecology receptors is expected to short-term and localised to the development area. Additionally, given the relatively limited overlap with the study area compared to the interconnector's overall GB extent (28%), no in-combination effects are predicted with the construction and decommissioning of VEs.

TIER 2 PROJECTS

12.2.35 An EIA Scoping Report has been submitted for the North Falls OWF project. Whilst the project is still early in the process to gaining consent, the construction and O&M of this Tier 2 project has the potential to cause in-combination increases in SSC and associated deposition with VE construction.

12.2.36 There is no information in the public domain regarding the defined area for total SSC and deposition, however based on OWF's of a similar size it is known that both the construction and O&M activities will be short-term, intermittent and localised to the site and therefore any in-combination impacts are expected to be minimal. Taking this into consideration, there are not predicted to be any significant in-combination impacts from the construction or operation of North Falls.

12.2.37 The Tier 2 project Sea Link is a proposed offshore HVDC link between Suffolk and Kent, the purpose of which is to take the power brought in by East Anglia ONE North, East Anglia TWO, Lionlink and Sizewell from Suffolk down to Kent to distribute within the Thames Valley where it is needed. It is not known what volumes of sediment are likely to be displaced as the project hasn't submitted its environmental assessment. However, we do know that the projects will cause intermittent disturbances over the construction period and that spatial overlap resulting in a heavy level (5 - 30 cm) of deposition is unlikely (as this is only predicted to occur within 0 to 50 m of impact).

12.2.38 The Gridlink Interconnector is a proposed 1.4 GW interconnector between Kingsnorth in the UK and Dunkerque in France has submitted a HRA scoping report which screened out the impacts relating to siltation rate changes, sediment smothering and changes in suspended solids in relation to benthic ecology receptors on the basis of minimal changes that will remain within natural variations. Therefore, it is considered that there will be no risk of in-combination effects with VE on any of the benthic sites identified.

TIER 3 PROJECTS

12.2.39 Nautilus MPI and Lionlink are predicted to overlap their construction impacts with VE construction, which is predicted to increase SSC and deposition within the wider benthic ecology study area. It is not known what volumes of sediment are likely to be displaced as the projects have not submitted their environmental assessments. However, we do know that the projects will cause intermittent disturbances over the construction period and that spatial overlap resulting in a heavy level (5 - 30 cm) of deposition is unlikely (as this is only predicted to occur within 0 to 50 m of impact).

CONCLUSION OF POTENTIAL IN-COMBINATION EFFECT RESULTING FROM INCREASES IN SSC & DEPOSITION DURING CONSTRUCTION & DECOMMISSIONING

12.2.40 In all cases, any potential increases in SSC and associated deposition will be short term, temporary and localised. As is noted above, there are a number of aggregate and disposal sites in close proximity the VE ECC in particular and thus in relatively close proximity to the Margate and Long Sands SAC. However, as highlighted within the alone assessment and above, works associated with construction and decommissioning activities and potential increases in SSC are expected to be restricted within a single tidal excursion and any sediment deposition will occur in close proximity to the source. Even if plumes do combine, and as highlighted within ES Volume 6, Part 2, Chapter 2: Marine Physical Processes and associated sediment modelling, that fine grained sediment plume will be subject to rapid dispersion to near background levels (tens of mg/l) within hundreds to a few thousands of metres at the point of release, thus minimising impacts upon the SAC.

12.2.41 With regards to the Essex Estuaries SAC, the ZoI for the Gridlink Interconnector and VE overlaps with the site. However, it is considered based on the project's environmental assessments and the understanding gained from similar projects and thus there is no potential for in-combination effects from increases in SSC and Deposition during construction and decommissioning. Additionally, the Maldon Saltings 3 (TH064), Northey Island (TH058), and Wrabness Beach East (TH229) disposal sites overlap with the SAC however given the nature of operation there is no potential for AEoI considered.

12.2.42 **Therefore, it is concluded that there is no potential for an AEoI to the conservation objectives of the features and sub-features of the Margate and Long Sands SAC and Essex Estuaries SAC in relation to potential increases to SSC and deposition from VE in-combination with other plans or projects and therefore, subject to natural change, the features will be maintained in the long term with respect to this effect.**

OPERATION AND MAINTENANCE

PHYSICAL HABITAT LOSS/ DISTURBANCE

12.2.43 There is the potential for in-combination habitat loss/ disturbance as a result of the O&M phase associated with VE and the Tier 1, 2 and 3 projects identified in Table 9.5. For the purposes of this assessment, this additive impact has been assessed from projects that fall within the benthic ecology study area.

12.2.44 The plans or projects identified to contribute to an in-combination effect on the sites listed above, as a result of physical habitat loss/ disturbance are as follows:

- Tier 1
  - O&M of OWF East Anglia TWO;
  - Construction and O&M of NeuConnect Interconnector.
- Tier 2:
  - O&M of OWF North Falls;
  - Construction and O&M of Sea Link Interconnector; and

- Construction and O&M of Gridlink Interconnector.
- Tier 3:
  - Construction and O&M of Nautilus MPI.

TIER 1 PROJECTS

12.2.45 In-combination permanent habitat loss is predicted to occur because of the presence of VE infrastructure and projects identified in Table 12.2. The Tier 1 project East Anglia TWO OWF and transmission asset is expected to contribute to long term habitat loss from the physical presence of foundations, scour and cable protection. East Anglia TWO array area only overlaps and not the protected sites screened into this assessment, with the benthic ecology study area and the total long term habitat loss associated with the array assets is 1.91 km^2, the transmission assets do not overlap with the benthic study area.

12.2.46 The NeuConnect Interconnector is anticipated to have cable protection associated with the route, where the target burial depth cannot be achieved. While the in-combination impact of permanent habitat loss will be locally significant and comprise a permanent change in seabed habitat within the footprint of the structures, the footprint of the area affected is highly localised. It is expected that the impacts are reversible following removal of any of the hard substrate, where this might occur however this is less certain. As the habitats and characterising biotopes are common and widespread throughout the wider region, the loss of these habitats is predicted to result in a slight alteration of the receptor that does not diminish regional ecosystem functions. The magnitude of loss for Tier 1 projects is therefore assessed as negligible.

12.2.47 As highlighted above, the NeuConnect Interconnector passes through Margate and Long Sands SAC. However, it should be noted that as outlined in Chapter 3 of the EA Report (AECOM, 2019), under the licence application no cable protection will be added to the seabed within Margate and Long Sands SAC as part of either the installation or maintenance phase.

TIER 2 PROJECTS

12.2.48 The Tier 2 project North Falls OWF has the potential to create an in-combination permanent habitat loss/ alteration with VE. Whilst there is currently limited detail on the area of loss, it is anticipated that as with VE, the magnitude for loss is likely to be negligible on account of the limited spatial extent of permanent infrastructure compared to the area of wider benthic resources. It should be noted that this loss is not expected to occur in the designated sites screened in for this in-combination assessment.

12.2.49 The Tier 2 projects 'Sea Link' and 'Grid Link' are anticipated to have some cable protection associated with the route, however aside from general indications of the type to be used (e.g. rock burial) there is currently limited information on this, including sizes and areas covered. Based on other cable projects, the footprint of any cable protection is expected to be limited in extent and highly localised.

TIER 3 PROJECTS

12.2.50 The Tier 3 project 'Nautilus MPI' is anticipated to have some cable protection associated with the route, however aside from general indications of the type to be used (e.g. rock burial) there is currently limited information on this, including sizes and areas covered. Based on other cable projects, the footprint of any cable protection is expected to be limited in extent and highly localized.

CONCLUSION ON THE POTENTIAL FOR AN IN-COMBINATION EFFECT AS A RESULT OF HABITAT DISTURBANCE / LOSS DURING OPERATION AND MAINTENANCE

12.2.51 As described above, the potential in-combination impact from permanent habitat loss will not have a significant effect upon the protected sites screened into this assessment. In particular, whilst there is small loss which was assessed alone for the project for Margate and Long Sands SAC, the plans or projects which were identified to contribute to an in-combination effect will not add further to this loss. Whilst the NeuConnect Interconnect cable is due to go through Margate and Long Sands SAC no cable protection is due to be used. Furthermore, the Proposed Development is implementing a range of mitigation measures as outlined within The Margate and Long Sands SAC Benthic Mitigation Plan (Volume 9, Report 13). This plan details where mitigation has been employed to reduce pressures on the benthic features of the Margate and Long Sands SAC. This plan provides clear evidence in response to Natural England's mitigation hierarchy.

12.2.52 With regards to the Essex Estuaries SAC, only the ZoI for the Gridlink Interconnector will overlap with the site. As described above, there is no anticipated effects from the cable burial, and thus there is no potential for in-combination effects within the site.

12.2.53 **Therefore, it is concluded that there is no potential for an AEoI to the conservation objectives of the features and sub-features of the Margate and Long Sands SAC and Essex Estuaries SAC in relation to permanent habitat loss/ disturbance from VE, in-combination with other plans or projects and therefore, subject to natural change, the features will be maintained in the long term with respect to this effect.**

12.3 MARINE MAMMALS

12.3.1 The potential for LSE in-combination from VE with regard to marine mammals is summarised in Section 11.2.28, with the Stage Two (AA) presented below.

12.3.2 Information to inform the AA alone for marine mammals is provided in Section 11.3 which assesses impacts on the three marine mammal features (harbour porpoise, harbour seal and grey seal) associated with five UK sites and 12 transboundary sites during construction, operation, maintenance and decommissioning.

12.3.3 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology considers that several of the impacts assessed for VE alone are not considered relevant in the in-combination assessment due to:

- The highly localised nature of the impacts;
- Management and mitigation measures in place at VE (as considered during the AA alone) and on other projects that will nullify the risk; and
- Where the potential significance of the impact from VE alone has been assessed as negligible.

12.3.4 Therefore, based on these reasons, the AA in-combination excludes several impacts assessed in the AA alone. Table 12.1 summarises the impacts that are assessed in the marine mammal in-combination assessment presented here.

Table 12.1 Screening of impacts for inclusion in AA in-combination, following AA alone conclusions (taken from ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
Underwater noise effects (PTS/injury, TTS/disturbance and barrier effects)	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 ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology
Vessel presence (collision risk injury)	No	It is expected that all offshore energy projects will employ a working in proximity to wildlife in the marine environment plan (or similar) or follow best practice guidance to reduce the already low risk of collisions with marine mammals
Vessel presence (disturbance at sea)	Yes, all phases	N/A
Changes to prey (prey habitat loss)	No	Impact is highly localised and of negligible significance according to ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with no AEoI concluded for the project alone and therefore no contribution in-combination

AA alone impact pathway	Screened in for AA in-combination	Reason for exclusion
Accidental pollution and changes in water quality	No	Impact is highly localised and of negligible significance according to ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with no AEoI concluded for the project alone and therefore no contribution in-combination
Habitat Loss	No	Impact is highly localised and of negligible significance according to ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, with no AEoI concluded for the project alone and therefore no contribution in-combination
Vessel presence (disturbance at haul out)	Yes, all phases	N/A

12.3.5 As with the AA alone presented in Section 11.3, the AA in-combination 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.

12.3.6 The AA in-combination for marine mammals has been determined based on three categories of plans and projects where there is potential for any phase of such projects to have temporal or spatial overlap with that of VE. For clarity, 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):

- OWFs;
- Tidal developments; and
- Seismic activities associated with the oil and gas industry.

12.3.7 The assessment presented here draws on the in-combination assessments presented in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.

12.3.8 Effectively for a project to be screened in for in-combination assessment, there needs to be potential for relevant works (in this case noisy activity) to occur within the same timeframe as relevant works at VE, with these identified in Table 12.2. The sites/ features included in-combination are then those that are located within the species-specific screening distance from one or more of the projects identified for in-combination assessment.

12.3.9 The locations of these projects in relation to VE are shown in Figure 12.2.

12.3.10 Each project has been considered on the basis of effect-receptor pathway, data confidence and the temporal and spatial scales involved, which is supported by the cumulative effect assessment technical note, ES Volume 6, Part 1, Annex 3.1: Cumulative Effects Assessment Methodology. This screened in only some of the projects presented in Table 12.1. The projects identified through this process are presented in Table 12.2.

Table 12.2 Projects included in the ES marine mammal in-combination assessment alongside VE (aligns with ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology, HP = Harbour Porpoise, HS = Harbour Seal, GS = Grey Seal).

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Arven	OWF	Q1 2026 – Q4 2028	In-planning	6	Y	N	N
Aspen	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Avalon	OWF (floating)	Q1 – Q2 2024	In-planning	4	Y	N	N
Ayre	OWF	Q3 2028 – Q4 2029	In-planning	6	Y	N	N
Beech	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Bellrock	OWF	Q1 2024 – Q4 2028	In-planning	6	Y	N	N
Berwick Bank Firth of Forth	OWF	Q1 2025 - Q4 2029	In-planning	4	Y	N	N
Blyth Demonstration Phases 2&3	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	Y
Borkum Riffgrund 3	OWF	Q4 2023 – Q4 2024	Under construction	2	Y	N	N
Bowdun	OWF	Q3 2028 – Q4 2029	In-planning	6	Y	N	N

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Broadshore	OWF	Q1 2027 – Q4 2031	Under construction	6	Y	N	N
Buchan	OWF	Q1 2028 – Q4 2031	In-planning	6	Y	N	N
Caledonia	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
CampionWind	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Cedar	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Cenos	OWF	Q1 2027 – Q4 2029	In-planning	6	Y	N	N
Centre-Manche 1	OWF	Q1 2031 – Q4 2031	In-planning	5	Y	N	N
Centre-Manche 2	OWF	Q1 2027 – Q4 2031	In-planning	7	Y	N	N
Culzean	OWF (floating)	Q3 2024	In-planning	6	Y	N	N
Dieppe - Le Treport	OWF	Q1 2025 – Q4 2025	In-planning	6	Y	N	N
Dogger Bank A	OWF	Q1 2023 – Q2 2025	Under Construction	3	Y	Y	Y

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Dogger Bank B	OWF	Q1 2023 – Q2 2025	Under Construction	3	Y	Y	Y
Dogger Bank C	OWF	Q1 2024 – Q2 2027	In-planning	3	Y	Y	Y
Dogger Bank D	OWF	Q1 2027 – Q2 2029	In-planning	6	Y	Y	Y
Dogger Bank South (East)	OWF	Q1 2025 – Q4 2028	In-planning	5	Y	Y	Y
Dogger Bank South (West)	OWF	Q1 2025 – Q4 2028	In-planning	5	Y	Y	Y
Dudgeon Extension	OWF	Q1 2025 – Q2 2028	In-planning	4	Y	Y	Y
Dunkerque	OWF	Q1 2025 – Q2 2028	In-planning	5	Y	N	N
East Anglia ONE NORTH	OWF	Q1 2026 – Q4 2028	In-planning	3	Y	Y	Y
East Anglia THREE	OWF	Q1 2024 – Q4 2024, Q3 2025 – Q2 2026	Under construction	3	Y	Y	Y
East Anglia TWO	OWF	Q1 2024- Q2 2026	Under construction	3	Y	Y	Y
EnBW He dreiht	OWF	Q4 2023 - Q4 2024	Under construction	2	Y	N	N

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Fecamp	OWF	Q4 2023	Under construction	2	Y	N	N
Firth of Forth - Alpha and Bravo	OWF	Q1 2024 – Q2 2024	Under construction	2	Y	N	N
Flora Floating	OWF	Q1 2027 – Q4 2028	In-planning	6	Y	N	N
ForthWind Offshore Wind Demonstration Project - phase 1	OWF	Q1 2027 – Q4 2028	Under construction	2	Y	N	N
Green Volt	OWF	Q1 2027 – Q4 2027	In-planning	4	Y	N	N
Harbour Energy North	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Harbour Energy South	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
HKZ Kavel III	OWF	Q1 2021 – Q4 2024	Under construction	2	Y	N	N
Hollandse Kust (West) VII	OWF	Q1 2024 – Q2 2024	In-Planning	2	Y	N	N
Hollandse Kust (West) VIII	OWF	Q1 2027 – Q4 2031	n-planning	2	Y	N	N
Hornsea Project Four (HOW04)	OWF	Q3 2026 – Q1 2028	In-planning	3	Y	Y	Y

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Hornsea Project Three (HOW03)	OWF	Q1 2025 – Q4 2025, Q1 2027 – Q2 2028	In-planning	3	Y	Y	Y
IJmuiden Ver	OWF	Q1 2027 - Q4 2029	In-planning	6	Y	N	N
IJmuiden Ver 2021 - Y-VER	OWF	Q1 2029 - Q4 2030	In-planning	6	Y	N	N
Inch Cape	OWF	Q1 2025 - Q4 2025	Under construction	2	Y	N	N
Marram	OWF	Q1 2030 - Q4 2030	In-planning	6	Y	N	N
Moray West	OWF	Q1 2023 - Q4 2025	Under construction	2	Y	N	N
Morven	OWF	Q1 2026 - Q4 2026	In-planning	6	Y	N	N
Muir Mhòr	OWF	Q1 2029 - Q4 2030	In-planning	6	Y	N	N
N-10.1	OWF	Q1 2029 - Q4 2029	In-planning	7	Y	N	N
N-10.2	OWF	Q1 2029 - Q4 2029	In-planning	7	Y	N	N
N-3.7	OWF	Q1 2026 – Q4 2026	In-planning	7	Y	N	N

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
N-6.6	OWF	Q1 2027 – Q4 2027	In-planning	7	Y	N	N
N-6.7	OWF	Q1 2027 – Q4 2027	In-planning	7	Y	N	N
N-9.1	OWF	Q1 2028 – Q4 2028	In-planning	7	Y	N	N
N-9.2	OWF	Q1 2028 – Q4 2028	In-planning	7	Y	N	N
N-9.3	OWF	Q1 2026 – Q4 2027	In-planning	7	Y	N	N
N-9.4	OWF	Q1 2027 – Q4 2031	In-planning	7	Y	N	N
Neart na Gaoithe	OWF	Q4 2023	Under construction	2	Y	N	N
Nordlicht I	OWF	Q1 2026 – Q4 2026	In-planning	4	Y	N	N
Nordsee Cluster A - N-3.8	OWF	Q1 2027 – Q4 2027	In-planning	7	Y	N	N
Nordsee Cluster B - N-3.5	OWF	Q1 2028 – Q4 2028	In-planning	7	Y	N	N
Nordsee Cluster B - N-3.6	OWF	Q1 2027 – Q4 2027	In-planning	7	Y	N	N

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Nordsren I	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	N
Nordsren II	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	N
Nordsren II vest	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	N
Nordsren III	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	N
Nordsren III vest	OWF	Q1 2024 – Q4 2024	In-planning	6	Y	N	N
Norfolk Boreas	OWF	Q3 2025 - Q4 2027	In-planning	3	Y	Y	Y
Norfolk Vanguard	OWF	Q4 2023 - Q1 2026	In-planning	3	Y	Y	Y
North Falls	OWF	Q1 2026 – Q4 2030	In-planning	5	Y	Y	Y
Ossian	OWF	Q1 2027 – Q4 2030	In-planning	6	Y	N	N
Outer Dowsing	OWF	Q1 2027 - Q4 2029	In-planning	5	Y	Y	Y
Parc eolien pose au large de la Normadie (AO4)	OWF	Q1 2028 - Q4 2029	In-planning	6	Y	N	N

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Pentland Floating Offshore Wind Demonstrator	OWF	Q2 2025 – Q3 2025	In-planning	3	Y	N	N
Perpetuus Tidal Energy Centre (PTEC)	Tidal	Q1 2022 - Q4 2025	Under construction	3	Y	N	N
Rampion 2 (Rampion Extension)	OWF	Q1 2025 – Q4 2027	In-planning	4	Y	N	N
Salamander	OWF	Q2 2026 – Q4 2030	In-planning	6	Y	N	N
Seismic Survey 1	Seismic	Q1 2024- Q4 2030	NA	6	Y	Y	Y
Seismic Survey 2	Seismic	Q1 2024- Q4 2030	NA	6	Y	Y	Y
Seismic Survey 3	Seismic	Q1 2024- Q4 2030	NA	6	Y	Y	Y
Seismic Survey 4	Seismic	Q1 2024- Q4 2030	NA	6	Y	Y	Y
SENSEWind Pelastar	OWF	Q1 2024 – Q4 2031	In-planning	6	Y	N	N
Sheringham Shoal Extension	OWF	Q1 2027 - Q4 2031	In-planning	4	Y	Y	Y
Sofia	OWF	Q1 2024 – Q4 2026	Under construction	3	Y	Y	Y

Project	Type	Project Construction dates	Status	TIER	HP	HS	GS
Stoura Floating	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Stromar	OWF	Q1 2027 – Q4 2031	In-planning	6	Y	N	N
Thor	OWF	Q1 2025 – Q4 2026	Under construction	3	Y	N	N
Vesterhav Nord/Syd	OWF	Q1 2022 – Q4 2023	Under construction	2	Y	N	N
West of Orkney	OWF	Q1 2029 – Q4 2029	In-planning	4	Y	N	N

12.3.11 The time period considered in the CEA for marine mammals is 2023-2031 inclusive. The tiering structure discussed in Section 12 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 (see Table 7.29 in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

12.3.12 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 AA in-combination presented below.

12.3.13 A description of the significance of potential in-combination effects upon the receptors grouped under marine mammals is provided below.

CONSTRUCTION AND DECOMISSIONING

UNDERWATER NOISE

12.3.14 The potential for an AEoI from in-combination disturbance as a result of underwater noise on marine mammals during construction and decommissioning relates to the following designated sites:

- 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, Klaverbank SCI, and Vlaamse Banken SAC; 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.

12.3.15 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.

12.3.16 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);
- Geophysical and seismic survey -planned geophysical/seismic survey included within the screening range (where that information is in the public domain).

12.3.17 It is of note that vessel disturbance is considered separately, as is operational noise.

12.3.18 The potential for underwater noise to result during construction of VE, together with the sensitivity of harbour porpoise, harbour seal and grey seal to such noise, has been discussed in Section 11.3 as part of the AA alone, with that information not repeated here.

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

IN-COMBINATION ASSESSMENT OF DISTURBANCE FROM UNDERWATER NOISE ON HARBOUR PORPOISE

12.3.20 Table 12.3 and Table 12.4 below provide further information on the potential for spatial and temporal in-combination effects (respectively) on the SNS SAC. The tables include the plans and projects in Figure 12.1 which are screened in for assessment in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology in relation to harbour porpoise.

12.3.21 Of the projects presented in Table 12.2, it is considered that only 12 projects have the potential to have an in-combination effect with VE on harbour porpoise at the SNS SAC since they overlap temporally with VE (2027-2034 inclusive) and spatially with the SNS SAC.

12.3.22 There is strong presumption of certainty that Tier 3 projects will proceed to construction on the specified timeframe and scale. VE is progressing on the timeframe and scale specified by the Applicant, as included within the assessment process as the project design and project programme (Section 7), and therefore can be afforded the same level of certainty within the in-combination assessment here.

12.3.23 For Tier 4, 5 and 6 projects, there is a much lower (and decreasing with the increasing tier allocation) degree of certainty in terms of project programme, timeframe and project scale. Whilst it is recognised that the planned construction windows of these projects, may overlap with (and may extend beyond) the construction window of VE, it is acknowledged, in common with all such projects with such a large construction window during the planning process and prior to securing a Contract for Difference (CfD), that actual construction will last for a proportion of the total construction window and that in reality the actual construction window may shift further. In addition, it is common for the scale of a project to change following consent or achieving CfD, for example a reduced number of WTGs (potentially with an increased capacity per WTG) may be progressed to final scheme design.

12.3.24 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[23]. 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 highlighted here will also be explained in the Outline SNS SAC SIP (submitted with the application) which aims to manage the risk posed by such uncertainty going forward, and to provide certainty in planning terms that where a risk of threshold exceedance has been identified, measures are in place to address that risk and ensure the thresholds are not breached. Such an approach was first used on East Anglia THREE, a project which achieved consent in August 2017.

12.3.25 The assessment of the potential for AEoI with respect to underwater noise for plans and projects in-combination with VE 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

12.3.26 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.

12.3.27 The overall aim of the assessment of disturbance within the SNS SAC is to identify the percentage of the relevant part of the SAC within which harbour porpoise may exhibit avoidance behaviour (displacement) together with an understanding of the total duration of such disturbance, within the overall construction window. The approach takes account of both spatial and temporal elements, as required by the definition of significance. As the entire VE array area construction activities fall within the SNS SAC winter area (although in total the construction timeline will extend across an estimated 12 months), the assessment is presented on a seasonal basis - to enable the potential for effect to be fully understood for which works may occur at VE.

12.3.28 The following assessment includes a number of assumptions, with these summarised as follows:

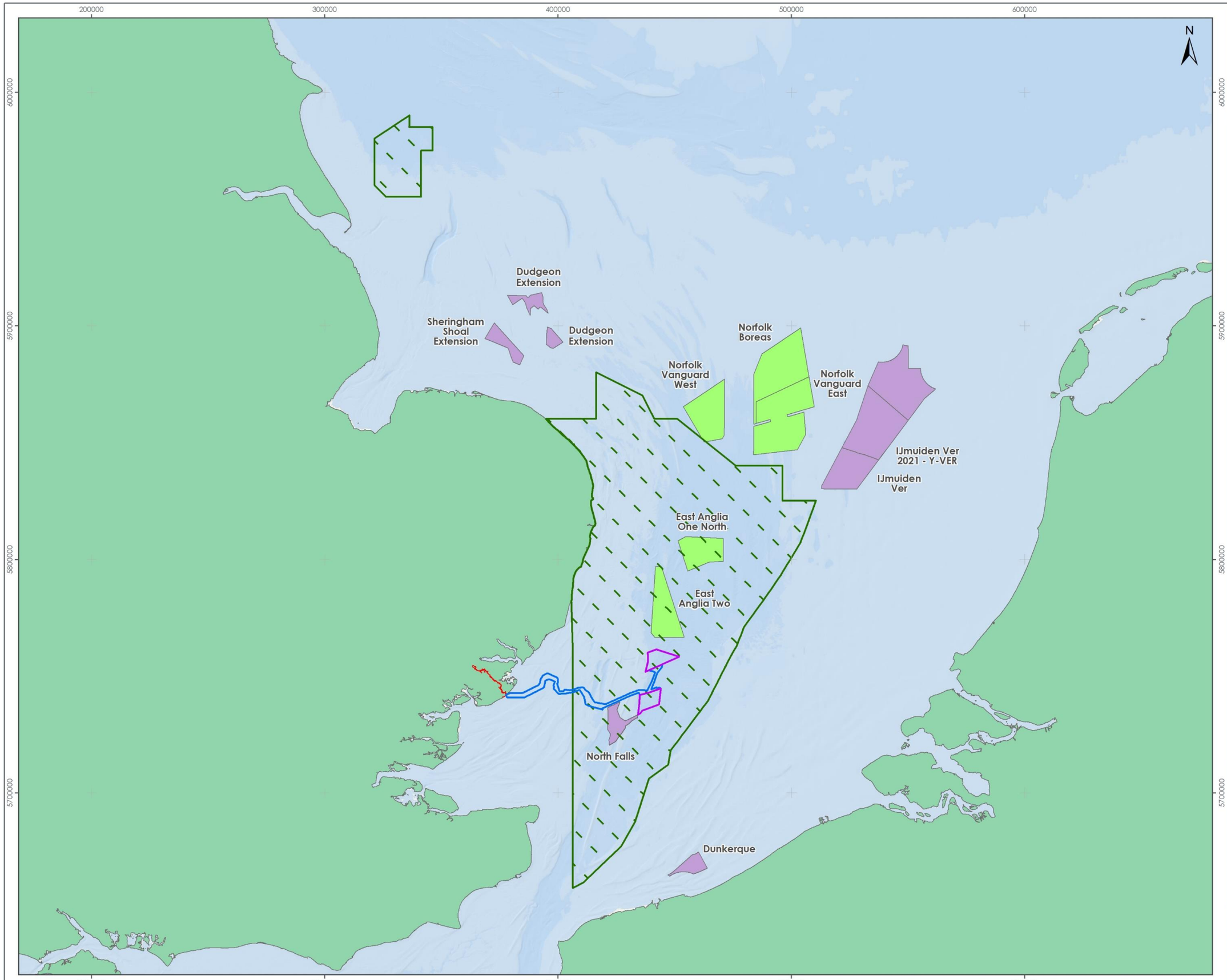
- Only relevant works at VE that may result in underwater noise planned during the winter seasons within the period Q1 2027 - Q4 2030 (i.e. the months during the expected construction timeframe that the winter area of the SNS SAC supports higher densities of harbour porpoise plus one year either side) are considered. This is in line with the in-combination assessment for marine mammals presented in ES Volume 6, Part 2, Chapter 7: Marine Mammal Ecology.
- An assumption that all UXO clearance, geophysical/ seismic survey and foundation piles at VE will be installed within the 2027-2030 timeframe, but UXO/

[23] The certainty attached to the projects within various tiers has been explored by previous projects, for example during the Examination of Hornsea Three. In that case, the Applicant provided text at Deadline 1 in response to the ExA question 1.1.6 (https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001153-DI_HOW03_ExAFirstWQ.pdf)

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 VE are relevant to the winter 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/ seismic survey occur, a 5 km buffer has been applied (as the 12 km EDR applies to air gun surveys not typical of an offshore wind farm).
- The maximum spatial overlap that may occur from an individual UXO clearance or piling location within each project has been assumed (based on a 26 km EDR).

12.3.29 Table 12.3 summarises the potential for effect from a single event (assumed worst case, whether that be monopiles or UXO clearance) per day for VE and the projects assessed in combination with VE. 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 12.4 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. Figure 12.1 shows the location of the projects considered in-combination for underwater noise disturbance impacts.



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Southern North Sea SAC (Winter Area)

OWFs within 26km of SNS SAC (Status)

- Consented
- In Planning

0 10 20 40
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:

Projects Considered In-combination for Underwater Noise where Overlap with the Winter Part of SNS SAC occurs

VER	DATE	REMARKS	Drawn	Checked
1	27/02/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 12.1

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,500,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

Table 12.3 Spatial Effect In -Combination from a Single Event (either piling or UXO clearance) in a Single Day in Winter Season (cells highlighted in red are at risk of exceeding the threshold if unmitigated through the SIP process).

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	Winter 2025-2026	Winter 2026-2027	Winter 2027-2028	Winter 2028-2029	Winter 2029-2030	Winter 2030-2031	
VE		-	-	-	2123.7	2123.7	2123.7	-	UXO/geophysical surveys Q1 – Q3 2026 Piling Q1 – Q4 2027
Total for VE	Total area (km)	-	-	-	2123.7	2123.7	2123.7	-	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	-	-	-	16.73%	16.73%	16.73%	-	Daily unmitigated % (EDR of 26 km)
Tier 2									
East Anglia TWO		2123.7	2123.7	-	-	-	-	-	Piling Q1 2024 – Q4 2026
Norfolk Vanguard		1878.7	1878.7	-	-	-	-	-	Piling Q2 2024-Q1 2025 OR Q2 2024-Q1 2025 and Q2 2027-Q1 2028.

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
									UXO/geophysical or 4- seismic assumed to predate piling.
Total for VE and Tier 2	Total area (km)	4002.4	4002.4	-	2123.7	2123.7	2123.7	-	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	31.53%	31.53%	-	16.73%	16.73%	16.73%	-	Daily unmitigated % (EDR of 26 km)
Tier 3									
Dudgeon Extension		29.7	29.7	29.7	29.7	-	-	-	Piling Q2 2025 – Q4 2028
Dunkerque		25.4	25.4	25.4	25.4	-	-	-	Piling Q1 2025 – Q4 2028
East Anglia One NORTH		-	2123.7	2123.7	2123.7	2123.7	-	-	Q1 2026 – Q4 2028
Norfolk Boreas		-	291.7	291.7	291.7	-	-	-	Q1 2025 – Q4 2028
Sherringham Shoal Extension		-	-	0.1	0.1	0.1	0.1	0.1	Q1 2025 – Q4 2028

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
Total for VE and Tiers 2 and 3	Total area (km)	4057.5	6472.9	2470.6	4594.3	4247.5	2149.1	0.1	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	31.96%	50.98%	19.46%	36.19%	33.46%	16.73%	0.00%	Daily unmitigated % (EDR of 26 km)
Tier 5									
North Falls		-	1081.4	1081.4	1081.4	1081.4	1081.4	1081.4	Q1 2026 – Q4 2028
Total for VE and Tiers 2, 3 and 5	Total area (km)	4057.5	7554.3	3552.0	5675.7	5328.9	3205.2	1081.5	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	31.96%	59.50%	27.98%	44.70%	41.97%	25.25%	8.52%	Daily unmitigated % (EDR of 26 km)
Tier 6									
Ijmuiden Ver		-	-	403.2	403.2	403.2	403.2	-	Q1 2027 – Q4 2029
IJmuiden Ver 2021 - Y-VER		-	-	-	-	0.6	0.6	0.6	Q1 2029 – Q4 2030
Total for VE and	Total area (km)	4057.5	7554.3	3955.2	6078.9	5732.7	3609.0	1082.1	Daily unmitigated area (EDR of 26 km)

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
Tiers 2, 3, 5 and 6	Total Area (%)	31.96%	59.50%	31.15%	47.88%	45.15%	28.43%	8.52%	Daily unmitigated % (EDR of 26 km)
Tier 7									
Seismic Survey 1		Information too high-level to include/ no information available in public domain							
Seismic Survey 2									
Seismic Survey 3									
Seismic Survey 4									
Total for VE and Tiers 2, 3, 5, 6 and 7	Total area (km)	4057.5	7554.3	3955.2	6078.9	5732.7	3609.0	1082.1	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	31.96%	59.50%	31.15%	47.88%	45.15%	28.43%	8.52%	Daily unmitigated % (EDR of 26 km)

12.3.30 **Table 12.4 Spatial Effect In-Combination from two Events (either piling or UXO clearance) in a Single Day per Season (cells highlighted in red are at risk of exceeding the threshold if unmitigated through the SIP process).**

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	Winter 2025-2026	Winter 2026-2027	Winter 2027-2028	Winter 2028-2029	Winter 2029-2030	Winter 2030-2031	
VE		-	-	-	3499.7	3499.7	3499.7	-	UXO/geophysical surveys Q1 – Q3 2026 Piling Q1 – Q4 2027
Total for VE	Total area (km)	-	-	-	3499.7	3499.7	3499.7	-	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	-	-	-	27.57%	27.57%	27.57%	-	Daily unmitigated % (EDR of 26 km)
Tier 2									
East Anglia TWO		3605.5	3605.5	-	-	-	-	-	Piling Q1 2024 – Q4 2026
Norfolk Vanguard		1461.8	1461.8	-	-	-	-	-	Piling Q2 2024-Q1 2025 OR Q2 2024-Q1 2025 and Q2 2027-Q1 2028. UXO/geophysical or4-

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	Winter 2025-2026	Winter 2026-2027	Winter 2027-2028	Winter 2028-2029	Winter 2029-2030	Winter 2030-2031	
									seismic assumed to predate piling.
Total for VE and Tier 2	Total area (km)	5067.4	5067.4	-	3499.7	3499.7	3499.7	-	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	39.91%	39.91%	-	27.57%	27.57%	27.57%	-	Daily unmitigated % (EDR of 26 km)
Tier 3									
Dudgeon Extension		29.7	29.7	29.7	29.7	-	-	-	Piling Q2 2025 – Q4 2028
Dunkerque		25.4	25.4	25.4	25.4	-	-	-	Piling Q1 2025 – Q4 2028
East Anglia One NORTH		-	3172.7	3172.7	3172.7	3172.7	-	-	Q1 2026 – Q4 2028
Norfolk Boreas		-	292.2	292.2	292.2	-	-	-	Q1 2025 – Q4 2028
Sherringham Shoal Extension		-	-	0.1	0.1	0.1	0.1	0.1	Q1 2025 – Q4 2028

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
Total for VE and Tiers 2 and 3	Total area (km)	5122.44	8587.26	3520.04	7019.74	6672.5	3499.8	0.1	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	40.35%	67.64%	27.73%	55.29%	52.56%	27.57%	0.00%	Daily unmitigated % (EDR of 26 km)
Tier 5									
North Falls		-	3554.7	3554.7	3554.7	3554.7	3554.7	3554.7	Q1 2026 – Q4 2028
Total for VE and Tiers 2, 3 and 5	Total area (km)	5122.44	12142.0	7074.7	10574.4	10227.2	7054.5	3554.8	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	40.35%	95.64%	55.72%	83.29%	80.55%	55.57%	28.00%	Daily unmitigated % (EDR of 26 km)
Tier 6									
Ijmuiden Ver		-	-	404.3	404.3	404.3	404.3	-	Q1 2027 – Q4 2029
IJmuiden Ver 2021 - Y-VER		-	-	-	-	0.6	0.6	0.6	Q1 2029 – Q4 2030

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
Total for VE and Tiers 2, 3, 5 and 6	Total area (km)	5122.4	12142.0	7479.0	10978.7	10632.1	7459.4	3555.4	Daily unmitigated area (EDR of 26 km)
	Total Area (%)	40.35%	95.64%	58.91%	86.47%	83.74%	58.75%	28.00%	Daily unmitigated % (EDR of 26 km)
Tier 7									
Seismic Survey 1		Information too high-level to include/ no information available in public domain							
Seismic Survey 2									
Seismic Survey 3									
Seismic Survey 4									
Total for VE	Total area (km)	5122.4	12142.0	7479.0	10978.7	10632.1	7459.4	3555.4	Daily unmitigated area (EDR of 26 km)

Project		Area of Overlap per Season (km)							Relevant activity
		Winter 2024-2025	**Winter 2025-2026**	**Winter 2026-2027**	**Winter 2027-2028**	**Winter 2028-2029**	**Winter 2029-2030**	**Winter 2030-2031**	
and Tiers 2, 3, 5, 6 and 7	Total Area (%)	40.35%	95.64%	58.91%	86.47%	83.74%	58.75%	28.00%	Daily unmitigated % (EDR of 26 km)

12.3.31 It should be noted that the above tables are very much an unmitigated 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. Additionally, it is worth noting that the contribution of VE to this worst-case, unmitigated scenario is within the winter '27-28, winter '28-29, and winter '29-30 seasons only.

12.3.32 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%. 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 (if needed), has potential 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

12.3.33 The Outline SNS SAC SIP (see Section 11 for additional detail) will manage adherence to the thresholds by addressing the risks with respect to the SNS SAC identified above. In particular, confirmation of the relevant project design for VE alone and includes measures for mitigation that would fully address that risk, drawing on the range of mitigation options available.

12.3.34 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 is providing much greater clarity on the risk posed by UXO clearance[24]. A recent paper by SMRU[25] also highlights how solutions to underwater noise are constantly developing. Further, the recent paper by Hastie *et al*. (2019) provides 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 and likely reduce the predicted impact ranges for impulsive noise sources (such as piling and UXO). The Outline SNS SAC SIP (to be submitted alongside the ES) will include a requirement for 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 VE alone, that the daily 20% and seasonal 10% thresholds with respect to the SNS SAC are not exceeded.

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/893773/NPL_2020_-_Characterisation_of_Acoustic_Fields_Generated_by_UXO_Removal.pdf

[25] https://www.nature.scot/doc/naturescot-research-report-1070-review-noise-abatement-systems-offshore-wind-farm-construction-noise

12.3.35 As concluded in Section 11, VE alone has the potential to trigger the 20% threshold under the worst case scenario however this is mitigated through the SIP process, enabling a conclusion of no AEoI. 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 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).

12.3.36 Figure 12.2 determines the risk from VE together with all in-combination projects, assuming a single event per day (on a minimum and maximum basis). For VE together with Tier 2, 3 and 4 projects, the potential for the daily 20% threshold exceedance is primarily limited to the winters of 2025-2028 even under the minimum scenarios. Table 12.4 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.

12.3.37 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 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 provides for this to be applied.

12.3.38 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 resulting in a reduction in the EDR of mitigated (15 km EDR) and unmitigated (26 km EDR) monopile installation[26].

26 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/889842/SACNoiseGuidanceJune2020.pdf

12.3.39 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 (Section 9.2.23) 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 VE, alone and/ or in-combination, would not exceed the 20% or 10% threshold. A SIP is understood to be a future requirement on all OWF within 26 km of the SNS SAC.

IN-COMBINATION EFFECTS ON DISTURBANCE ACROSS A SEASON

12.3.40 As regards the consideration of the potential for an in-combination effect across a season (the 10% value, Table 12.5), there is a risk of the seasonal threshold being exceeded, regardless of whether or not VE 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.

12.3.41 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 VE, with the level of certainty attached to these varying depending on their allocated tier project.

Table 12.5 Summary of risk to the 10% threshold in-combination from piling in a winter season (Single piling events as is the temporal maximum design scenario).

Tier	Project	Activities per winter season	Maximum area (km^2) overlap per day	Average % overlap per wintering season	Threshold risk?
N/A	VE	81 piling days	2123.7	7.4%	Represents a considerable proportion. Capacity therefore exists with primary mitigation (through management of activities) as provided for in the SIP. It is important to note that the number of piling days indicated here and in the ES is indicative and will be refined and updated for DCO application as appropriate.
2	East Anglia Three	95 piling days	1046.4	4.3%	Represents a considerable proportion. Will require consideration of the SNS SAC (requirement of the project level SIP).
2	East Anglia TWO	75 piling days	2123.7	6.9%	Represents a considerable proportion. Will require consideration of the SNS SAC (requirement of the project level SIP).
2	Norfolk Vanguard	29.5 piling days	1089.1	1.4%	Small contribution to the total. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	Dudgeon Extension	25 piling days	29.7	0.0%	No contribution to the total.
3	Dunkerque	Information too high level to include			

Tier	Project	Activities per winter season	Maximum area (km^2) overlap per day	Average % overlap per wintering season	Threshold risk?
3	East Anglia 1 N	67 piling days	2123.7	6.1%	Represents a considerable proportion. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	Norfolk Boreas	154 piling days	181.5	1.2%	Small contribution to the total. Will require consideration of the SNS SAC (requirement of the project level SIP).
3	Sheringham Extension	32 piling days	2112.3	2.9%	Small contribution to the total.
5	North Falls	22.5 piling days	1081.4	1.0%	Will require consideration of the SNS SAC (requirement of the project level SIP).
6	Ijmuiden Ver	Information too high level to include			
6	Ijmuiden Ver 2021 – Y-VER	Information too high level to include			

12.3.42 Table 12.5 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.

12.3.43 It can be concluded that, with the mitigation afforded by the SIP (see Section 9.2.23), and the Outline Piling and UXO MMMPs (See Volume 9, Report 14.1 and 14.2 respectively) and the anticipated requirement for a UXO-specific MMMP **an AEoI will not occur as a result of disturbance to harbour porpoise (as defined by the daily 20% and seasonal 10% thresholds) for VE alone and/or in-combination during construction and decommissioning as a result of piling.**

SEISMIC AND GEOPHYSICAL SURVEY

12.3.44 No specific information on the requirement for seismic and geophysical survey for VE alone are identified at this point, although any surveys that are required will occur within the period broadly Q1 2026 - Q3 2026. 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 VE 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 VE IN-COMBINATION WITH RESPECT TO THE SNS SAC

12.3.45 A summary of the key points for VE in relation to the SNS SAC are provided in Table 12.6below.

12.3.46 In the context of the conservation objectives at the site (see Section 11.3), the Outline Piling and UXO MMMP (Volume 9, Report 14.1 and 14.2 respectively), the Outline SNS SAC SIP (volume 9, Report 15) there will be no effect on the viability of harbour porpoise as a component of the site (conservation objective 1), no significant disturbance of the species (conservation objective 2) and no negative impact on the supporting habitat and processes for the species (including prey) (conservation objective 3). This will maintain FCS and there is, therefore, no AEoI resulting from disturbance of harbour porpoise within the SNS SAC from VE in-combination and therefore, subject to natural change, the feature will be maintained in the long-term.

Table 12.6 Summary of the in-combination risk for VE and the SNS SAC.

Project element	Winter season	Risk management
Piling within the VE array area	Risk of exceedance of the daily 20% threshold for VE in-combination with Tier 1c projects on maximum design scenarios 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.
UXO clearance within the VE array area	Risk of exceedance of the daily 20% threshold for VE in-combination with Tier 1c projects on a maximum basis 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 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.	

Project element	Winter season	Risk management
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 and controlled through the SIP. Given the location of the winter extents relative to VE, any contribution would be limited to survey within a short section of the ECC in any case.	

IN-COMBINATION ASSESSMENT OF DISTURBANCE FROM UNDERWATER NOISE ON HARBOUR SEAL AND GREY SEAL

12.3.47 Table 12.7 below, drawing on the information presented in Figure 12.1 which summarises the relevant projects to be assessed in-combination for potential temporal and spatial effects in relation to construction of VE. 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 12.7 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; and Vlaamse Banken SAC.	Harbour seal	Dogger Bank A	3
		Dogger Bank B	3
		Sofia	3
		Dogger Bank C	3
		Hornsea 3	3
		Norfolk Vanguard	3
		Norfolk Boreas	3
		East Anglia 1 North	3
		East Anglia 2	3
		Hornsea 4	4
		Outer Dowsing	5
		Dudgeon Extension	5
		Sherringham Extension	5
		North Falls	5
		Dogger Bank South W	5
		Dogger Bank South E	5
	Grey seal	Dogger Bank A	3

Designated Site	Relevant Species	Project	Tier
Humber Estuary SAC; Humber Estuary Ramsar; Berwickshire and North Northumberland Coast SAC; 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.		Dogger Bank B	3
		Sofia	3
		Dogger Bank C	3
		Hornsea 3	3
		Norfolk Vanguard	3
		Norfolk Boreas	3
		East Anglia 1 North	3
		East Anglia 2	3
		Blyth Demo	3
		Hornsea 4	4
		Outer Dowsing	5
		Dudgeon Extension	5
		Sherringham Extension	5
		North Falls	5
		Dogger Bank South W	5
		Dogger Bank South E	5
		Seagreen C	5

12.3.48 Consideration of the potential for an in-combination effect on harbour seal and grey seal, on a site-by-site basis, applies the same conservation objectives as the assessment alone. For harbour seal and grey seal, the relevant points effectively relate to the habitat (its structure and function, extent and distribution and the supporting processes on which the habitats depend) together with the population and distribution of the species.

12.3.49 For both species, there is no potential for underwater noise alone or in-combination to affect the habitats used by seals. Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; of the ES 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 VE 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.

12.3.50 The potential for VE 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 VE alone is less than one animal in all cases, based on a PTS range of <100 m (a precautionary maximum, being the minimum range feasible within the model, see Section 7.11 in Volume 6, Part 2, Chapter 7: Marine Mammal Ecology). For UXO clearance, the number of harbour seal and grey seal potentially affected is less than one animal (0.01% of the MU population) and 2 individuals (0.003% of the MU) respectively (see Section 7.11 in Volume 6, Part 2, Chapter 7: Marine Mammal Ecology), therefore only likely to occur for a fraction of the total UXO clearances anticipated. Such an effect is fully provided for within the Piling and UXO MMMP (see Volume 9, Report 14.1 and 14.2 respectively) P, 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 VE 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.**

12.3.51 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 VE than others).

HARBOUR SEAL

12.3.52 Volume 6, Part 2, Chapter 7: Marine Mammal Ecology identifies the potential for the highest level of predicted disturbance to harbour seals across the Southeast England MU is in 2024 and 2025, when several central/ southern North Sea projects are constructing. The impact from construction phase underwater noise from Tier 1-3 projects (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 230 individuals per day, which is 4.7% of the harbour seal MU population (4,868 individuals). By comparison, the total impact to the Southeast England MU is expected to be much lower throughout the VE construction window (2028-2030). At this time, a maximum of 9 harbour seals (0.2% MU, 4,868 individuals) may be disturbed per day in 2028 (assuming all Tier 1-3 projects are constructing at the same time, and that disturbance is additive across projects), reducing to only 2 harbour seals (0.0% MU, 4868 individuals) in 2029 and 2030 (as no Tier 1-3 projects are due to be piling then). 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), and a sensitivity of low, resulting in a significance of minor.

GREY SEAL

12.3.53 Volume 6, Part 2, Chapter 7: Marine Mammal Ecology identifies the potential for the highest level of predicted disturbance to harbour seals across the Southeast England MU is in 2024, when several central/ southern North Sea projects are constructing. The impact from construction phase underwater noise from Tier 1-3 projects (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 to2,097 individuals per day, which is 3.2% of the grey seal MU population (65,505 individuals) per day. By comparison, the total impact to the Southeast and Northeast England MUs is expected to be much lower throughout the VE construction window (2028-2030). At this time, a maximum of 167 grey seals (0.3% MU, 65,505 individuals) may be disturbed per day in 2028 (assuming all Tier 1-3 projects are constructing at the same time, and that disturbance is additive across projects), reducing to only 112 grey seals (0.2 % MU. 65,505 individuals) in 2029 and 2030 (as no Tier 1-3 projects are due to be piling then). 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), and a sensitivity of low for UXO and negligible for piling, resulting in a significance of minor.

CONCLUSION FOR THE IN-COMBINATION ASSESSMENT OF DISTURBANCE FROM UNDERWATER NOISE ON HARBOUR SEAL AND GREY SEAL

12.3.54 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 in relation to the conservation objectives (see Section 11.3) it can be concluded that there is no effect on the habitat (its structure and function, extent and distribution and the supporting processes on which the habitats depend, conservation objectives 1-3), or the population and distribution of the species of harbour seal and grey seal at any of the sites considered (conservation objectives 4-5). There is, **therefore, no potential for AEoI on any of the sites under consideration as a result of VE 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.**

VESSEL PRESENCE DISTURBANCE

12.3.55 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, Klaverbank SCI, and Vlaamse Banken SAC;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.

12.3.56 The potential for LSE during decommissioning would be similar to, and potentially less than, those outlined in the construction phase.

12.3.57 The cumulative assessment presented in Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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 Figure 12.1, 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 VE). For example, Volume 7, Report 6: Navigation 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 wind farms 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). There is already a high level of existing vessel movements within the area (a maximum of 21 vessels per day passing through). Therefore, it is generally considered that animals will be used to a high quantity of vessels meaning they will have a tolerance to the maximum peak addition of 35 vessels at any one time from VE alone (see the MDS presented within (Table 11.11).

IN-COMBINATION ASSESSMENT OF VESSEL PRESENCE DISTURBANCE ON HARBOUR PORPOISE

12.3.58 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 wind farm 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 wind farm activity would require assessment, with that assessment for VE alone presented above.

12.3.59 For the assessment alone during construction, any vessel disturbance was found to be within the footprint of any disturbance resulting from other project activities such as piling. However, the potential for piling related disturbance in-combination remains, and effects on harbour porpoise receptors are difficult to quantify and assess at this stage (as these will be informed by more detailed project construction programmes). To address this uncertainty and conclude the assessment, the Applicant commits to providing a SIP, as consistent with preceding OWF projects that have received DCO consent. Based on this commitment, and the security provided through the SIP process, and a conclusion of no AEoI on harbour porpoise from piling in-combination can be concluded. As vessel related disturbance will be restricted to the same area that disturbance from piling is expected to be restricted to, it is reasonable to conclude that the SIP will also manage vessel related disturbance by default, and therefore the same conclusion applies for disturbance effects on harbour porpoise in-combination. Furthermore, regarding any vessels that are not related to piling (including those beyond the 26 km EDR), it is anticipated that disturbance is restricted to up to 1 km from the vessel routes (Graham *et al*., 2019). These will be subject to the Working in Proximity to Wildlife in the Marine Environment (Volume 9, Report 18.1) which, combined with other projects implementing similar vessel management measures is anticipated to provide added assurance that there will be no AEoI from vessel disturbance on harbour porpoise in-combination.

12.3.60 There will therefore be no effect on the viability of harbour porpoise as a component of the site (conservation objective 1), no significant disturbance of the species (conservation objective 2) and no negative impact on the supporting habitat and processes for the species (including prey) (conservation objective 3). This will maintain FCS and there is, **therefore, no AEoI from VE in-combination and therefore, subject to natural change, the harbour porpoise will be maintained in the long-term.**

IN-COMBINATION ASSESSMENT OF VESSEL PRESENCE DISTURBANCE ON HARBOUR AND GREY SEALS

12.3.61 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 co-occurrence, 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. 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.

12.3.62 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, conservation objectives 1-3) together with the population and distribution of the species of harbour seal and grey seal (conservation objectives 4-5) for any of the sites under consideration as a result of VE 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.**

OPERATION AND MAINTENANCE

VESSEL PRESENCE DISTURBANCE

12.3.63 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, Klaverbank SCI, and Vlaamse Banken SAC;Transboundary sites (twelve sites for grey seal), specifically Doggerbank (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.

12.3.64 Volume 6, Part 2, Chapter 7: Marine Mammal Ecology 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 an in-combination 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. Operational noise for VE is effectively scoped out of further assessment within the ES.

12.3.65 Vessel routes to and from offshore windfarms and other projects will use existing vessel routes where marine mammals will be accustomed to regular vessel movements and therefore vessel activity will already be an existing feature of the baseline. Vessel activity within array areas 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 (Volume 6, Part 2, Chapter 7: Marine Mammal Ecology).

12.3.66 There is therefore no potential for VE to contribute in any meaningful way to any in-combination effect. With relation to the SNS SAC, there will be no effect on the viability of harbour porpoise as a component of the site, no significant disturbance of the species and no negative impact on the supporting habitat and processes for the species (including prey). This will maintain FCS and it can therefore be concluded that **therefore, no AEoI will result from vessel related disturbance for this site under consideration as a result of VE alone and/ or in-combination and therefore, subject to natural change, the feature will be maintained in the long-term.**

12.3.67 For both harbour and grey seals, it can be concluded that there will be no effect on the habitat (its structure and function, extent and distribution and the supporting processes on which the habitats depend, conservation objectives 1-3), together with the population and distribution of the species (conservation objectives 4-5). It can **therefore be concluded that no AEoI will result on the harbour seal and grey seal features at any of the sites under consideration as a result of VE alone and/or in-combination.**

12.4 OFFSHORE AND INTERTIDAL ORNITHOLOGY

12.4.1 The in-combination effect of collision and displacement impacts on ornithological features has been calculated using a 'tiered approach' to determine the potential for an AEoI in-combination as presented in Table 9.7 in ES Volume 6, Part 2, Chapter 4: Offshore Ornithology. A description of the significance of project alone effects upon the features of the relevant designated sites screened in for LSE is provided in Table 12.8.

12.4.2 OWFs for which there is potential for the C&D or O&M phases to have temporal or spatial overlap with that of VE, were screened in for the in-combination assessment for offshore and intertidal ornithology and are presented in Table 4.51 in ES Volume 6, Part 2, Chapter 4: Offshore Ornithology.

12.4.3 Pre-application phase projects have been considered within the in-combination long list. However, there is insufficient data for those projects that are yet to submit PEIR (or for Scottish projects that are yet to submit their application) and so their impacts have not yet been included. This includes Dogger Bank D.

CONSTRUCTION AND DECOMISSIOING

12.4.4 The HRA Screening process undertaken for this RIAA identified no potential effects requiring further assessment during the C&D phase of VE in-combination with other plans or projects. This is based on any potential contribution to the in-combination impact for features assessed for disturbance and displacement at all relevant sites not being of sufficient magnitude to make a material contribution to natural mortality rates. In addition, any impact will be limited both spatially (e.g. disturbance ranges of 2 km for auks) and temporally and therefore the likelihood of accumulating impacts with other projects is low.

12.4.5 There are only four other OWF projects with potential temporal overlap of construction activities within a reasonable distance of the VE array, including North Falls, East Anglia ONE North, East Anglia TWO and the Sheringham and Dudgeon Extension Projects. There is a low probability that these projects will have overlapping construction periods because the East Anglia Projects are due to begin construction in Q2 2025, two years prior to VE, while the Sheringham and Dudgeon Extension Projects are also expected to begin construction in 2025 at the earliest. In addition, due to the lower level of disturbance impact during the C&D phase compared with operation, East Anglia Projects did not consider C&D phase disturbance impacts. Furthermore, the Sheringham and Dudgeon Extension Projects are located 135 km away from VE and therefore do not have connectivity with the red-throated diver feature of the OTE SPA assessed in VE during the construction phase.

12.4.6 There are also several cable laying projects, such as NeuConnect and SeaLink/ Nautilus that begin construction in the vicinity of the VE array from 2023 onwards. NeuConnect is expected to be operational by 2028 and the timeline of SeaLink Nautilus is unclear, therefore it is unlikely that either project will overlap with the cable laying or construction of VE. In addition, the impacts from these projects is not possible to assess accurately due to lack of required project information. The area around the VE array has extremely high vessel traffic and consequently any additional activity from these projects will contribute an inconsequential level of effect to any in-combination impact.

12.4.7 The impact alone assessments of relevant ornithological receptors revealed only trivial and inconsequential effects for all displacement risk species, with no potential for any contribution for an in-combination effect during construction (summarised in Table 12.8 below). Considering this, it is reasonable to deduce that construction and decommissioning would not result in adverse impacts in-combination with other projects. Table 12.8 presents a summary of sites and features for disturbance and displacement assessment during construction and decommissioning phases for VE in-combination.

Table 12.8 Overview of the potential contribution of impacts assessed alone to potential in-combination impacts.

Designated Site	Feature	Considered in-combination?
OTE SPA	Red-throated diver	Not considered because the magnitude and duration of these impacts indicates that the likelihood of an in-combination disturbance effect is extremely small. The assessment alone concluded potential for a trivial and inconsequential level of effect (maximum of 3.30 birds), that would be well within the error margins of the assessment, and therefore there is no potential for any contribution for an in-combination effect. While the ECC route will partially overlap with the OTE SPA, cable laying is unlikely to be undertaken in combination with any other projects which have connectivity to the red-throated diver feature at the OTE SPA. In addition the project has committed to not installing export cables within the Outer Thames Estuary SPA between 1st November to 31st March inclusive to mitigate disturbance impacts on red throated diver. It should also be noted that whilst some displacement of red throated divers in the ECC crossing the OTE SPA will occur during the construction phase, in practice, it is expected that increases in vessel activity within the OTE SPA beyond the existing level are not anticipated. In addition, current planned or operational projects with potential impacts to the red-throated diver feature of OTE SPA have mitigated for their impacts by agreeing to a seasonal restriction to construction. This, in effect, reduces potential impacts to red-throated divers to negligible levels. Therefore, there is no potential for in-combination impact to this feature at OTE SPA.
Flamborough and Filey Coast SPA	Gannet	Not considered because the assessment alone concluded potential for a trivial and inconsequential level of effect (0.75 breeding adult birds per annum across all bio-seasons), that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination effect.
	Guillemot	Not considered because the assessment alone concluded potential for a trivial and inconsequential

Designated Site	Feature	Considered in-combination?
		level of effect, (0.41 breeding adult birds per annum across all bio-seasons), that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination effect.
	Razorbill	Not considered because the assessment alone concluded potential for a trivial and inconsequential level of effect (0.11 breeding adult birds per annum across all bio-seasons), that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination effect.
Farne Island SPA	Guillemot	Not considered because the assessment alone concluded potential for a trivial and inconsequential level of effect (0.35 breeding adult birds per annum across all bio-seasons), that would be well within the error margins of the assessment, and therefore no potential for any contribution for an in-combination effect.

OPERATION AND MAINTENANCE

DISTURBANCE AND DISPLACEMENT

12.4.8 The potential for OWF disturbance and displacement to result in an AEoI in-combination with VE relates to the following designated site and the relevant features as presented in Table 12.9.

- Flamborough and Filey Coast SPA; gannet, guillemot, and razorbill;
- Farne Islands SPA; guillemot.

Table 12.9 Summary of sites and features for disturbance and displacement assessment during O&M phases for VE in-combination.

Designated Site	Feature	Considered in-combination?
Flamborough and Filey Coast SPA	Gannet	Yes, it is included in-combination as requested by Natural England (Natural England ETG, August 2023). Assessment alone concluded potential for a trivial and inconsequential level of effect (1.27 breeding adults per annum, equating to a 0.08% increase in baseline mortality). The Project considers this level of effect to provide no material contribution to the in-combination impact at this site.

Designated Site	Feature	Considered in-combination?
	Guillemot	Yes, it is included in-combination as requested by Natural England (Natural England ETG, August 2023). Assessment alone concluded potential for a trivial and inconsequential level of effect (0.82 breeding adults per annum, equating to a <0.01% increase in baseline mortality). The Project considers this level of effect to provide no material contribution to the in-combination impact at this site.
	Razorbill	Yes, it is included in-combination as requested by Natural England (Natural England ETG, August 2023). Assessment alone concluded potential for a trivial and inconsequential level of effect (0.22 breeding adults, equating to a <0.01% increase in baseline mortality). The Project considers this level of effect to provide no material contribution to the in-combination impact at this site.
Farne Islands SPA	Guillemot	No it is not included because the assessment alone concluded potential for a trivial and inconsequential level of effect (0.69 breeding adults, equating to a <0.02% increase in baseline mortality). The Project considers this level of effect to provide no material contribution to the in-combination impact at this site.

12.4.9 The assessments provided within this RIAA include a number of assumptions when calculating the predicted impacts and potential effects that are considered by VE to be appropriately precautionary, including;

- The project alone impacts were assessed over the full-breeding bio-season for all species. This is a precautionary approach to the assessment because generally a greater impact is attributed to nearby SPAs during the breeding bio-season. However, the in-combination assessment focused on the migration-free breeding bio-season because data from all projects was not available for the full-breeding season. The full-breeding season impacts for VE were used within the in-combination assessment.
- By using the mean of the peaks for each bio-season from each survey year it is assumed that a high population is maintained for each of the months within the bio-season, whilst the actual abundance of each species is considerably less the peak count for much of the bio-season;

- Based on the latest evidence (e.g., APEM 2021; MacArthur Green, 2023), the maximum extent of displacement considered for each species in the assessments is likely to be greater than experienced within the array area and buffer; and
- Assuming a 1% mortality of birds displaced from offshore windfarms is highly likely to be an over-estimate, because the species assessed in this RIAA have large foraging ranges and are not solely dependent upon the area within both the VE array area and buffer for their foraging needs within the breeding and non-breeding bio-seasons.

FLAMBOROUGH AND FILEY COAST SPA - DISPLACEMENT

GANNET

12.4.10 Gannets were screened into the assessment for the O&M phase to assess the impacts from displacement from VE in-combination with other plans or projects in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

12.4.11 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 mean count is 30,466 adults based on the 2023 count (Butcher *et al*., 2022).

12.4.12 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK waters in the North Sea and English Channel were screened in based on the potential for adverse effects from activities taking place at these sites in combination with the O&M of VE. The VE array area, and several other projects are within the mean max foraging range of gannet from the FFC SPA (315.2 km), and also within the mean max plus 1SD foraging distance (509.4 km) (Woodward *et al*., 2019) and were consequently screened in for the breeding bio-season. Notably, gannets range further afield, and are not constrained by the requirement to provision for chicks, outside of the breeding bio-season, and so consideration is also given to other OWFs within the wider UK North Sea and English Channel BDMPS area. Projects included within the in-combination assessment are presented in Table 12.10 below.

12.4.13 During the breeding bio-season the potential impacts on gannets from the FFC SPA due to displacement may be attributed more highly to OWFs within areas of sea within foraging distance from this breeding colony. To assess the potential in-combination impacts on gannet across multiple OWFs, information on the seasonal abundance of gannets at each OWF site plus a 2 km buffer was compiled. Seasonal gannet abundances were then attributed to the FFC SPA. As outlined in Section 11.4, the approach to gannet apportioning was 82% adults and 74% apportioned to FFC, as agreed with Natural England.

12.4.14 During the non-breeding bio-season, apportionment was carried out by calculating the proportion of the breeding adults within the UK North Sea and English Channel BDMPS population that can be attributed to the specific SPAs as defined by Furness (2015) (presented in Chapter 6, Part 5, Annex 4.15: Apportioning Note). Using this approach, 7.19% and 5.44%, of individuals within the VE array were apportioned to FFC SPA during return migration and post-breeding migration bio-seasons, respectively.

12.4.15 The total numbers presented in Table 12.10 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Deadline 8 Apportioning and HRA Updates Technical Note (Royal HaskoningDHV, 2023a). The following amendments were made to the values presented:

- Inclusion of values from the Green Volt RIAA (Royal HaskoningDHV, 2023b), West of Orkney RIAA (Xodus & MacArthur Green 2023), Berwick Bank RIAA (RPS and Royal HaskoningDHV, 2022), Outer Dowsing draft RIAA (GoBe and SLR, 2023), North Falls RIAA (SSE Renewables and RWE, 2023), and Dogger Bank South PEIR (MacArthur Green 2023);
- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and
- Inclusion of values for VE.

12.4.16 A displacement rate of 70% and a mortality rate of 1% were deemed appropriate by the Applicant for the assessment of in-combination effects on gannet Table 12.10. Based on advice from Natural England, a displacement range of between 60% to 80% is also presented in Table 12.10.

Table 12.10 In-combination displacement total for gannet attributed to the FFC SPA.

Tier	Offshore Wind Farm	Seasonal population at risk of displacement			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Beatrice	0.0	0.0	0.0	0.0
1	Beatrice Demonstrator	-	-	-	0.0
1	Blyth Demonstration Site	-	-	-	0.0
1	Dudgeon	53	1.2	0.7	54.9
1	East Anglia One	161	174.6	4.7	340.3
1	EOWDC	0.0	0.2	0	0.2
1	Galloper	0.0	43.5	17.1	60.6
1	Greater Gabbard	0.0	3.3	6.5	9.8
1	Gunfleet Sands	0.0	0.6	0.6	1.2
1	Hornsea Project One	671	33.3	15.5	719.8
1	Hywind	0.0	0.0	0.0	0.2
1	Kentish Flats	-	-	-	0.0
1	Kentish Flats Extension	0.0	0.6	0.0	0.6

Tier	Offshore Wind Farm	Seasonal population at risk of displacement			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Lincs	-	-	-	0.0
1	London Array	-	-	-	0.0
1	Methil	0.0	0.0	0.0	0.0
1	Race Bank	92	1.5	1.8	95.3
1	Rampion	0.0	28.3	0.0	28.3
1	Scroby Sands	-	-	-	0.0
1	Sheringham Shoal	47	1.5	0.1	48.6
1	Teesside	0.5	0.0	0.0	0.5
1	Thanet	-	-	-	0.0
1	Westermost Rough	-	-	-	0.0
1	Kincardine	0.0	0.0	0.0	0.0
1	Hornsea Project Two	457	54.7	7.7	519.4
1	Moray East	0.0	14	1.7	15.7
1	Neart na Gaoithe	0.0	26.5	17.4	43.9

Tier	Offshore Wind Farm	Seasonal population at risk of displacement			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Triton Knoll	211	0.7	1.5	213.2
1	Firth of Forth Alpha and Bravo	0.0	31.9	20.6	52.5
1	East Anglia Three	412	60.9	32.5	505.4
1	Dogger Bank Creyke Beck Projects A and B	577.5	98.3	24.4	700.2
1	Dogger Bank Teesside Projects A and B	1125	42.6	28.8	1,196.4
1	Hornsea Three	844	47	32.5	923.5
1	Inch Cape	0.0	33.7	13.1	46.8
1	Moray West	0.0	21.1	8.9	30.0
1	Hornsea Four	883.1	38.3	25.0	946.4
1	East Anglia ONE North	149	22.5	2.7	174.2
1	East Anglia TWO	192	42.8	11.9	246.7
1	Norfolk Boreas	1,229	82.7	32.6	1,344.3
1	Norfolk Vanguard	271	117.7	27.1	415.8

Tier	Offshore Wind Farm	Seasonal population at risk of displacement			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	DEP and SEP	337.4	30.6	3.6	371.6
2	Rampion 2	0.0	3.7	2.8	6.5
2	Greenvolt	2.5	0.8	4.4	7.7
2	Pentland	-	-	0.0	0.0
2	Berwick Bank	54.9	30.0	10.8	95.6
2	West of Orkney	-	43.5	55.9	99.4
2	Outer Dowsing (PEIR)	419.1	8.2	10.7	438.0
2	North Falls	37.4	22.0	15.3	74.7
2	Dogger Bank South (PEIR)	202.6	49.5	1.0	253.1
2	**VE (NE approach to apportioning)**	141.0	35.0	5.0	181.0
	All Projects Total (NE approach to apportioning)	8,570.0	1,247.3	444.8	10,262.3

BREEDING

12.4.17 The in-combination number of breeding adults predicted to be displaced from the assessed OWFs, including VE, in the breeding bio-season is 5,999 (5,999.0) based on 70% displacement. The predicted consequent mortality is 60 (60.0) breeding adults.

12.4.18 Considering the potential impact of this loss to the FFC SPA, with a population of 16,938 breeding adults and annual background mortality of 1,372 breeding adults per annum, the addition of 60 suffering displacement consequent mortality would represent a 4.372% increase in baseline mortality, of which VE contributes one (1.37) individual, representing an increase in baseline mortality of 0.092%.

12.4.19 As the gannet population at the FFC SPA has increased significantly since the citation population count, the impact on the population is more reasonably assessed against the latest population count undertaken in 2023, which was 30,466 breeding adults. Considering the impact on the FFC SPA based on this population (with an annual background mortality of this number of adult birds being 2,681 breeding adults per annum), the addition of 60 breeding adults suffering displacement consequent mortality would represent a 2.431% increase in baseline mortality, of which VE contributes less than one (1.37) individual, representing an increase in baseline mortality of 0.051%.

NON-BREEDING

12.4.20 The in-combination number of birds predicted to be displaced from the assessed OWFs, including VE, is 1,247 (1,247.3) in the post-breeding migration bio-season, and 445 (444.8) in the return migration bio-season. The predicted consequent mortality as a result of displacement is eight (7.5) individuals in the post-breeding migration bio-season, and three (2.7) individuals in the return migration bio-season. This equates to a total consequent mortality from displacement across the whole non-breeding bio-season of 11 (10.20) individuals per annum.

12.4.21 Considering the potential impact of this loss to the FFC SPA citation population, the addition of 11 individuals would represent a 0.740% increase in baseline mortality, of which VE contributes an increase of less than one (0.27) breeding adult mortality, equating to an increase of 0.018% in baseline mortality. Considering the more recent 2023 population count for gannet, the addition of 11 individuals would represent a 0.411% increase in baseline mortality, of which VE contributes less than one breeding adult mortality, equating to an increase in baseline mortality of 0.009%.

Table 12.11 In-combination range-based displacement mortalities for gannet based on the values advocated by Natural England for both citation population counts and more recent 2023 population counts.

FFC SPA Breeding	Abundance of adults apportioned to SPA (array area plus 2 km buffer)	60% Displacement, 1% Mortality	70% Displacement, 1% Mortality					80% Displacement, 1% Mortality		
		Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Breeding	8570.0	51.4	3.748	2.084	60.0	4.372	2.431	68.6	4.997	2.778
Post-breeding migration	1247.3	7.5	0.545	0.303	8.7	0.636	0.354	10.0	0.727	0.404
Return migration	444.8	2.7	0.195	0.108	3.1	0.227	0.126	3.6	0.259	0.144
Total	**10262.3**	**61.6**	**4.488**	**2.495**	**71.8**	**5.236**	**2.911**	**82.1**	**5.984**	**3.327**

Table 12.12 In-combination displacement matrix for adult gannet attributed to the FFC SPA across all bio-seasons, with values in light green representing the range-based values dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	10	21	51	103	205	308	410	513	616	718	821	924	1,026
20	21	41	103	205	410	616	821	1,026	1,231	1,437	1,642	1,847	2,052
30	31	62	154	308	616	924	1,231	1,539	1,847	2,155	2,463	2,771	3,079
40	41	82	205	410	821	1,231	1,642	2,052	2,463	2,873	3,284	3,694	4,105
50	51	103	257	513	1,026	1,539	2,052	2,566	3,079	3,592	4,105	4,618	5,131
60	62	123	308	616	1,231	1,847	2,463	3,079	3,694	4,310	4,926	5,542	6,157
70	72	144	359	718	1,437	2,155	2,873	3,592	4,310	5,029	5,747	6,465	7,184
80	82	164	410	821	1,642	2,463	3,284	4,105	4,926	5,747	6,568	7,389	8,210
90	92	185	462	924	1,847	2,771	3,694	4,618	5,542	6,465	7,389	8,312	9,236
100	103	205	513	1,026	2,052	3,079	4,105	5,131	6,157	7,184	8,210	9,236	10,262

ANNUAL

12.4.22 The total in-combination number of gannet displacement consequent mortalities predicted from the OWFs assessed, including VE, is 72 (71.8) breeding adults per annum (Table 12.12). Based on the citation population count, the addition of 72 mortalities equates to a 5.236% increase in baseline mortality (VE alone contributes an increase of one (1.27) individual per annum, representing a 0.085% increase in baseline mortality). Based on the more recent 2023 population count for gannet, the addition of 72 individuals equates to a 2.911% increase in baseline mortality (the contribution of one individual from VE alone represents an increase of just 0.047%). Although, the in-combination displacement impacts exceed a 1% increase in baseline mortality, the contribution from VE alone across all bio-seasons equates to less than half an individual and therefore the level of additional impact from VE would be indistinguishable from natural fluctuations in the population and is thus not of sufficient magnitude to make a material contribution to natural mortality rates. It is concluded that predicted gannet mortality due to displacement at VE would not adversely affect the integrity of the Flamborough and Filey Coast SPA. Therefore, further consideration of the impact in the form of a PVA is not required. However, as a precautionary approach, PVA has been undertaken on combined displacement and collision impacts at FFC SPA in-combination with other OWF projects in Section 12.4.

12.4.23 Please see Section 12.4.17 for an overview of the combined impact of disturbance and collision on gannet from FFC SPA in-combination with other OWF projects.

GUILLEMOT

12.4.24 Guillemot has been screened into the in-combination assessment of the O&M phase to assess the impacts from displacement from VE in-combination with other projects in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each qualifying feature.

12.4.25 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 149,980 breeding adults based on the most recent 2022 colony count.

12.4.26 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK wasters in the North Sea and English Channel were screened in based on the potential for potential adverse effects on integrity from activities taking place at these sites in combination with the O&M phase of VE. The VE array area, and several other projects are outside the mean max foraging range of guillemot from the FFC SPA (73.2 km), and also outside the mean max plus 1SD foraging distance (150.7 km) (Woodward *et al.*, 2019) and were consequently screened out for the breeding bio-season. Notably, guillemots range further outside of the breeding bio-season, and so consideration is also given to other OWFs within the wider UK North Sea and English Channel BDMPS region. Projects included within the in-combination assessment are presented in Table 12.13 below.

12.4.27 The total numbers presented in Table 12.13 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Deadline 8 Apportioning and HRA Updates Technical Note (Royal HaskoningDHV, 2023a). The following amendments were made to the values presented:

- Inclusion of values from the Green Volt RIAA (Royal HaskoningDHV, 2023b), West of Orkney RIAA (Xodus & MacArthur Green 2023), Berwick Bank RIAA (RPS and Royal HaskoningDHV, 2022), Outer Dowsing draft RIAA (GoBe and SLR, 2023), North Falls RIAA (SSE Renewables and RWE, 2023), and Dogger Bank South PEIR (MacArthur Green 2023);
- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and
- Inclusion of values for VE.

12.4.28 As per evidence presented in paragraphs 11.4.36 and 11.4.37 and a displacement rate of 50% and a mortality rate of 1% were deemed appropriate by the Applicant for the assessment of in-combination effects on guillemot. Based on advice from Natural England, a displacement range of between 30% to 70%, and a mortality range of between 1% and 10% is also presented in Table 12.13.

Table 12.13 In-combination displacement total for guillemot attributed to the FFC SPA.

Tier	OWF	Seasonal population at risk of displacement		
		Breeding	Non-breeding	Total
1	Beatrice	0	121	121
1	Beatrice Demonstrator	-	-	0
1	Blyth Demonstration Site	0	58	58
1	Dudgeon	0	24	24
1	East Anglia One	0	28	28
1	EOWDC	0	10	10
1	Galloper	0	26	26
1	Greater Gabbard	0	24	24
1	Gunfleet Sands	0	16	16
1	Hornsea Project One	4,554	356	4,910
1	Humber Gateway	99	6	105
1	Hywind	0	94	94
1	Kentish Flats	0	0	0
1	Kentish Flats Extension	0	0	0

Tier	OWF	Seasonal population at risk of displacement		
		Breeding	Non-breeding	Total
1	Kincardine	0	0	0
1	Lincs, Lynn & Inner Dowsing	0	36	36
1	London Array	0	17	17
1	Methil	0	0	0
1	Race Bank	0	31	31
1	Rampion	0	684	684
1	Scroby Sands	-	-	0
1	Sheringham Shoal	0	32	32
1	Teesside	267	40	307
1	Thanet	0	6	6
1	Westermost Rough	347	21	368
1	Hornsea Project Two	3,581	579	4,161
1	Moray East	0	24	24
1	Neart na Gaoithe	0	166	166
1	Triton Knoll	425	33	458
1	Firth of Forth Alpha	0	206	206
1	Firth of Forth Bravo	0	181	181
1	East Anglia Three	0	126	126
1	Dogger Bank A	1,893	270	2,163
1	Dogger Bank B	3,318	467	3,785
1	Dogger Bank C	1,149	100	1,249
1	Hornsea Three	0	782	782
1	Inch Cape	0	140	140
1	Moray West	0	1,680	1,680
1	Sofia	1,824	163	1,987
1	Norfolk Boreas	0	606	606
1	Norfolk Vanguard	0	210	210
1	East Anglia ONE North	0	83	83
1	East Anglia TWO	0	74	74

Tier	OWF	Seasonal population at risk of displacement		
		Breeding	Non-breeding	Total
2	DEP and SEP	0	703	703
2	Hornsea Four	9,382	22,927	32,309
2	Greenvolt	-	711	711
2	Pentland	-	-	0
2	West of Orkney	-	189	189
2	Berwick Bank	-	711	711
2	Rampion 2		573	573
2	Outer Dowsing	12,284	22,248	34,532
2	North Falls	-	198	198
2	Dogger bank south	18,004	1,118	19,122
2	VE	0	163	163
	All Project Total	57,127	57,058	114,186

NON-BREEDING

12.4.29 The in-combination number of birds predicted to be displaced from the assessed OWFs, including VE, is 28,529 (28,529.1) in the nonbreeding bio-season based on 50% displacement. The predicted consequent mortality as a result of displacement is 285 (285.3) individuals in the non-breeding bio-season.

12.4.30 Considering the potential impact of this loss to the FFC SPA, with a citation population of 83,214 breeding adults and an annual background mortality of 5,076 breeding adults per annum, the addition of 285 individuals would represent a 5.620% increase in baseline mortality, of which VE contributes an increase of less than one (0.82) breeding adult mortality, equating to an increase of 0.016% in baseline mortality.

12.4.31 As the guillemot population at the FFC SPA has increased significantly since the citation population count, the impact on the population is more reasonably assessed against the latest population count undertaken in 2022, which was 149,980 breeding adults. Considering the impact on the FFC SPA based on this population (with an annual background mortality of this number of adult birds being 9,149 breeding adults per annum), the addition of 285 individuals would represent a 3.118% increase in baseline mortality, of which VE contributes less than one breeding adult mortality, equating to an increase in baseline mortality of 0.009%.

Table 12.14 In-combination range-based displacement mortalities for guillemot based on the values advocated by Natural England for both citation population counts and more recent 2022 population counts. VE contributes only to the non-breeding season impacts to this SPA.

FFC SPA Breeding	Abundance of adults apportioned to SPA (array area plus 2 km buffer)	30% Displacement, 1% Mortality	50% Displacement,	1% Mortality				70% Displacement, 2% Mortality		
		Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Breeding	57,127.1	171.4	3.376	1.87347	285.64	5.627	3.122	799.8	15.756	8.742
Non breeding	57,058.2	171.2	3.372	1.871	285.3	5.620	3.118	798.8	15.737	8.731
Total	114,186.1	342.6	6.749	3.744	570.9	11.248	6.241	1598.6	31.493	17.473

Table 12.15 In-combination displacement matrix for adult guillemot attributed to the FFC SPA across all bio-seasons, with values in light green representing the range-based values and dark green representing the Applicant's approach value.

Displacement Rate (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	114	228	571	1,142	2,284	3,426	4,567	5,709	6,851	7,993	9,135	10,277	11,419
20	228	457	1,142	2,284	4,567	6,851	9,135	11,419	13,702	15,986	18,270	20,553	22,837
30	343	685	1,713	3,426	6,851	10,277	13,702	17,128	20,553	23,979	27,405	30,830	34,256
40	457	913	2,284	4,567	9,135	13,702	18,270	22,837	27,405	31,972	36,540	41,107	45,674
50	571	1,142	2,855	5,709	11,419	17,128	22,837	28,547	34,256	39,965	45,674	51,384	57,093
60	685	1,370	3,426	6,851	13,702	20,553	27,405	34,256	41,107	47,958	54,809	61,660	68,512
70	799	1,599	3,997	7,993	15,986	23,979	31,972	39,965	47,958	55,951	63,944	71,937	79,930
80	913	1,827	4,567	9,135	18,270	27,405	36,540	45,674	54,809	63,944	73,079	82,214	91,349
90	1,028	2,055	5,138	10,277	20,553	30,830	41,107	51,384	61,660	71,937	82,214	92,491	102,767
100	1,142	2,284	5,709	11,419	22,837	34,256	45,674	57,093	68,512	79,930	91,349	102,767	114,186

12.4.32 The total in-combination number of guillemot displacement consequent mortalities predicted from the OWFs assessed, including VE, is 571 (570.9) breeding adults per annum (Table 12.15). Based on the citation population count, the addition of 571 mortalities equates to a 11.248% increase in baseline mortality (VE alone contributes an increase of less than one (0.8) individual per annum, representing a 0.016% increase in baseline mortality). Based on the more recent 2022 population count for guillemot, the addition of 571 individuals equates to a 6.241% increase in baseline mortality.

12.4.33 Considering the contribution from VE alone during only the non-breeding bio-season of <1 individual equating to <0.05% increase in baseline mortality, it is considered that VE is providing no material contribution to the in-combination impacts to the Flamborough and Filey Coast SPA. It is therefore concluded that predicted guillemot mortality due to displacement at VE would not adversely affect the integrity of the Flamborough and Filey Coast SPA. However, considering the in-combination impact from other projects exceeds a 1% increase in baseline mortality, further assessment in the form of PVA has been undertaken.

12.4.34 PVA was undertaken on a range of scenarios for both VE alone and in-combination with other projects (as presented in Table 12.16. For each scenario, counterfactual of population growth (CGR) and counterfactual of population size (CPS) have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period of 40 years relative to a baseline scenario. The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2022 FFC count).

12.4.35 At the FFC SPA, the mean annual population growth rate between 1969 and 2022 is approximately 4%. Though it is not possible to predict how this growth rate will change over the 40-year lifetime of VE, the current population growth rate suggests that the colony is expected to continue increasing in size, even when considering all scenarios presented in Table 12.17.

12.4.36 The worst-case scenario of 70% displacement and 2% mortality would result in an annual reduction in population growth rate of 1.2%, while the more realistic scenario of 50% displacement and 1% mortality would reduce it by 0.4%. Notably, the worst case scenario is considered precautionary, and not representative of actual impacts expected as a result of VE in-combination with other projects. This was also supported in advice given by Natural England to Norfolk Boreas at Deadline 4 (Natural England 2020):

'However, while there is some empirical evidence to support the displacement levels for auks we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of guillemot density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important

areas. Therefore, we do not anticipate that mortality rates to be at the top of the range considered.'

12.4.37 This advice is also considered relevant for VE because many of the same sites are screened in for both projects, and the individuals present in VE array area are expected to have similar habitat preferences. Consequently, the results from 70% displacement and 10% mortality are not considered ecologically justified, with the Applicant's approach of 50% displacement and 1% mortality forming the main basis of the Project assessment. This is also supported by more recent available data which suggests 70% displacement and 10% mortality is a large overestimation of actual impacts (APEM, 2021; MacArthur Green, 2023).

12.4.38 As presented in Table 12.16, the CGR and CPS VE in-combination based on 50% displacement and 1% mortality are 0.996 and 0.839 respectively (Table 12.16). At the FFC SPA, the mean annual population growth rate between 1969 and 2022 is approximately 4%. Based on this, an annual reduction of approximately 0.4% resulting from this scenario would be indistinguishable from natural fluctuations in the population. Natural England have previously stated that a maximum reduction in the growth rate of 0.4% would not cause an AEoI of the guillemot feature of the FFC SPA (Natural England, 2021b).

12.4.39 Furthermore, it should be noted that displacement assessments are based on several highly precautious elements, including:

- The use of mean peak estimates in the displacement assessment results in the unrealistically high estimates of seasonal abundance;
- PVA does not incorporate density dependence, resulting in over-precautionary model outputs; and
- The FFC SPA guillemot population is modelled as a closed population, with no emigration or immigration.

Table 12.16 PVA outputs for breeding adult guillemot at the Flamborough and Filey Coast SPA resulting from displacement impacts.

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Project alone				
50% displacement, 1% mortality	0.82	<0.001	1.000	1.000
70% displacement, 2% mortality	2.28	<0.001	1.000	0.999
In-combination				
50% displacement, 1% mortality	570.9	0.004	0.996	0.839

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
70% displacement, 2% mortality	1,598.6	0.011	0.988	0.611

12.4.40 As outlined above, results based on 50% displacement and 1% mortality are considered the most ecologically relevant, yet still sufficiently precautionary. Based on analysis of this scenario, it is considered that the target for the guillemot feature for the guillemot feature to 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 would still be met over the operational lifespan of VE. In addition, VE alone is considered to be making no material contribution to any existing impacts, with less than one guillemot mortality attributed to the FFC SPA. **Therefore, it is concluded there is no 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 VE in-combination and therefore, subject to natural change, guillemot will be maintained as a feature in the long term.**

RAZORBILL

12.4.41 Razorbill has been screened into the in-combination assessment of the O&M phase to assess the impacts from displacement from VE in-combination with other projects in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each qualifying feature.

12.4.42 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 61,346 breeding adults based on the most recent 2022 colony count.

12.4.43 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK waters in the North Sea and English Channel were screened in based on the potential for potential adverse effects on from activities taking place at these sites in combination with the O&M of VE. The VE array area, and several other projects are outside the mean max foraging range of razorbill from the FFC SPA (88.7 km), and also outside the mean max plus 1SD foraging distance (164.6 km) (Woodward *et al.*, 2019) and were consequently screened out for the breeding bio-season. Notably, razorbills range further outside of the breeding bio-season, and so consideration is given a greater number of OWFs within the wider UK North Sea and English Channel BDMPS area. Projects included within the in-combination assessment are presented in Table 12.17 below.

12.4.44 The total numbers presented in Table 12.17 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Deadline 8 Apportioning and HRA Updates Technical Note (Royal HaskoningDHV, 2023a). The following amendments were made to the values presented:

12.4.45 Inclusion of values from the Green Volt RIAA (Royal HaskoningDHV, 2023b), West of Orkney RIAA (Xodus & MacArthur Green 2023), Berwick Bank RIAA (RPS and Royal HaskoningDHV, 2022), Outer Dowsing draft RIAA (GoBe and SLR, 2023), North Falls RIAA (SSE Renewables and RWE, 2023), and Dogger Bank South PEIR (MacArthur Green 2023);

- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and
- Inclusion of values for VE.

12.4.46 As per evidence presented in Section 11.4 (detailed in Chapter 6, Part 5, Annex 4.15: Apportioning Note), a displacement rate of 50% and a mortality rate of 1% were deemed appropriate by the Applicant for the assessment of in-combination effects on razorbill. Based on advice from Natural England, a displacement range of between 50% to 70%, and a mortality range of between 1% and 2% is also presented in Table 12.18.

Table 12.17 In-combination displacement total for razorbill attributed to the FFC SPA.

Tier	OWF	Seasonal population at risk of displacement				
		Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Total
1	Beatrice	0.0	28.3	15.0	28.3	71.6
1	Beatrice Demonstrator	-	-	-	-	-
1	Blyth Demonstration Site	0.0	3.1	1.6	3.1	7.8
1	Dudgeon	0.0	11.8	20.1	11.8	43.7
1	East Anglia One	0.0	0.9	4.2	11.0	17.0
1	EOWDC	0.0	2.2	0.2	0.9	3.3
1	Galloper	0.0	1.5	2.8	13.4	17.7
1	Greater Gabbard	0.0	0.0	10.5	2.8	13.3
1	Gunfleet Sands	0.0	0.0	0.8	0.0	0.8
1	Hornsea Project One	534.5	163.6	41.0	61.3	800.4
1	Humber Gateway	0.0	0.7	0.4	0.7	1.8
1	Hywind	0.0	24.4	0.3	-	24.7
1	Kentish Flats Extension	-	-	-	-	0.0

Tier	OWF	Seasonal population at risk of displacement				
		Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Total
1	Kentish Flats I	-	-	-	-	0.0
1	Kincardine	0.0	0.0	0.0	0.0	0.0
1	Lincs, Lynn & Inner Dowsing	0.0	1.1	0.6	1.1	2.8
1	London Array	0.0	0.7	0.4	0.7	1.8
1	Methil	0.0	0.0	0.0	0.0	0.0
1	Race Bank	0.0	1.4	0.8	1.4	3.6
1	Rampion	0.0	2.2	33.6	113.1	148.9
1	Scroby Sands	-	-	-	-	0.0
1	Sheringham Shoal	0.0	45.7	5.7	1.0	52.4
1	Teesside	0.0	2.1	0.1	0.7	2.9
1	Thanet	0.0	0.0	0.4	0.7	1.1
1	Westermost Rough	91.0	4.1	4.1	3.1	102.3
1	Hornsea Project Two	1,210.0	143.5	19.4	56.7	1,429.6
1	Moray East	0.0	37.5	0.8	5.7	44.0

Tier	OWF	Seasonal population at risk of displacement				
		Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Total
1	Neart na Gaoithe	0.0	186.7	13.7	-	200.4
1	Triton Knoll	0.0	8.6	23.1	4.0	35.7
1	East Anglia Three	0.0	38.1	40.5	51.8	130.4
1	Firth of Forth Alpha	0.0	-	29.8	-	29.8
1	Firth of Forth Bravo	0.0	-	34.3	-	34.3
1	Dogger Bank A	375.0	53.6	46.7	141.1	616.4
1	Dogger Bank B	461.4	71.3	57.9	174.0	764.6
1	Dogger Bank C	250.2	10.6	25.9	65.2	351.9
1	Hornsea Three	0.0	69.0	99.0	72.0	240.0
1	Inch Cape	0.0	97.6	17.6	-	115.2
1	Moray West	0.0	120.5	5.0	121.9	247.4
1	Sofia	345.9	20.1	38.5	100.4	504.9
1	East Anglia ONE North	0.0	2.9	1.5	7.0	11.4
1	East Anglia TWO	0.0	1.5	3.7	7.8	13.0

Tier	OWF	Seasonal population at risk of displacement				
		Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Total
1	Norfolk Boreas	0.0	8.9	28.8	11.7	49.4
1	Norfolk Vanguard	0.0	29.5	22.7	31.4	83.6
2	DEP and SEP	86.0	153.0	41.0	16.0	296.0
2	Rampion 2	-	0.9	32.7	213.0	246.6
2	Hornsea Four	385.5	2,845.4	12.5	15.2	3,258.6
2	Greenvolt		2.0	2.0	2.0	5.9
2	Pentland	-	-	-	-	0.0
2	West of Orkney	-	4.9	4.9	4.9	14.6
2	Berwick Bank	-	299.1	37.8	252.8	589.6
2	Outer Dowsing (PEIR)	2,736.9	79.5	23.2	177.8	3,017.4
2	North Falls	-	9.0	69.0	63.0	141.0
2	Dogger bank south	3,028.6	41.8	37.5	291.6	3,399.5
2	VE	0.0	9.6	9.6	25.6	44.8
	All Projects Total	**9,505.0**	**4,638.8**	**921.6**	**2,167.6**	**17,233.9**

NON-BREEDING

12.4.47 The in-combination number of razorbill predicted to be displaced from the assessed OWFs, including VE, is 4,638 (4,638.8) in the post-breeding migration bio-season, 921 (921.6) in the migration-free winter bio-season, and 2,167 (2,167.6) in the return migration bio-season based on 50% displacement. The predicted consequent mortality as a result of displacement is 24 (23.19) individuals in the post-breeding migration bio-season, five (4.61) individuals in the migration-free winter bio-season, and 11 (10.84) individuals in the return migration bio-season. This equates to a total consequent mortality from displacement across the whole nonbreeding bio-season of 39 (38.64) individuals per annum.

12.4.48 Considering the potential impact of this loss to the FFC SPA, with a citation population of 21,140 breeding adults and an annual background mortality of 2,220 breeding adults per annum, the addition of 39 individuals would represent a 1.741% increase in baseline mortality, of which VE contributes an increase of less than one (0.22) breeding adult mortality, equating to an increase of 0.010% in baseline mortality.

12.4.49 As the razorbill population at the FFC SPA has increased significantly since the citation population count, the impact on the population is more reasonably assessed against the latest population count undertaken in 2022, which was 61,346 breeding adults. Considering the impact on the FFC SPA based on this population (with an annual background mortality of this number of adult birds being 6,441 breeding adults per annum), the addition of 39 individuals would represent a 0.600% increase in baseline mortality, of which VE contributes less than one breeding adult mortality, equating to an increase in baseline mortality of 0.003%.

Table 12.18 In-combination range-based displacement mortalities for razorbill based on the values advocated by Natural England for both citation population counts and more recent 2022 population counts.

FFC SPA Breeding	Abundance of adults apportioned to SPA (array area plus 2 km buffer)	30% Displacement, 1% Mortality	50% Displacement, 10% Mortality					70% Displacement, 10% Mortality		
		Estimated increase in mortality (breeding adults) per annum	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)	Estimated Mortality Rate (individuals)	Increase in baseline mortality citation (%)	Increase in baseline mortality recent (%)
Migration-free breeding	9,505.0	28.51	1.285	0.443	47.52	2.141	0.738	665.35	29.975	10.329
Post-breeding migration	4,638.8	13.92	0.627	0.216	23.19	1.045	0.360	324.72	14.629	5.041
Migration-free winter	921.6	2.76	0.125	0.043	4.61	0.208	0.072	64.51	2.906	1.002
Return migration	2,167.6	6.50	0.293	0.101	10.84	0.488	0.168	151.73	6.836	2.356
Total	**17,233.9**	**51.70**	**2.329**	**0.803**	**86.17**	**3.882**	**1.338**	**1,206.37**	**54.348**	**18.729**

Table 12.19 In-combination displacement matrix for adult razorbill attributed to the FFC SPA across all bio-seasons, with values in light green representing the range-based values and dark green representing the Applicant's approach value.

Displacement Rate (%) / Mortality Rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	17	34	86	172	345	517	689	862	1,034	1,206	1,379	1,551	1,723
20	34	69	172	345	689	1,034	1,379	1,723	2,068	2,413	2,757	3,102	3,447
30	52	103	259	517	1,034	1,551	2,068	2,585	3,102	3,619	4,136	4,653	5,170
40	69	138	345	689	1,379	2,068	2,757	3,447	4,136	4,826	5,515	6,204	6,894
50	86	172	431	862	1,723	2,585	3,447	4,309	5,170	6,032	6,894	7,755	8,617
60	103	207	517	1,034	2,068	3,102	4,136	5,170	6,204	7,238	8,272	9,306	10,340
70	121	241	603	1,206	2,413	3,619	4,826	6,032	7,238	8,445	9,651	10,857	12,064
80	138	276	689	1,379	2,757	4,136	5,515	6,894	8,272	9,651	11,030	12,408	13,787
90	155	310	776	1,551	3,102	4,653	6,204	7,755	9,306	10,857	12,408	13,960	15,511
100	172	345	862	1,723	3,447	5,170	6,894	8,617	10,340	12,064	13,787	15,511	17,234

12.4.50 The total in-combination number of razorbill mortalities as a consequence of displacement predicted from the OWFs assessed, including VE, is 86 (86.17) breeding adults per annum (Table 12.19). Based on the citation population count, the addition of 86 mortalities equates to a 3.882% increase in baseline mortality (VE alone contributes an increase of less than one (0.22) individual per annum, representing a 0.010% increase in baseline mortality). Based on the more recent 2022 population count for razorbill, the addition of 86 individuals equates to a 1.338% increase in baseline mortality.

12.4.51 It is concluded that predicted razorbill mortality due to displacement at VE would not adversely affect the integrity of the Flamborough and Filey Coast SPA, with impacts based on the most recent population count representing a <0.05% increase in baseline mortality. Additionally, considering the contribution from VE alone during only the non-breeding bio-season of <1 individual (representing an increase of just 0.005%) it is considered that VE is providing no material contribution to potential effects on the integrity of the Flamborough and Filey Coast SPA as a result of the project. However, considering the in-combination impact from other projects exceeds a 1% increase in baseline mortality, further assessment in the form of PVA has been undertaken.

12.4.52 PVA was undertaken on a range of scenarios for both VE alone and in-combination with other projects (as presented in Table 12.20). For each scenario, CGR and CPS have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period of 40 years relative to a baseline scenario. The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2022 FFC count).

12.4.53 At the FFC SPA, the mean annual population growth rate between 1969 and 2022 is approximately 6%. Though it is not possible to predict how this growth rate will change over the 40-year lifetime of VE, the current population growth rate suggests that the colony is expected to continue increasing in size, even when considering all scenarios presented in Table 12.20.

12.4.54 The worst-case scenario of 70% displacement and 2% mortality would result in an annual reduction in population growth rate of 0.46%, which would not cause the current annual rate of 6% to be reversed into a decline. Notably, this scenario is considered highly precautionary, and not representative of actual impacts expected as a result of VE in-combination with other projects. This was also supported in advice given by Natural England to Norfolk Boreas at Deadline 4 (Natural England 2020):

'While there is some empirical evidence to support the displacement levels for auks we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of razorbill density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from less good areas

would be lower than displacement from optimal/important areas. Therefore, we do not expect mortality rates to be at the top of the range considered.'

12.4.55 This advice is also considered relevant for VE, with many of the same sites screened in for both projects being the same, with birds present in the VE array also expected to be utilising the same habitats. Consequently, the results from 70% displacement and 10% mortality are not considered ecologically justified, with the Applicant's approach of 50% displacement and 1% mortality forming the main basis of the Project assessment.

12.4.56 As presented in Table 12.20, the CGR and CPS for VE in-combination based on 50% displacement and 1% mortality are 0.998 and 0.934 respectively (Table 12.20). At the FFC SPA, the mean annual population growth rate between 1969 and 2022 is approximately 6%. Based on this, an annual reduction of roughly 0.2% resulting from this scenario would be indistinguishable from natural fluctuations in the population. Additionally, Natural England have previously stated that a maximum reduction in the growth rate of 0.5% would not cause an AEoI of the razorbill feature of the FFC SPA (Natural England, 2021b), though with the annual population growth rate over the last 50 years being approximately 6%, it is highly likely that even a higher reduction in population growth rate would not lead to a reduction in the population.

12.4.57 Furthermore, it should be noted that displacement assessments are based on several highly precautious elements, including:

- The use of mean peak estimates in the displacement assessment results in the unrealistically high estimates of seasonal abundance;
- PVA does not incorporate density dependence, resulting in over-precautionary mode outputs; and
- The FFC SPA razorbill population is modelled as a closed population, with no emigration or immigration.

Table 12.20 PVA outputs for breeding adult razorbills at the Flamborough and Filey Coast SPA resulting from displacement impacts.

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Project alone				
50% displacement, 1% mortality	0.22	<0.001	1.000	1.000
70% displacement, 2% mortality	0.63	<0.001	1.000	0.999
In-combination				
50% displacement, 1% mortality	86.17	0.001	0.998	0.934
70% displacement, 2% mortality	241.20	0.003	0.995	0.826

12.4.58 Based on the evidence presented above, results based on 50% displacement and 1% mortality are considered the most relevant, while still sufficiently precautionary. Based on analysis of this scenario, it is considered that the target for the razorbill feature to 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 would still be met for over the operational lifespan of VE. In addition, VE alone is making no material contribution to any existing impacts, with less than one guillemot mortality attributed to the FFC SPA. **Therefore, it is concluded there is no potential for an AEoI to the conservation the conservation objectives of the razorbill feature of FFC SPA in relation to disturbance and displacement effects in the O&M phase from VE in-combination and therefore, subject to natural change, razorbill will be maintained as a feature in the long term.**

COLLISION RISK

12.4.59 When birds fly through the offshore wind farms (e.g. while foraging, commuting or on migration), there is potential risk for collision with turbine rotor blades and other infrastructure, resulting in injury or fatality, which may result in an AEoI in-combination with VE relating to the following designated sites and the relevant features as presented in Table 12.21

- Flamborough and Filey Coast SPA; gannet and kittiwake; and
- Alde-Ore Estuary SPA and Ramsar; lesser black-backed gull.

12.4.60 The sites and relevant interest features were screened in for LSE for the project 'alone' and the attribution of the predicted collision mortality. With the project 'alone' collision mortality and attribution having been completed the assessment of potential in-combination impacts can be carried out on a quantitative basis.

Table 12.21 Summary of sites and features for collision assessment during O&M phases for VE in-combination.

Site	Feature	Considered in-combination
Alde-Ore Estuary SPA and Ramsar	Lesser black-backed gull	Yes
Flamborough and Filey Coast SPA	Gannet	Yes
	Kittiwake	Yes

FLAMBOROUGH AND FILEY COAST SPA - COLLISION

GANNET

12.4.61 Gannets were screened into the in-combination assessment for the O&M phase to assess the impacts from displacement from VE in-combination with other projects in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

12.4.62 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 mean count is 30,466 adults based on the 2023 count (Butcher *et al*., 2023).

12.4.63 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK waters in the North Sea and English Channel were screened in based on the potential for adverse effects the integrity of the gannet feature of the FFC SPA on from activities taking place in combination with the O&M of VE (Table 12.22). The VE array area, and several other projects are within the mean max foraging range of gannet from the FFC SPA (315.2 km), and also within the mean max plus 1SD foraging distance (509.4 km) (Woodward *et al*., 2019) and were consequently screened in for the breeding bio-season. Notably, gannets range further outside of the breeding bio-season, and so consideration is also given to other OWFs within the wider UK North Sea and English Channel BDMPS area. Projects included within the in-combination assessment are presented in Table 12.26 below.

12.4.64 During the breeding bio-season the potential impacts on gannets from the FFC SPA due to collision are highly likely to be attributed more highly to OWFs within areas of sea within foraging distance from this breeding colony. To assess the potential in-combination impacts on gannet across multiple OWFs, information was compiled on the seasonal abundance of gannets at each OWF site plus a 2 km buffer within foraging range. Seasonal gannet abundances were then attributed to the FFC SPA.

12.4.65 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. 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 return migration and post-breeding migration bio-seasons were estimated to be 7.19% and 5.44%, respectively, which was agreed as appropriate by Natural England during the Norfolk Boreas examination (Natural England, 2020) and for this project through the evidence plan process.

12.4.66 The total numbers presented are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Deadline 8 Apportioning and HRA Updates Technical Note (Royal HaskoningDHV, 2023a). The majority of these values have been updated to reflect the updated avoidance rate of 99.2% and 70% macro-avoidance, as agreed by Natural England for SEP and DEP (Planning Inspectorate Document Reference: EN010109) exception of Lynn and Inner Dowsing and Methil where the avoidance rate used was now known, and therefore no adjustment was made. The following amendments were made to the values presented:

- Inclusion of values from the Green Volt RIAA (Royal HaskoningDHV, 2023b), West of Orkney RIAA (Xodus & MacArthur Green 2023), Berwick Bank RIAA (RPS and Royal HaskoningDHV, 2022), Outer Dowsing draft RIAA (GoBe and SLR, 2023),

North Falls RIAA (SSE Renewables and RWE, 2023), and Dogger Bank South PEIR (MacArthur Green 2023);

- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and
- Inclusion of values for VE.

12.4.67 Collision mortalities taken from Green Volt, West of Orkney and Berwick Bank are based on old avoidance rates (98.9%) and do not incorporate macro-avoidance. Therefore these values were adjusted accordingly by dividing the existing CRM values by (1-0.989) and multiplying by (1-0.992) to update to the 99.2% avoidance rate advocated for in the most recent Natural England guidance (Natural England, 2022), then multiplying by (1-0.7) to apply the 70% macro-avoidance.

Table 12.22 In-combination collision total for gannet attributed to the FFC SPA.

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Beatrice demo	0.0	0.0	0.0	0.0
1	Beatrice	0.0	0.5	0.1	0.6
1	Blyth Demonstration Site	0.0	0.0	0.0	0.1
1	Dudgeon	4.9	0.4	0.3	5.5
1	East Anglia One	0.7	1.4	0.1	2.2
1	EOWDC	0.0	0.1	0.0	0.1
1	Galloper	0.0	0.3	0.2	0.5
1	Greater Gabbard	0.0	0.1	0.1	0.2
1	Gunfleet Sands	-	-	-	0.0
1	Hornsea Project One	2.5	0.3	0.3	3.1
1	Humber Gateway	0.4	0.0	0.0	0.4
1	Kentish Flats	0.0	0.0	0.0	0.0
1	Kentish Flats Extension	-	-	-	0.0

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Kincardine	0.0	0.0	0.0	0.0
1	Lincs	0.5	0.0	0.0	0.5
1	Lynn & Inner Dowsing	0.1	0.0	0.0	0.1
1	London Array	0.0	0.0	0.0	0.0
1	Methil	0.0	0.0	0.0	0.0
1	Race Bank	7.4	0.1	0.1	7.5
1	Rampion	0.0	0.7	0.0	0.7
1	Scroby Sands	-	-	-	0.0
1	Sheringham Shoal	3.1	0.0	0.0	3.1
1	Teesside	0.5	0.0	0.0	0.5
1	Thanet	0.0	0.0	0.0	0.0
1	Westermost Rough	0.0	0.0	0.0	0.0
1	Hornsea Project Two	1.5	0.1	0.1	1.7
1	Moray East	0.0	0.4	0.1	0.5

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Neart na Gaoithe	0.0	0.5	0.3	0.8
1	Triton Knoll	5.8	0.7	0.4	6.9
1	Firth of Forth Alpha and Bravo	0.0	0.5	0.9	1.4
1	Dogger Bank A & B	8.9	0.9	0.7	10.5
1	Dogger Bank C & Sofia	1.6	0.1	0.1	1.9
1	East Anglia Three	1.3	0.3	0.1	1.8
1	Hornsea Three	1.3	0.0	0.0	1.5
1	Inch Cape	0.0	0.3	0.1	0.4
1	Moray West	0.0	0.0	0.0	0.0
1	East Anglia ONE North	2.7	0.1	0.0	2.8
1	East Anglia TWO	2.7	0.2	0.0	3.0
1	Hornsea Four	3.1	0.1	0.0	3.2
1	Norfolk Boreas	3.1	0.1	0.1	3.3
1	Norfolk Vanguard	1.8	0.2	0.1	2.1

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
2	DEP and SEP	0.3	0.0	0.0	0.3
2	Rampion 2	0.0	0.0	0.0	0.1
2	Greenvolt	0.1	0.0	0.0	0.1
2	Pentland	-	-	-	0.0
2	West of Orkney	-	0.1	0.1	0.2
2	Berwick Bank	0.4	0.1	0.0	0.5
2	Outer Dowsing (PEIR)	1.4	0.0	0.0	1.5
2	North Falls	0.7	0.1	0.1	0.9
2	Dogger Bank South	1.6	0.2	0.0	1.7
2	**VE**	1.4	0.1	0.0	1.5
	All Projects Total (NE approach to apportioning)	59.8	9.0	4.5	73.9

BREEDING

12.4.68 The in-combination number of gannets from FFC SPA predicted to be subject to collision resultant mortality from the assessed OWFs, including VE, is 60 (59.78) breeding adult birds in the breeding bio-season (based on the VE approach to apportioning).

12.4.69 Considering the potential impact of this loss to the FFC SPA, with a population of 16,938 breeding adults and annual background mortality of 1,372 breeding adults per annum, the addition of 60 individuals suffering collision consequent mortality would represent a 4.357% increase in baseline mortality, of which VE contributes one (1.37) individual, representing a 0.092% increase in baseline mortality.

12.4.70 Considering the more recent 2023 gannet population count at the FFC SPA of 30,466 breeding adults and an annual background mortality of 2,468 breeding adults per annum, the addition of 60 breeding adults suffering collision consequent mortality would represent a 2.400% increase in baseline mortality, of which VE contributes one (1.37) individuals, representing a 0.051% increase in baseline mortality.

NON-BREEDING

12.4.71 The in-combination number of gannets from FFC SPA predicted to be subject to collision resultant mortality from the assessed OWFs, including VE, is nine (8.98) individuals in the post-breeding migration bio-season, and four (4.49) individuals in the migration-free winter bio-season. This equates to a total collision consequent mortality across the whole nonbreeding bio-season of 13 (13.48) individuals per annum.

12.4.72 Considering the potential impact of this loss to the FFC SPA, with a citation population of 16,938 breeding adults and annual background mortality of 1,372 breeding adults per annum, the addition of 13 breeding adults suffering collision consequent mortality would represent a 0.980% increase in baseline mortality, of which VE contributes less than one (0.14) individuals, representing a 0.009% increase in baseline mortality.

12.4.73 Considering the more recent 2023 gannet population count at the FFC SPA of 30,466 breeding adults and an annual background mortality of 2,468 breeding adults per annum, the addition of 13 breeding adults suffering collision consequent mortality would represent a 0.621% increase in baseline mortality, of which VE contributes less than one (0.14) individual, representing a 0.006% increase in baseline mortality.

ANNUAL TOTAL

12.4.74 The total in-combination number of gannet mortalities resulting from collisions from the OWFs assessed, including VE, is 74 (73.86) breeding adults per annum. Based on the citation population count, the addition of 74 mortalities equates to a 5.383% increase in baseline mortality (VE alone contributes an increase of two (1.51) individual per annum, representing a 0.100% increase in baseline mortality). Based on the more recent 2023 population count for gannet, the addition of 74 individuals equates to a 3.404% increase in baseline mortality (VE alone contributes an increase of two (1.51) individual per annum, representing a 0.06% increase in baseline mortality).

12.4.75 Regardless of contributions from other projects, the contribution from VE alone across all bio-seasons equates to <1 individual (representing an increase in baseline mortality of <0.1% based on both the citation and more recent 2023 population counts), and therefore it is considered that VE is not making any material contribution to any existing impact. However, considering the in-combination impact from other projects exceeds a 1% increase in baseline mortality, further assessment in the form of PVA has been undertaken.

COMBINED COLLISION AND DISPLACEMENT IMPACTS

12.4.76 When considering combined collision and displacement impacts, the annual total number of mortalities is predicted 146 (145.66) breeding adults based on the Applicants approach (70% displacement, 1% mortality). The full range of potential impacts are presented in Table 12.23 below.

Table 12.23 Combined in-combination collision and displacement impacts for gannet at the FFC SPA.

Impact	Project alone mortalities (annual total)	In-combination mortalities (annual total)
Collision impact	1.51	73.86
Displacement impact (60% displacement, 1% mortality	1.09	61.60
Displacement impact (70% displacement, 1% mortality	1.27	71.80
Displacement impact (80% displacement, 1% mortality	1.45	82.10
Combined collision and displacement impact (70% displacement, 1% mortality)	**2.78**	**145.66**

12.4.77 Based on the citation population count, the addition of 146 mortalities equates to a 10.619% increase in baseline mortality (VE alone contributes an increase of three (2.78) individuals per annum, representing a 0.185% increase in baseline mortality). Based on the more recent 2023 population count for gannet, the addition of 146 individuals equates to a 5.904% increase in baseline mortality (VE alone contributes an increase of two (2.78) individuals per annum, representing a 0.107% increase in baseline mortality).

12.4.78 Though it is considered that VE is not providing any material contribution to existing impacts on gannets at the FFC SPA (VE contributes less than three (2.78) individuals), further analysis in the form of PVA has been carried out as a precautionary approach.

12.4.79 PVA was undertaken on a range of scenarios as presented in Table 12.25. For each scenario, CGR and CPS have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period of 40 years relative to a baseline scenario. The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2023 FFC count).

12.4.80 Between 1960 and 2023, the FFC gannet population has grown from 9 to 15,233 pairs. Mean annual percentage population growth rates are presented in Table 12.24 below.

Table 12.24 Mean annual percentage population growth rates of gannet at the FFC SPA.

Year	FFC SPA colony count (AON)	Mean annual % population growth rate since previous count
1960	9	-
1969	21	8.7%
1987	780	22.2%
1999	2,552	11.2%
2008	6,386	11.0%
2017	13,392	8.6%
2022	13,125	0.5%
2023	15,233	16.1%

12.4.81 When considering the worst-case scenario of 80% displacement and 1% mortality, the annual reduction in population growth rate is predicted as 0.6%. Based on the annual population growth rates presented in Table 12.24, this reduction is expected to be indistinguishable from natural fluctuations in the population, especially when considering the most recent population count which represented a 16.1% increase compared with 2022 levels. This is particularly notable considering that multiple operational OWFs are operational within the North Sea, yet the FFC population has still shown one of the largest annual percentage increases since colony creation.

12.4.82 The scenario which is considered the most ecologically justified, which used a 70% displacement and 1% mortality rate and the VE approach to apportioning resulted in a CGR and CGS of 0.997 and 0.892 respectively. This represents a 0.3% reduction in annual growth rate which, based on values presented in Table 12.25, is similarly expected to be indistinguishable from natural fluctuations in the population. Natural England responses to the Norfolk Boreas Project stated that they believe the annual growth rate of the FFC SPA is "likely to do better than a 1.3% annual growth rate in the foreseeable future" (Natural England, 2020), and based on trends presented above it is expected that trends may greatly exceed this.

12.4.83 Consequently, it is concluded that the conservation objective of the gannet feature of the FFC SPA (maintain the size of the breeding population at a level which is above 8,469 pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent), would still be met over the operational lifespan of VE, and therefore **an AEoI from combined collision and displacement mortalities in-combination can be ruled out.**

Table 12.25 PVA outputs for breeding adult gannets at the Flamborough and Filey Coast SPA incorporating combined collision and displacement impacts.

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Project alone				
70% displacement, 1% mortality	1.9	<0.001	1.000	0.997
In-combination				
70% displacement, 1% mortality	144.2	0.005	0.997	0.892

KITTIWAKE

12.4.84 Kittiwakes were screened into the in-combination assessment for the O&M phase to assess the impacts from collision from VE in-combination with other projects in relation to the following conservation objectives for this species, as a feature of the FFC SPA:

- Maintain the population of each of the qualifying features.

12.4.85 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 89,040 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

12.4.86 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK wasters in the North Sea and English Channel were screened in based on the potential for potential adverse effects on from activities taking place at these sites in combination with the O&M of VE. The VE array area, and several other projects are within the mean max foraging range of kittiwake from the FFC SPA (156.1 km), and also within the mean max plus 1SD foraging distance (300.6 km) (Woodward *et al*., 2019) and were consequently screened based on assessments for the breeding bio-season. Kittiwake from FFC SPA were screened out of this assessment during the breeding bio-season because site-specific tracking studies provide no evidence that kittiwake from FFC SPA forage as far south as the VE array site. Since kittiwakes range further outside of the breeding bio-season, and so consideration is also given to other OWFs within the wider UK North Sea and English Channel BDMPS area. Projects included within the in-combination assessment are presented in Table 12.26 below.

12.4.87 The total numbers presented in Table 12.26 are derived from in-combination tables presented for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Deadline 8 Apportioning and HRA Updates Technical Note (Royal HaskoningDHV, 2023a). The majority of these values have been updated to reflect the updated avoidance rate of 99.2%, with the exception of Kentish Flats Extension and Methil where the avoidance rate used was not known, and therefore no adjustment was made.

12.4.88 Numbers presented by Sheringham Shoal and Dudgeon Extension Projects exclude projects where kittiwake impacts have been compensated for as they are no longer considered relevant to the in-combination assessment. This approach is also adopted by VE, though compensated impacts are included to present as a separate scenario. Projects where impacts have been compensated for include Hornsea Three, Norfolk Boreas, Norfolk Vanguard, East Anglia One North, East Anglia TWO and Hornsea Four. Numbers for Hornsea Four are already provided by the Sheringham Shoal and Dudgeon Extension Projects, though for the other projects numbers were taken from the East Anglia TWO and East Anglia ONE North Windfarms Deadline 13 In-combination and In-combination Collision Risk and Displacement Update RIAA (MacArthur Green and Royal HaskoningDHV, 2021). Notably Hornsea Four kittiwake impacts have also been compensated for and are not considered relevant to the in-combination assessment, though adjusted values are presented by Sheringham Shoal and Dudgeon extension projects for this project which are also included in the separate scenario. The following amendments were made to the values presented:

- Inclusion of values from the Green Volt RIAA (Royal HaskoningDHV, 2023b), West of Orkney RIAA (Xodus & MacArthur Green 2023), Berwick Bank RIAA (RPS and Royal HaskoningDHV, 2022), Outer Dowsing draft RIAA (GoBe and SLR, 2023), North Falls RIAA (SSE Renewables and RWE, 2023), and Dogger Bank South PEIR (MacArthur Green 2023);
- Impacts from the following projects were included in-combination as a precautionary measure due to uncertainties of compensation outcomes. The projects included that are bound by their DCOs to provide compensation are the following: Hornsea Three, Norfolk Boreas, Norfolk Vanguard, East Anglia One North, East Anglia TWO and Hornsea Four;
- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and

- Inclusion of values for VE.

12.4.89 Collision mortalities taken from Green Volt, West of Orkney and Berwick Bank are based on old avoidance rates (98.9%). Therefore, these values were adjusted accordingly by dividing the existing CRM values by (1-0.989) and multiplying by (1-0.992) to update to the 99.2% avoidance rate, as agreed by Natural England for SEP and DEP (Planning Inspectorate Document Reference: EN010109), advocated for in the most recent Natural England guidance (Natural England, 2022). This adjustment was also made to the values from Hornsea Three, East Anglia ONE North, East Anglia TWO, Norfolk Boreas and Norfolk Vanguard (i.e., compensated impacts), as this adjustment is not presented in the Deadline 13 Cumulative and In-combination Collision Risk and Displacement Update RIAA (MacArthur Green and Royal HaskoningDHV, 2021).

Table 12.26 In-combination collision total for kittiwake attributed to the FFC SPA.

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Beatrice	0.0	0.4	2.1	2.5
1	Beatrice demo		-	-	0.0
1	Blyth Demonstration Site	0.0	0.1	0.1	0.1
1	Dudgeon		-	-	0.0
1	East Anglia One	0.0	6.3	2.5	8.7
1	EOWDC	0.0	0.2	0.1	0.3
1	Galloper	0.0	1.1	1.7	2.8
1	Greater Gabbard	0.0	0.6	0.6	1.2
1	Gunfleet Sands		-	-	0.0
1	Hornsea Project One	26.5	2.2	1.1	29.8
1	Humber Gateway	1.4	0.1	0.1	1.6
1	Kentish Flats	0.0	0.1	0.1	0.1
1	Kentish Flats Extension	0.0	0.0	0.2	0.2
1	Kincardine	0.0	0.4	0.1	0.4
1	Lincs	0.5	0.1	0.1	0.6
1	Lynn & Inner Dowsing	-	-	-	0.0
1	London Array	0.0	0.1	0.1	0.2
1	Methil	0.0	0.0	0.0	0.0

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Race Bank	1.4	0.9	0.3	2.6
1	Rampion	0.0	1.5	1.5	3.1
1	Scroby Sands		-	-	0.0
1	Sheringham Shoal		-	-	0.0
1	Teesside	0.0	0.9	0.1	1.1
1	Thanet	0.0	0.0	0.0	0.1
1	Westermost Rough	0.1	0.0	0.0	0.1
1	Hornsea Project Two	9.7	0.4	0.1	10.2
1	Moray East	0.0	0.1	1.0	1.1
1	Neart na Gaoithe	0.0	2.2	0.2	2.5
1	Firth of Forth Alpha and Bravo	0.0	12.3	12.9	25.2
1	East Anglia Three	0.0	2.7	2.0	4.7
1	Dogger Bank A & B	40.6	5.3	15.5	61.3
1	Dogger Bank C & Sofia	19.2	3.6	11.3	34.1
1	Hornsea Three*	72	2	1	75.0
1	Inch Cape	0.0	8.8	3.3	12.1

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
1	Moray West	0.0	0.9	0.4	1.3
1	East Anglia ONE North*	0	0.43	0.25	0.7
1	East Anglia TWO*	0	0.3	0.5	0.8
1	Norfolk Boreas*	11.4	1.7	0.9	14.0
1	Norfolk Vanguard*	18.7	0.9	1.4	21.0
1	Hornsea Four*	51.2	0.5	0.2	52.0
2	DEP and SEP	6.1	0.2	0.1	6.4
2	Berwick Bank	0.4	7.1	10.0	17.4
2	Pentland floating	-	-	-	0.0
2	Greenvolt	-	0.2	0.1	0.4
2	West of Orkney	-	2.0	2.5	4.5
2	Rampion 2	0.0	0.1	0.4	0.4
2	Outer Dowsing	12.5	1.0	3.6	17.1
2	North Falls	6.3	0.5	1.0	7.8

Tier	OWF	Collisions attributed to FFC SPA			
		Migration-free breeding	Post-breeding migration (autumn)	Return migration (spring)	Total
2	Dogger Bank South	91.7	2.7	2.2	96.7
2	VE	0.0	0.4	0.4	0.8
All Projects Total (excluding compensated project)		**234.2**	**71.1**	**80.4**	**385.3**
All Projects Total (including compensated project)		**387.5**	**76.9**	**84.6**	**548.8**

NON-BREEDING

12.4.90 The in-combination number of kittiwakes from FFC SPA predicted to be subject to collision resultant mortality from the assessed OWFs, including VE, is 77 (76.9) breeding adults in the post-breeding migration bio-season, and 85 (84.6) breeding adults in the return migration bio-season. The equates to a total collision consequent mortality across the whole nonbreeding bio-season of 162 (161.5) breeding adults per annum.

12.4.91 Considering the potential impact of this loss to the FFC SPA, with a citation population of 89,040 breeding adults and annual background mortality of 13,000 breeding adults per annum, the addition of 162 breeding adults suffering collision consequent mortality would represent a 1.243% increase in baseline mortality, of which VE contributes 1 (0.82) individual, representing a 0.006% increase in baseline mortality.

12.4.92 Considering the more recent 2022 kittiwake population count at the FFC SPA of 89,148 breeding adults and an annual background mortality of 13,016 breeding adults per annum, the addition of 162 breeding adults suffering collision consequent mortality would represent a 1.241% increase in baseline mortality, of which VE contributes one (0.82) individual, representing a 0.006% increase in baseline mortality.

ANNUAL TOTAL

12.4.93 The total in-combination number of kittiwake collision consequent mortalities predicted from the OWFs assessed, including VE, is 549 (548.8) breeding adults per annum. Based on the citation population count, the addition of 549 mortalities equates to a 4.221% increase in baseline mortality, of which VE contributes 1 (0.82) individual, representing a 0.006% increase in baseline mortality. Based on the more recent 2022 population count for kittiwake, the addition of 549 individuals equates to a 4.216% increase in baseline mortality, of which VE contributes one (0.82) individual, representing a 0.006% increase in baseline mortality.

12.4.94 The SoS has concluded an AEoI at FFC SPA due to collision mortality for a number of consented projects within the Southern North Sea, therefore PVA has been undertaken to predict the potential impacts on the population over a range of scenarios for both VE alone and in-combination with other projects (as presented in Table 12.27). For each scenario, the counterfactual of population growth (CGR) and counterfactual of population size (CPS) have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period relative to a baseline scenario (up until an operation year of 2070). The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2022 FFC count).

12.4.95 The FFC kittiwake population has shown varying population trends, increasing from 17,600 pairs in 1952 to 85,395 pairs in 1979, with the population then declining to the current level of 44,574 pairs in 2022. However, it should be noted that the peak count of 85,395 pairs in 1979 is widely disputed (e.g., Coulson 2011 and 2017; McArthur Green 2015), with recorders at the time considered to have recorded the number of individuals birds present as opposed to breeding birds, inflating the recorded population count to double what it should be. Taking this into consideration, the population decrease would be significantly less than recorded between 1979 and current counts. More recent trends, display an increase of roughly 2% per annum between 2000 and 2017, despite multiple OWFs being operational in the North Sea, though it is also acknowledged the population has shown a decline of 13% between 2017 and 2022.

Table 12.27 PVA outputs for breeding adult kittiwakes at the Flamborough and Filey Coast SPA incorporating combined collision and displacement impacts.

PVA Scenario, format	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Project alone	0.8	<0.000	1.000	1.000
Project in-combination (including compensated projects)	548.8	0.006	0.993	0.740

12.4.96 The worst case in-combination results of the PVA analysis (including compensated projects) have a CGS of 0.993 and CPS of 0.740. Considering the variable population trends at the FFC SPA, an annual reduction in population growth of 0.6% is not expected to be distinguishable from natural fluctuations, and impacts from OWFs are expected to be minimal compared to other ongoing pressures (e.g., sandeel availability). Additionally, the contribution from VE alone across all bio-seasons equates to 1 (0.82) individual (representing an increase of just 0.006% in baseline mortality), this level of additional impact would be undetectable within the wider context of natural fluctuations in the population, and is thus not of sufficient magnitude to make a material contribution to natural mortality rates. **Consequently, VE considers it reasonable to conclude no AEoI of FFC SPA in terms of collision risk to kittiwake.**

ALDE-ORE ESTUARY SPA AND RAMSAR - COLLISION

LESSER BLACK-BACKED GULL

12.4.97 Lesser black-backed gulls were screened into the in-combination assessment for the O&M phase to assess the impacts from collision from VE in-combination with other projects in relation to the following relevant conservation objectives for this species, as a feature of the Alde-Ore SPA:

- Maintain the population of each of the qualifying features.

12.4.98 Based on the above the conservation objective for the Alde-Ore 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):

- Restore the size of the breeding population to a level which is above 14,070 pairs whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

12.4.99 For the in-combination assessment, a range of proposed, consented, under-construction and operational OWFs in UK waters in the North Sea and English Channel were screened in based on potential adverse effects on lesser black-backed gull from activities taking place at these sites in combination with the O&M of VE. The VE array area, and several other projects are within the mean-maximum foraging range of lesser black-backed gull from the Alde-Ore SPA (141 km), and also within the maximum recorded foraging distance (181 km) (Woodward *et al*., 2019) and were consequently screened based on assessments. Notably, based on tracking studies of lesser black-backed gull (e.g. Thaxter *et al*., 2015), it is considered unlikely that individuals from this SPA will have any considerable overlap with VE. However, a precautionary approach was undertaken for the breeding bio-season, with wind farms within 141 km of the Alde-Ore SPA considered on the grounds that only these wind farms have the potential to contribute to mortality on the SPA population at this time of year. Consequently, projects included for assessment in the breeding bio-season include Greater Gabbard, Gunfleet Sands, Kentish Flats, Kentish Flats Extension, London Array, Scroby Sands, Sheringham Shoal, Thanet, Thanet Extension, Dudgeon, Dudgeon Extension Project, East Anglia ONE, East Anglia ONE North, East Anglia TWO, Galloper, East Anglia THREE, Norfolk Vanguard, and Norfolk Boreas. For the non-breeding bio-season, consideration was also given to other OWFs within the wider UK North Sea and English Channel BDMPS area. The projects included within the in-combination assessment are presented in Table 12.28 below.

12.4.100 The total numbers presented in Table 12.28 are derived from in-combination tables presented for the East Anglia ONE North and East Anglia TWO RIAAs (MacArthur Green and Royal Haskoning DHV, 2021). The following amendments were made to the values presented:

- Inclusion of values from the SEP & DEP RIAA (Equinor, 2022);
- Inclusion of values from the Rampion 2 RIAA (GoBe, 2023);
- Inclusion of values from the Outer Dowsing draft RIAA (GoBe and SLR, 2023);
- The removal of values for the Thanet Extension project following the SoS decision to withhold consent for this project;
- Removal of Beatrice Demonstrator as the project will be decommissioned by the time VE is predicted to be operational; and
- Inclusion of values for VE.

12.4.101 Notably, lesser black-backed gulls migrating through the VE site will originate from a large geographic area, though it is only possible to apportion mortality to the Alde-Ore SPA population on the basis of its size relative to the wider lesser black-backed gull population. Across all age classes the Alde-Ore Estuary SPA represents approximately 3.3% of the BDMPS autumn population, about 3.3% of the BDMPS spring population and a maximum of 5% of the BDMPS winter population. For many wind farms there is insufficient information to determine in which months non-breeding bio-season collisions occur. Therefore, on the basis of the whole period a weighted Alde-Ore Estuary SPA percentage of 4% has been calculated (5 months at 3.3% and 4 months at 5%).

12.4.102 As outlined in Section 11.4, two approaches are presented for impacts from VE; a VE approach, which incorporates Furness (2015) adult proportions and sabbatical rates, and a NE approach which incorporates site specific data and no sabbaticals). The VE approach is considered more ecologically relevant and will form the main basis of the assessment, however results based on both approaches are presented.

12.4.103 For the purpose of the in-combination assessment, the collisions across the non-breeding bio-seasons for lesser black-backed gull were pooled into one non-breeding bio-season.

Table 12.28 In-combination collision total for lesser black-backed gull attributed to the Alde-Ore SPA.

Tier	OWF	Breeding bio-season collisions apportioned to the Alde-Ore SPA from sites within 141 km	Non-breeding apportioned to the Alde-Ore SPA (based on 4% apportioning)	Total Apportioned to the SPA
1	Beatrice	-	-	-
1	Blyth Demonstration Site	-	0.0	0.0
1	East Anglia One	2.8	0.5	3.3
1	EOWDC	-	-	-
1	Galloper	23.1	1.7	24.8
1	Greater Gabbard	10.3	0.8	11.1
1	Gunfleet Sands	0.4	0.0	0.4
1	Dudgeon	1.5	0.4	1.9
1	Hornsea Project One	-	0.3	0.3
1	Humber Gateway	-	0.0	0.0
1	Hywind	-	0.0	0.0
1	Hywind 2 Demonstration	-	-	-
1	Kentish Flats	0.1	0.1	0.2
1	Kentish Flats Extension	0.1	0.0	0.1

Tier	OWF	Breeding bio-season collisions apportioned to the Alde-Ore SPA from sites within 141 km	Non-breeding apportioned to the Alde-Ore SPA (based on 4% apportioning)	Total Apportioned to the SPA
1	Kincardine	-	-	0.0
1	Lincs	-	0.1	0.1
1	Lynn & Inner Dowsing	-	-	-
1	London Array	-	-	-
1	Methil	-	0.0	0.0
1	Race Bank	-	0.2	0.2
1	Rampion	-	0.1	0.1
1	Scroby Sands	-	-	-
1	Sheringham Shoal	0.3	0.1	0.4
1	Teesside	-	0	0
1	Thanet	1.8	0.2	2.0
1	Westermost Rough		0	0
1	Hornsea Project Two	-	0	0
1	Moray East	-	-	-

Tier	OWF	Breeding bio-season collisions apportioned to the Alde-Ore SPA from sites within 141 km	Non-breeding apportioned to the Alde-Ore SPA (based on 4% apportioning)	Total Apportioned to the SPA
1	Neart na Gaoithe	-	0	0
1	Seagreen Alpha & Bravo	-	0.1	0.1
1	Triton Knoll	-	0.5	0.5
1	Firth of Forth Alpha and Bravo	-	0.3	0.3
1	East Anglia Three	0.6	0.1	0.7
1	Dogger Bank A & B	-	0.2	0.2
1	Dogger Bank C & Sofia	-	0.1	0.1
1	Hornsea Three	-	0	0
1	Inch Cape	-	0	0
1	Moray West	-	0	0
1	East Anglia ONE North	0.3	0	0.3
1	East Anglia TWO	2.1	0	2.1
1	Norfolk Boreas	1.7	0.1	1.8
1	Norfolk Vanguard	1.8	0.1	1.9

Tier	OWF	Breeding bio-season collisions apportioned to the Alde-Ore SPA from sites within 141 km	Non-breeding apportioned to the Alde-Ore SPA (based on 4% apportioning)	Total Apportioned to the SPA
1	Hornsea Four	-	-	-
1	Sheringham Shoal and Dudgeon Extension Projects	0.3	0	0.3
2	Thanet Extension	-	-	-
2	Rampion 2	0	0.0	0.0
2	Green Volt	-	0.0	0.0
2	Pentland	-	0.0	0.0
2	West of Orkney	-	0.0	0.0
2	Berwick Bank	-	0.0	0.0
2	Outer Dowsing	0.4	0.0	0.4
2	North Falls Offshore Wind Farm	3.1	0.0	3.1
2	Dogger Bank South	-	-	-
3	Dogger Bank D	-	-	-
2	VE (VE approach)	**5.5**	**0.2**	**5.7**
2	VE (NE approach)	**11.1**	**0.2**	**11.3**

Tier OWF	Breeding bio-season collisions apportioned to the Alde-Ore SPA from sites within 141 km	Non-breeding apportioned to the Alde-Ore SPA (based on 4% apportioning)	Total Apportioned to the SPA
All Projects Total (VE approach)	56.2	5.9	62.1
All Projects Total (NE approach)	61.8	5.9	67.7

BREEDING

12.4.104 The resultant in-combination collision mortality of lesser black-backed gulls during the breeding season was determined from all OWFs projects within 141 km of Alde-Ore Estuary SPA (i.e. projects in bold in Table 12.29, including VE). The number of bird mortalities apportioned to the SPA was predicted to be 57 (56.2) breeding adults (based on the VE approach to apportioning).

12.4.105 Considering the potential impact of this loss to the Alde-Ore SPA, with a citation population of 28,140 breeding adults and annual background mortality of 3,236 breeding adults per annum, the addition of 57 breeding adults suffering collision consequent mortality would represent a 1.736% increase in baseline mortality, of which VE contributes five (5.48) individuals, representing a 0.169% increase in baseline mortality.

12.4.106 Considering the more recent 2022/23 lesser black-backed gull population count at the Alde-Ore SPA of 3,498 breeding adults and an annual background mortality of 402 breeding adults per annum, the addition of 57 breeding adults suffering collision consequent mortality would represent a 13.975% increase in baseline mortality, of which VE contributes five (5.48) individuals, representing a 1.361% increase in baseline mortality.

NON-BREEDING

12.4.107 The resultant in-combination collision mortality of lesser black-backed gulls from all OWFs (applying the weighted apportioning percentage of 4% as discussed in Section 11.4 and outlined in Chapter 6, Part 5, Annex 4.15: Apportioning Note), attributed to Alde-Ore Estuary SPA is 15 (15.10) breeding adults.

12.4.108 Considering the potential impact of this loss to the Alde-Ore SPA, with a citation population of 28,140 breeding adults and annual background mortality of 3,236 breeding adults per annum, the addition of six breeding adults suffering collision consequent mortality would represent a 0.183% increase in baseline mortality, of which VE contributes less than one (0.22) individual, representing a 0.007% increase in baseline mortality.

12.4.109 Considering the more recent 2022/23 lesser black-backed gull population count at the Alde-Ore SPA of 3,498 breeding adults and an annual background mortality of 402 breeding adults per annum, the addition of six breeding adults suffering collision consequent mortality would represent a 1.473% increase in baseline mortality, of which VE contributes less than one (0.22) individual, representing a 0.055% increase in baseline mortality.

ANNUAL TOTAL

12.4.110 The total in-combination number of lesser black-backed gulls from the Alde-Ore SPA predicted to be subject to collision resultant mortality from the assessed OWFs, including VE, is 62 (62.1) breeding adults.

12.4.111 Considering the potential impact of this loss to the Alde-Ore SPA, with a citation population of 28,140 breeding adults and annual background mortality of 3,236 breeding adults per annum, the addition of 62 breeding adults suffering collision consequent mortality would represent a 1.919% increase in baseline mortality, of which VE contributes five (5.70) individuals, representing a 0.176% increase in baseline mortality.

12.4.112 Considering the more recent 2022/23 lesser black-backed gull population count at the Alde-Ore SPA of 3,498 breeding adults and an annual background mortality of 402 breeding adults per annum, the addition of 62 breeding adults suffering collision mortality would represent a 15.448% increase in baseline mortality, of which VE contributes five (5.70) individuals, representing a 1.417% increase in baseline mortality. Impacts based on the NE approach to apportioning (sites-specific adult proportions, excluding sabbaticals in the breeding population) are presented in Table.

Table 12.29 Lesser black-backed gull collision impacts at the Alde Ore Estuary SPA based on VE and NE apportioning approaches.

Approach	Annual mortalities	% Increase in baseline mortality (citation count)	% Increase in baseline mortality (recent 2022 count)
VE approach to apportioning	62.1	1.919	15.448
NE approach to apportioning	67.7	2.092	16.841

12.4.113 As the predicted impacts exceed a 1% increase in baseline mortality, further analysis in the form of PVA has been undertaken. PVA was undertaken on a range of scenarios for both the VE alone and in-combination with other projects (as presented in Table 12.30). For each scenario, CGR and CPS have been presented from the model outputs, measuring the changes in annual growth rate and population size respectively at the end of the impacted period of 40 years relative to a baseline scenario. The impact on adult survival is also presented, calculated as the number of mortalities divided by the relevant population size used in the PVA analysis (in this case, the 2022/23 Alde-Ore Estuary SPA count).

Table 12.30 PVA outputs for breeding adult lesser black-backed gulls at the Alde Ore Estuary SPA from collision impacts.

PVA Scenario	Annual mortality	Impact on adult survival	Median CGR	Median CPS
Alone (VE approach)	5.70	0.002	0.998	0.927
In-combo (VE approach)	62.10	0.018	0.980	0.433
Alone (NE approach)	11.31	0.003	0.996	0.86
In-combo (NE approach)	67.70	0.019	0.978	0.401

12.4.114 At the Alde-Ore Estuary SPA, the population of lesser black-backed gulls has experienced substantial declines over the last 25 years (Figure 12.2) with the population declining from a peak-mean population of 14,070 pairs between 1994-1997 to approximately 1,750 pairs at the recent 2022 count. This has been largely driven by fox predation, flooding and poor habitat quality.

12.4.115 The CGS and CPS for the in-combination impacts, incorporating updated avoidance rates, are 0.979 and 0.433 respectively (based on the VE approach to apportioning), and 0.978 and 0.401 based on the NE approach to apportioning. This represents a 2.1% and 2.2% reduction in annual population growth rate (based on the VE and NE approaches respectively). **Taking into account the ongoing declines at this population, the potential for an AEoI on the conservation objectives for lesser black-backed gull at the Alde Ore Estuary SPA cannot be ruled out.**

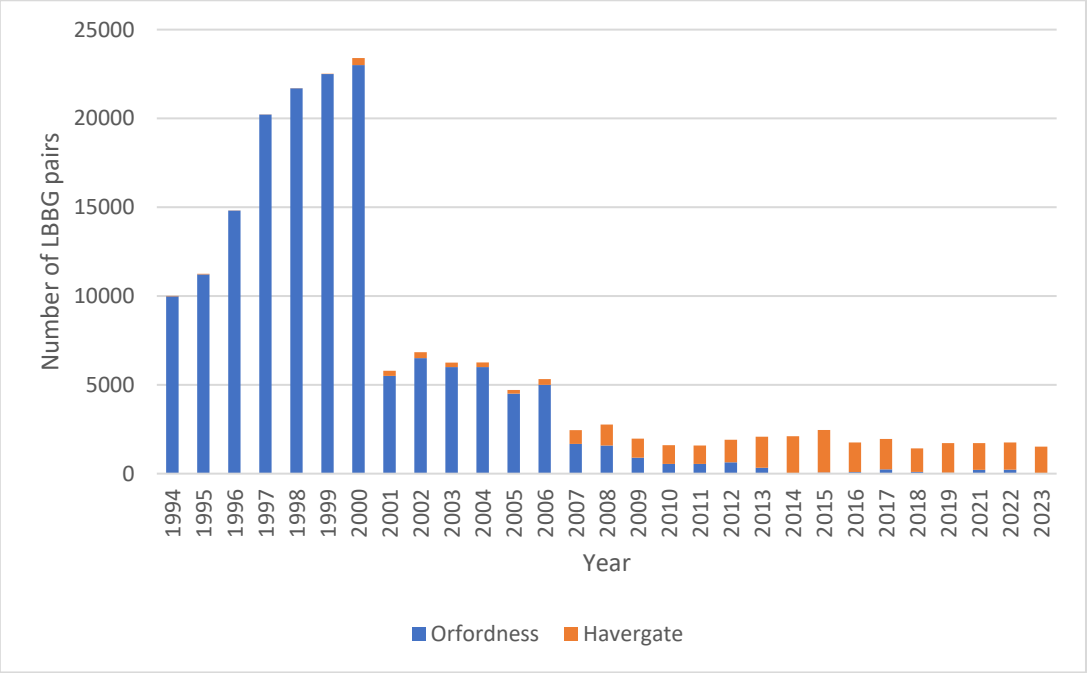


Figure 12.2 Historical breeding population trends of lesser black-backed gull at the AOE SPA.

12.4.116 Previous applications within the southern North Sea (including Norfolk Vanguard, Norfolk Boreas, East Anglia ONE North and East Anglia TWO) have been granted consent subject to compensation measures for lesser black-backed gull at the Alde-Ore Estuary. Given that AEoI cannot be ruled out, the Applicant has prepared a derogation case [Volume5, Report 5] and is proposing compensation measures. The proposed compensation would be secured through the DCO with the final details to be approved by the Secretary of State. The compensation measures would be delivered a minimum of 3 years before operation of any turbines to allow them to become established for any impact occurs.?

EXISTING HEADROOM

12.4.117 The impacts taken into consideration within the in-combination assessment of the RIAA are from the current consented scenarios. However, the majority of operational projects within the southern North Sea are not built out to their maximum consented potential (e.g. Dudgeon OWF, Galloper OWF, Race Bank, Sheringham OWF and Triton Knoll OWF) and as such, the impacts presented within the in-combination assessment are considerably higher than the realised impacts.

12.4.118 Galloper OWF has not been built out to its full consented capacity, leading to a difference between some consented parameters (such as number of turbines and total rotor swept area) and the as built parameters. Whilst an assessment using the as-built scenario would provide the most realistic outputs, the consent allowing further build out is still in place. There remains a theoretical possibility of additional turbines being added to the design of existing OWFs.

12.4.119 The consent for Galloper OWF required approval from the Secretary of State for the maximum number of wind turbines to be constructed to be given before the development is commenced. That approval was issued in November 2015 and provided that the maximum number of turbines which could be constructed is 84. There is accordingly a reliable level of certainty that further turbines (over 84) cannot be constructed as they are not approved and the operation of the development has now commenced.

12.4.120 Galloper OWF, is therefore limited to 84 turbines (and has only built 56 of those). Consequently, for collision risk species the predicted impacts from this project will be at least 40% lower than the impacts presented within this in-combination assessment. In addition, the footprint of the windfarm has reduced substantially, decreasing the projects impact on species vulnerable to displacement. Given the impacts, apportioned to Alde Ore Estuary, from Galloper OWF are predicted to be 22.4 lesser black backed gull and 2.8 kittiwake, the headroom released by reducing these impacts by 40% (i.e. 8.6 lesser black backed gull and 1.1 kittiwake) exceeds the full contribution from VE alone to these SPAs.

12.4.121 The above considerations would reduce or remove the risk of an AEoI RIAA conclusion (in-combination) for these species and their respective sites, if the VE impacts are considered with Galloper OWF.

12.4.122 On this basis, it is reasonable to assume that HRA derogation is not necessary for kittiwake and guillemot features of the FFC SPA. However, in the case of lesser black-backed gull a potential reduction of 22.4 birds from the in-combination total would not alter the conclusions of the assessment, and therefore an adverse effect on site integrity cannot be discounted at AOE SPA and Ramsar. Consequently, a full derogation case is being progressed for this species.

12.4.123 It would be considered reasonable to factor in available 'headroom' (as discussed above) in determining a 'more realistic' extent of identified effects and consequently the quantum of any necessary compensation. If all available headroom from existing projects were to be released it would allow a determination of a 'more realistic' extent of identified effects.

12.5 MIGRATORY FISH

12.5.1 The potential for LSE in-combination from VE with regard to migratory fish is summarised with the Stage Two (AA) in-combination assessment presented below.

12.5.2 Information to inform the AA alone for migratory fish is provided in Section 11.5, which assesses only one site and one feature (twaite shad of Vlaamse Banken SAC) with the potential to be affected by impacts associated with underwater noise during construction and decommissioning of VE. Based on this, the potential for LSE in-combination during construction and decommissioning has only been identified for the following feature and impacts:

- Twaite shad:
  - In-combination effects from underwater noise (mortality or mortal injury, recoverable injury and TTS/behavioural changes).

12.5.3 As described in Section 11.5.35, no information on the conservation status or conservation targets for the Vlaamse Banken SAC features have been sourced. Therefore, as a proxy the conservation objective for twaite shad at Severn Estuary SAC has been applied for the AA alone. The same approach is taken for the AA in-combination; however, the conservation objectives are not repeated here.

12.5.4 The AA in-combination for migratory fish will be determined based on the following:

12.5.5 OWFs where there is potential for any phase of such projects to have temporal or spatial overlap with that of VE.

12.5.6 Information on the AA in-combination assessment for migratory fish draws on the potential for combined effects as addressed in Section 6.13 of ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology. In this, each project has been considered on the basis of effect-receptor pathway, data confidence and the temporal and spatial scales involved, which is supported by the cumulative effect assessment technical note, Volume 6, Part 1, Annex 3.1: Cumulative Effects Assessment Methodology. This screened in a number of projects as presented in Table 9.5. For clarity, a screening range of 100 km was applied around the VE array areas to encapsulate projects (both planned and operational) with potential in-combination impacts from underwater noise, including that of VE. The tiering structure discussed in Section 12 was used for the assessment.

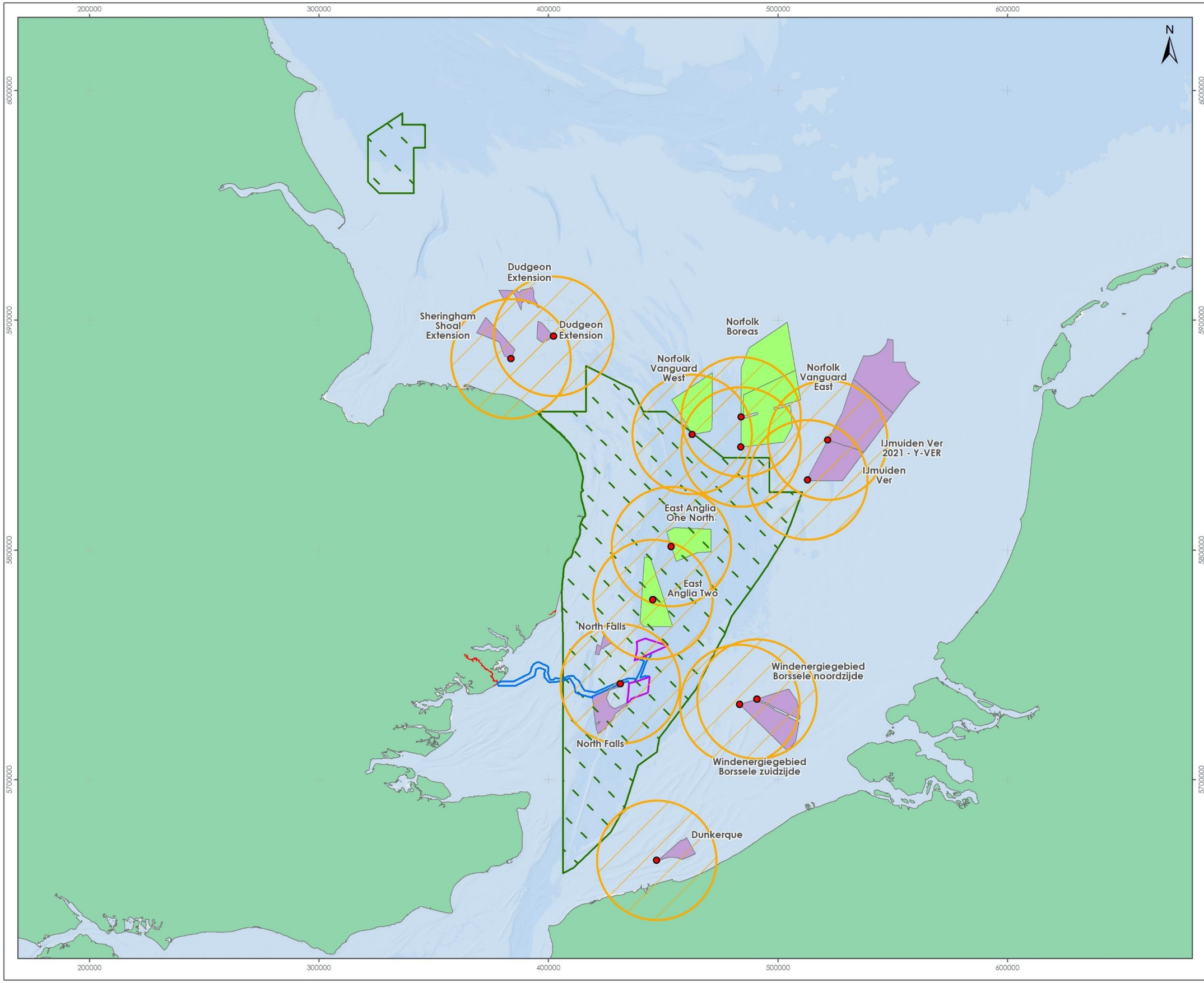
12.5.7 Where possible for each project, information on the expected impacts on twaite shad of Vlaamse Banken SAC from underwater noise have been collated and used to inform the AA in-combination presented below.

12.5.8 It should be noted that the in-combination noise assessment has been based on information and assessments, where available, as presented in the respective Environmental Statements. Construction timescales are indicative and subject to change.

CONSTRUCTION AND DECOMMISSIONING

IN-COMBINATION ASSESSMENT OF IMPACTS ASSOCIATED WITH UNDERWATER NOISE ON TWAITE SHAD

12.5.9 According to ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology, assessing underwater noise in-combination impacts on twaite shad within 100 km of VE is considered a precautionary buffer upon which to include projects within the area. However, if in-combination impacts on twaite shad were to occur, the activities presenting the highest risk are pile driving activities during the construction phase of some OWF. Specifically, these are the construction of East Anglia ONE North OWF, North Falls OWF and IJmuiden Ver OWF and decommissioning of Scroby Sands OWF. To this effect, it is considered that activities at aggregate sites, disposal sites and telecommunication cables do not have the potential to contribute sufficient levels of underwater noise to warrant their inclusion in the in-combination underwater noise assessment. The location of the projects included in the in-combination assessment are presented in Figure 12.3.



LEGEND

- Array Areas
- Offshore Export Cable Corridor
- Onshore Order Limits
- Southern North Sea SAC (Winter Area)
- Worst Case Modelling Points
- Worst Case 26km Buffer from relevant OWFs

OWFs within 26km of SNS SAC (Status)

- Consented
- In Planning

0 10 20 40
Kilometers

Data Source:
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

PROJECT TITLE:

FIVE ESTUARIES OFFSHORE WINDFARM

DRAWING TITLE:
EDRs for In-combination Projects that Overlap with the Winter Area of the Southern North Sea SAC

VER	DATE	REMARKS	Drawn	Checked
1	26/01/2024	For Issue	BPHB	BJ

DRAWING NUMBER: 12.2

SCALE:	PLOT SIZE:	DATUM:	PROJECTION:
1:1,500,000	A3	WGS84	UTM31N

FIVE ESTUARIES
OFFSHORE WIND FARM

12.5.10 The East Anglia ONE North OWF HRA Screening Report[27] concludes that there is no potential for LSE on twaite shad either alone or in-combination and that transboundary impacts on fish would be scoped out; therefore, it is considered that there is no potential for in-combination impacts in association with VE and East Anglia ONE North OWF and this project is not considered further.

12.5.11 The North Falls OWF is at the scoping stage whereby no application has been submitted, and the Environmental Statement for the IJmuiden Ver OWF is not publicly available. Therefore, for both of these projects since no information is available on their expected impacts on twaite shad it is assumed that project parameters regarding underwater noise from piling would be similar to those for VE. Based on this assumption, it is expected that although there is the potential for underwater noise impacts to cause LSE, the AAs alone would conclude no AEoI from impacts associated with underwater noise on twaite shad for both projects.

12.5.12 The Scroby Sands OWF Environmental Statement concluded no detrimental effects on fish receptors from all phases of the project (PowerGen Renewables Offshore Ltd, 2001), and additionally the decommissioning phase for Scoby Sands (2031-2035) is not considered to overlap with the construction phase of VE and therefore there is no potential for LSE in-combination.

12.5.13 It is considered that in-combination risks of mortal or recoverable injury or mortality of twaite shad from piling noise would not be expected to occur as a result of VE and these projects either due to the small range within which potential injury effects would be expected (i.e., predicted to occur within tens to hundreds of meters of piling activity- for VE mortal injury is <100 m for both the spatial and temporal MDS, while for recoverable injury this raises to 700 m for the spatial MDS). Given that the distances between the OWF projects are larger than the injury impact ranges from piling, there is no temporal or spatial overlap of injurious impacts. In addition, due to the small impact ranges for injurious impacts, it is reasonable to conclude that very low numbers of twaite shad associated with Vlaamse Banken SAC will be exposed to the impact anyway, even 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 maintenance of the twaite shad population.

12.5.14 With regard to the in-combination behavioural effects associated with underwater noise as a result of North Falls OWF, IJmuiden Ver OWF and VE, the assessment considers the temporal and spatial MDS during all phases of the projects. In addition, the decommissioning of Scroby Sands OWF is considered.

12.5.15 As with the AA alone for twaite shad, the AA in-combination assessment of whether TTS onset and behavioural changes could cause an AEoI on Vlaamse Banken SAC focuses on whether in-combination impacts could compromise the maintenance of the size of the site-specific twaite shad population.

[27] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-001000-5.3.1%20EA1N%20Information%20to%20Support%20AA%20Report%20Appendix%201%20HRA%20Screening%20Report.pdf

12.5.16 The Scroby Sands OWF Environmental Statement concluded no detrimental effects on fish receptors from all phases of the project (PowerGen Renewables Offshore Ltd, 2001); therefore, it is considered that there is no potential for in-combination impacts in association with VE and Scroby Sands OWF and this project is not considered further.

12.5.17 There is currently limited detail on the North Falls OWF and the IJmuiden Ver OWF, therefore it is not possible to undertake detailed in-combination assessments of behavioural effects on twaite shad. However, Table 6.2 in ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; calculates indicative maximum durations for piling for these projects based on the likely similarity with VE parameters.

12.5.18 This approach identified that in-combination underwater noise (behavioural) impacts are predicted to be of regional spatial extent and medium-term duration (i.e. cumulatively over approximately seven years). However, in reality, projects may not overlap temporally with the construction period of VE. Given this, the intermittent nature of piling and the ability of fish to recover from TTS and disturbance impacts, ES Volume 6, Part 2, Chapter 6: Fish and Shellfish Ecology; considers that it is unlikely that there will be a significant in-combination effects on fish receptors caused by temporal overlap between the relevant projects.

12.5.19 This is because while the predicted behavioural response may be sufficient to result in temporary avoidance of these areas by some species, with some temporary redistribution of fish in the wider area between the affected areas, between piling events, fish may resume normal behaviour and distribution, as evidenced by work of McCauley *et al*. (2000). This showed that fish returned to normal behavioural patterns within 14 to 30 minutes after the cessation of seismic airgun firing. However, there are some uncertainties over the response of fish to intermittent piling over a prolonged period and the extent that behavioural reactions will cause a negative effect in individuals.

12.5.20 As explained above, it is assumed that effects on a designated site generally reduce with increasing distance from an impact source. Therefore, it is reasonable to conclude that very low numbers of twaite shad associated with Vlaamse Banken SAC will be exposed to TTS or behavioural change impacts. Therefore, effects from these impacts are not expected to manifest at levels that could compromise the maintenance of the twaite shad population.

12.5.21 **There is, therefore, no potential for an AEoI of the twaite shad feature of Vlaamse Banken SAC in relation to mortality, mortal injury, TTS or behavioural changes directly associated with underwater noise from VE in-combination with other plans or projects. Therefore, subject to natural change, the feature will be maintained in the long term.**

12.6 ONSHORE ECOLOGY

12.6.1 NSIP projects that could have an effect on the same designated sites identified for VE are considered within the in-combination assessment.

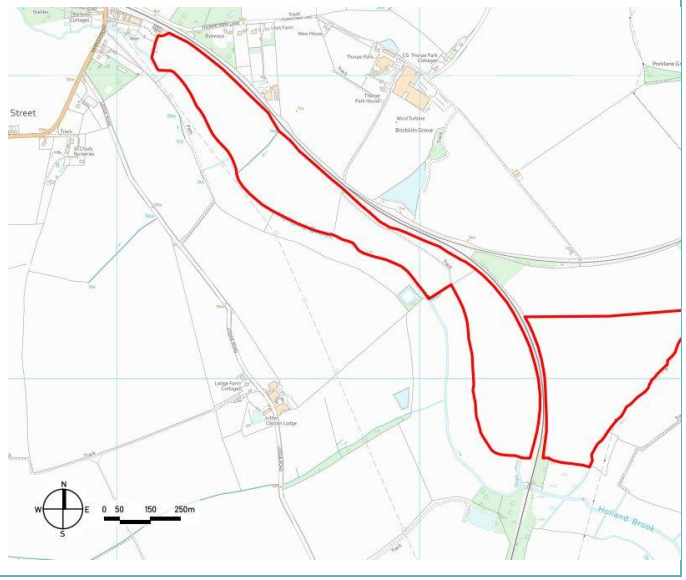
12.6.2 From the HRA screening report, the potentially relevant NSIP projects that have been identified are:

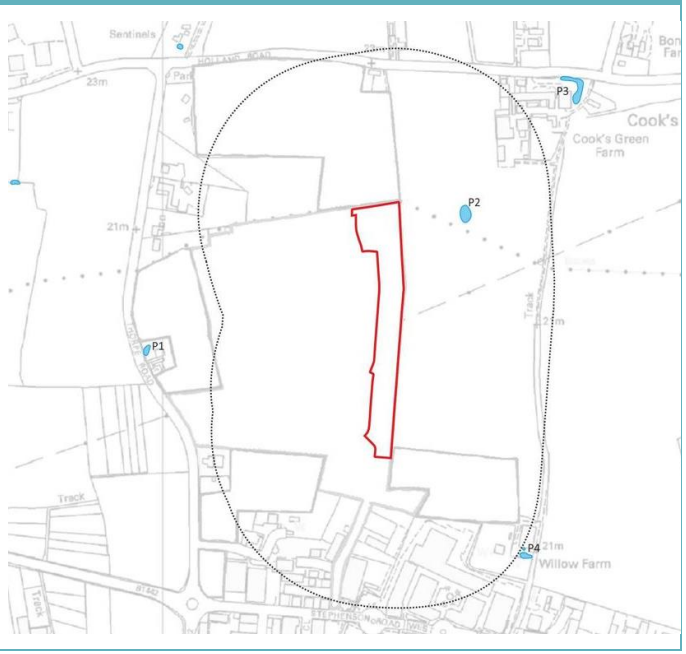
- North Falls OWF
- Tarchon interconnector

- Bradwell B new nuclear power station;
- Tendring/Colchester Borders Garden Community;
- Rivenhall IWMF and Energy Centre;
- Bramford to Twinstead Electrical Line;
- Sea Link Electrical Line Suffolk to Kent;
- A12 Chelmsford to A120 Widening Scheme;
- Improvements to the A120 to Harwich and
- Harwich Freeport.
- East Anglia Green Energy Enablement (Green) project (EAG) (new high voltage network reinforcement between Norwich, Bramford and Tilbury).
- Non NSIP projects considered in the in-combination assessment are detailed within Table 12.31.

Table 12.31 Non-NSIP applications considered within the onshore in combination assessment.

Code	Development type	Project	Status	Detail	Site boundary
1	Mixed use development	22/00979/DETAIL	Awaiting decision (24 Jun 2022)	The site is located to the north of Weeley, approximately 1.8 km west from the ECC. Mixed use development including 280 homes, offices, land for a new primary school, railway footbridge, attenuation basins, open space, play equipment and associated infrastructure.	

Code	Development type	Project	Status	Detail	Site boundary
2	Energy	22/02117/FUL/ 23/00008/REFUSE	Refused, appeal lodged against refusal	The site is located within and to the west of the ECC on land between the rail line branches to Clacton-on-Sea and Frinton-on-Sea. Proposed Solar Energy Scheme	

Code	Development type	Project	Status	Detail	Site boundary
3	Residential	20/00179/FUL	Approved (18 Jan 2022)	The site is located to the East of Little Clacton on Thorpe Road, approximately 1.9 km south-west of the ECC. 50 residential dwellings.	

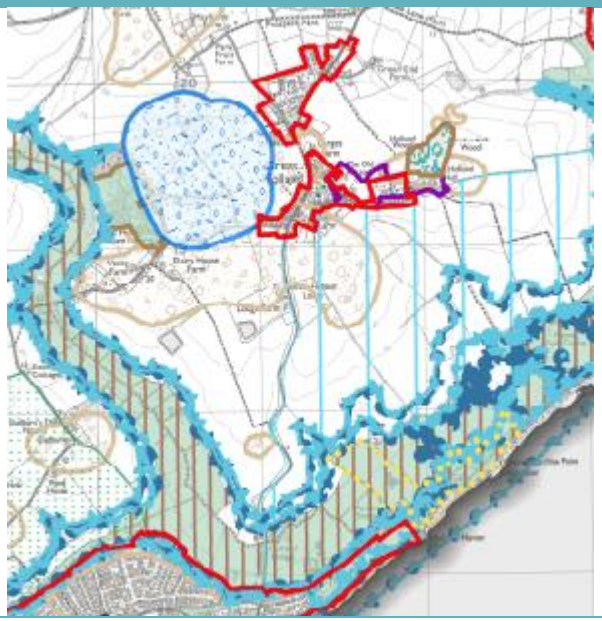
Code	Development type	Project	Status	Detail	Site boundary
4	Residential	17/01988/FUL	Approved (11 Jun 2019)	The site is located on the B1032 in Kings Cross approximately 1.7 km to the south-east of the ECC. Residential development providing 41 dwellings for over 55s including apartments and houses; parking and landscaping.	
5	Solar Farm	202695 (Colchester City Council)	Approved	Solar farm development 400m from Abberton Reservoir SPA	

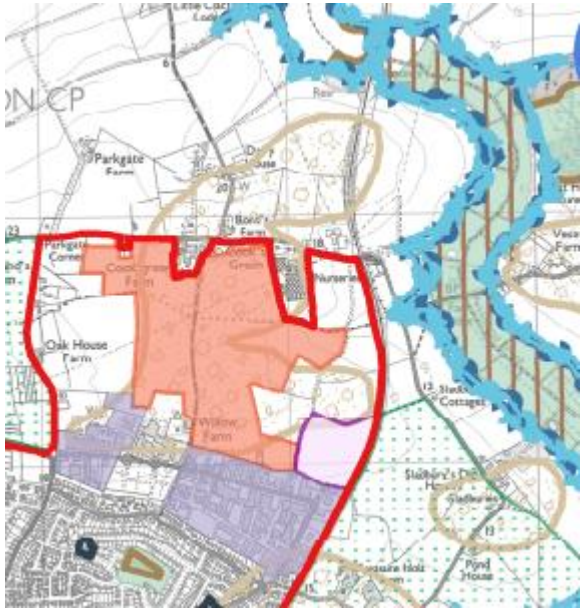
12.6.3 Local plans of the following nearby locations were reviewed to assess potential of allocations being 'major developments' for the in-combination assessment:

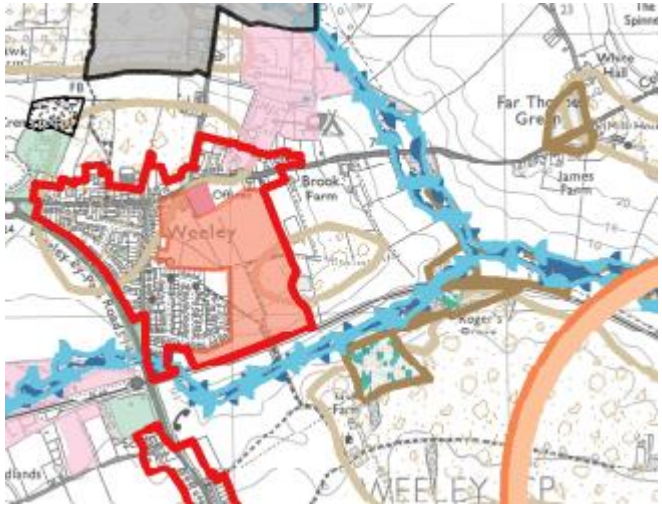
- Tendring
- Colchester
- Maldon
- Babergh
- Suffolk Coast

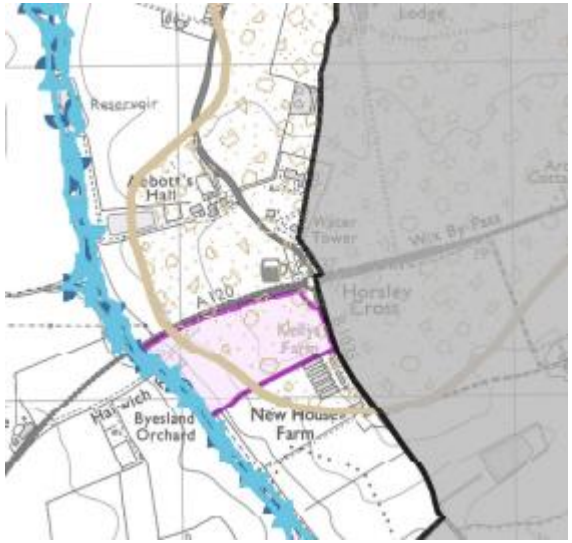
12.6.4 Details of the allocations identified are provided in Table 12.32.

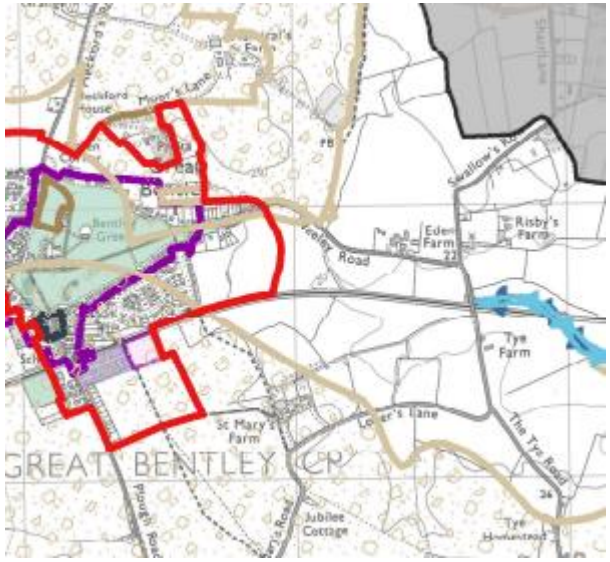
Table 12.32 Review of local plans and allocations of 'major development' size for inclusion in in combination assessment.

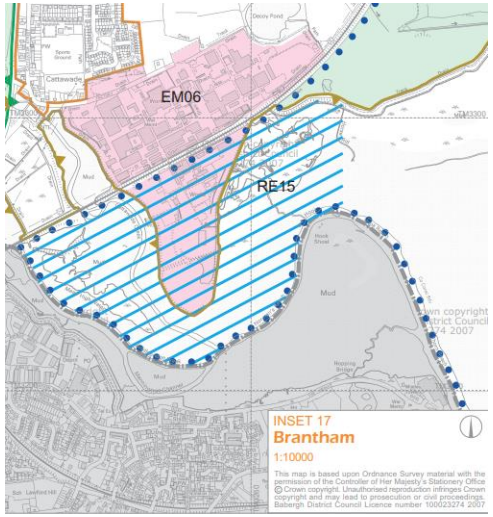
Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
6	Tendring-SE	Mining	Hamford Water SPA/Ramsar/SAC (3.1)	0.3	

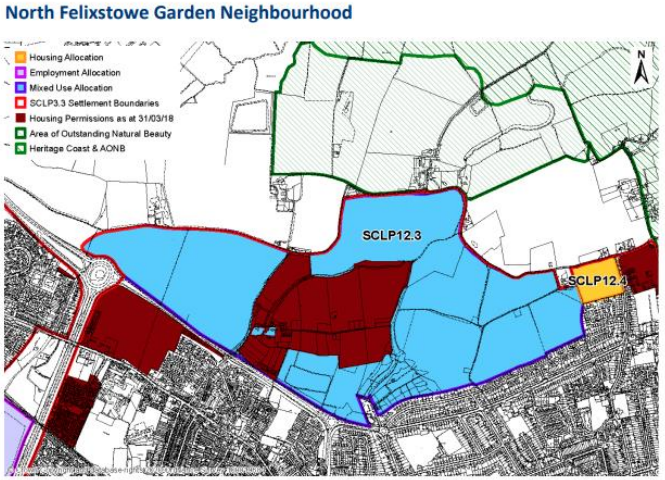
Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
7	Tendring-SE	Mixed-Use Allocations Employment Allocation	6.6 Colne Estuary (Mid-Essex Coast Phase 2) Ramsar site /SPA	1.3	

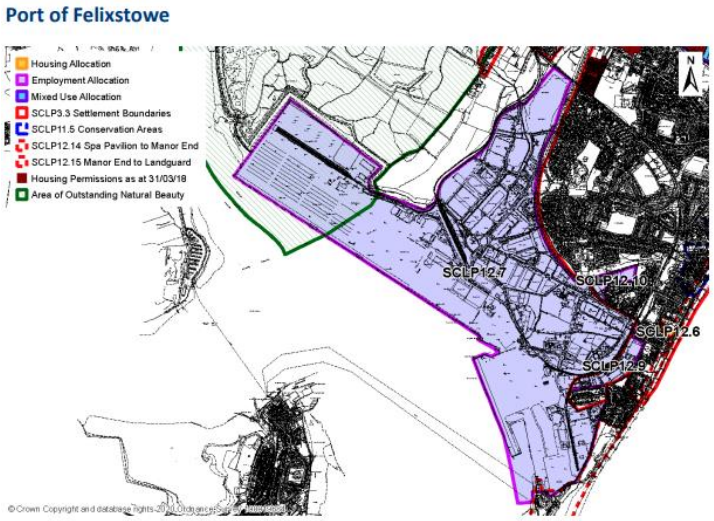
Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
8	Tendring-SE	Mixed Use Allocation	4.26 Hamford Water SPA/ Ramsar/ SAC	2.00	

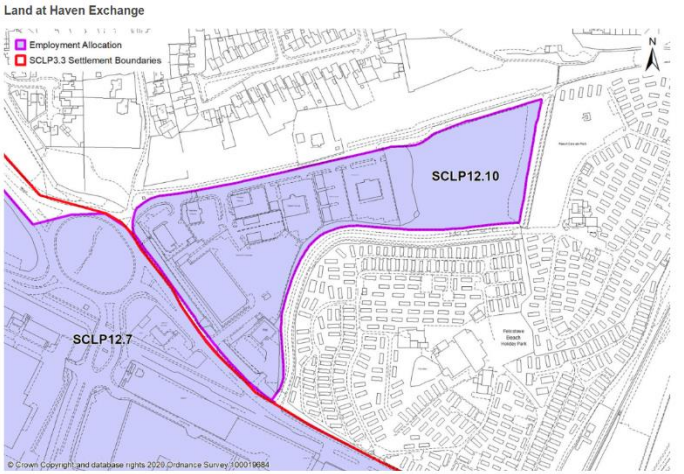
Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
9	Tendring-W	Employment Allocation	4.11 Stour and Orwell Estuaries SPA/ Ramsar	0	

Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
10	Tendring-W	Employment Allocation	2.95 Colne Estuary (Mid-Essex Coast Phase 2) Ramsar/ SPA; Essex Estuaries SAC	5.0	

Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
11	Babergh	Existing Employment Allocation	0 - Stour and Orwell Estuaries SPA/ Ramsar	3.79	

Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
12	East Suffolk Local plan	Mixed housing and employment	3.8 -Stour and Orwell SPA/ Ramsar site	17	

Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
13	East Suffolk Local plan	Employment allocation	Adjacent to the Stour and Orwell SPA/ Ramsar site	12	

Reference	Local plan	Allocation type/ details	Location (nearest designated site distance) (km)	Approx. distance from onshore Order Limits (km)	Screen shot of allocation
14	East Suffolk	Employment	3.2 - Stour and Orwell SPA/ Ramsar site	14	

CONSTRUCTION AND DECOMISSIONING

12.6.5 The potential for an AEoI in-combination as a result of undermining the conservation objectives of identified designated sites onshore during construction and decommissioning relates to the sites listed above.

12.6.6 The potential for undermining conservation objectives during decommissioning is considered de minimus, as the habitats that have been identified as most sensitive (those in use by SAC/SPA/ Ramsar site features) are located away from the ONSS, where the majority of decommissioning activity will take place. Moreover, only one project could be undertaking decommissioning at a similar time, North Falls, works would be in the vicinity of the substation specifically and no bird species associated with identified designates sites have been identified in that locality. Based primarily on the location of the ONSS, there will be no adverse effect on the integrity of the designated sites identified due to decommissioning.

12.6.7 An assessment of the potential for adverse effects on site integrity was undertaken if construction of VE was to occur at the same time as the identified projects, based on location of VE, refer to Table 12.33.

12.6.8 The projects and plans were then reviewed against likelihood to affect the relevant designated site, based on Table 12.27and proximity to the relevant designated sites

Table 12.33 In-combination effects for identified pathways for projects and plans onshore.

Project	Fisher's estuarine moth potential for in-combination effect Y/N	Non- breeding waterbird intertidal potential for in-combination effect Y/N	Non- breeding waterbird Holland Haven Marshes SSSI potential for in-combination effect Y/N	Non- breeding waterfowl cable route potential for in-combination effect Y/N	Breeding waterbird potential for in-combination effect Y/N
North Falls	Y	Y	Y	Y	Y
Bradwell B new nuclear power station	N	Y	N	N	N
Tendring/Colchester Borders Garden Community	Y	N	N	Y* lapwing/ Brent goose only	N
Rivenhall IWMF and Energy Centre	N	N	N	Y* lapwing only	N
Bramford to Twinstead Electrical Line	N	N	N	Y* lapwing only	N
Sea Link (Suffolk to Kent) onshore	N	Y	N	Y* lapwing only	N
A12 Chelmsford to A120 widening scheme	N	N	N	Y* lapwing only	N

Project	Fisher's estuarine moth potential for in-combination effect Y/N	Non- breeding waterbird intertidal potential for in-combination effect Y/N	Non- breeding waterbird Holland Haven Marshes SSSI potential for in-combination effect Y/N	Non- breeding waterfowl cable route potential for in-combination effect Y/N	Breeding waterbird potential for in-combination effect Y/N
Improvements to the A120 to Harwich	Y	N	N	Y* lapwing only	N
Harwich Free Port	N	N- already disturbed intertidal habitat	N	N	N
EAG	N	N	N	Y*lapwing only	N
1-Planning application	N	N	N	Y* lapwing only	N
2-Planning application	N	N	N	Y* lapwing/ Brent goose only	N
3-Planning application	N	N	N	Y* lapwing only	N
4-Planning application	N	N	N	N	N
5-Planning application	N	N	N	N	N
6- Allocation	N	N	N	Y* lapwing/ Brent goose only	N
7- Allocation	N	N	N	Y* lapwing only	N

Project	Fisher's estuarine moth potential for in-combination effect Y/N	Non- breeding waterbird intertidal potential for in-combination effect Y/N	Non- breeding waterbird Holland Haven Marshes SSSI potential for in-combination effect Y/N	Non- breeding waterfowl cable route potential for in-combination effect Y/N	Breeding waterbird potential for in-combination effect Y/N
8- Allocation	N	N	N	Y* lapwing only	N
9- Allocation	N	N	N	Y* lapwing only	N
10-Allocation	N	N	N	Y* lapwing only	N
11-Allocation	N	N	N	Y	N
12-Allocation	N	N	N	Y* lapwing only	N
13-Allocation	N	Y	N	Y* lapwing only	N
14-Allocation	N	N	N	Y* lapwing only	N

Table 12.34 In-combination effects for identified designated sites for projects and plans onshore.

Project	Hamford Water SAC	Hamford Water SPA/ Ramsar site	Stour and Orwell estuary SPA/ Ramsar site	Colne Estuary SPA/ Ramsar site	Abberton reservoir SPA/ Ramsar site	Blackwater Estuary SPA/ Ramsar site
North Falls	Y	Y	Y	Y	Y	Y
Bradwell B new nuclear power station	N	Y	Y	Y	Y	Y
Tendring/Colchester Borders Garden Community	Y	N	Y- lapwing only	N	N	N
Rivenhall IWMF and Energy Centre	N	N	Y- lapwing only	N	N	N
Bramford to Twinstead Electrical Line	N	N	Y- lapwing only	N	N	N
Sea Link (Suffolk to Kent)	N	Y	Y	Y	Y	Y
A12 Chelmsford to A120 widening scheme	N	N	Y- lapwing only	N	N	N
Improvements to the A120 to Harwich	Y	N	Y- lapwing only	N	N	N
Harwich Freeport	N	N	N	N	N	N
EAG	N	N	Y- lapwing only	N	N	N

Project	Hamford Water SAC	Hamford Water SPA/ Ramsar site	Stour and Orwell estuary SPA/ Ramsar site	Colne Estuary SPA/ Ramsar site	Abberton reservoir SPA/ Ramsar site	Blackwater Estuary SPA/ Ramsar site
1-Planning application	N	N	Y- lapwing only	N	N	N
2-Planning application	N	Y Brent goose only	Y Brent goose and lapwing only	Y Brent goose only	N	Y Brent goose only
3-Planning application	N	N	Y- lapwing only	N	N	N
4-Planning application	N	N	N	N	N	N
5-Planning application	N	N	N	N	Y	N
6- Allocation	N	Y Brent goose only	Y Brent goose and lapwing only	Y Brent goose only	N	Y Brent goose only
7 Allocation	N	N	Y- lapwing only	N	N	N
8- Allocation	N	N	Y- lapwing only	N	N	N
9 Allocation	N	N	Y- lapwing only	N	N	N
10- Allocation	N	N	Y- lapwing only	N	N	N
11- Allocation	N	Y	Y	Y	Y	Y
12- Allocation	N	N	Y	N	N	N

Project	Hamford Water SAC	Hamford Water SPA/ Ramsar site	Stour and Orwell estuary SPA/ Ramsar site	Colne Estuary SPA/ Ramsar site	Abberton reservoir SPA/ Ramsar site	Blackwater Estuary SPA/ Ramsar site
13 -Allocation	N	N	Y	N	N	N
14- Allocation	N	N	N	N	N	N

12.6.9 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 habitat used by the different species, this is due to the effects being similar across avian species. Fisher's estuarine moth is discussed individually.

FISHER'S ESTUARINE MOTH – HAMFORD WATER SAC

12.6.10 North Falls, if undertaken at the same time has been assessed as the project alone (Scenario 1 refer to 11.6.2). If undertaken at a different time to VE, (Scenario 2 or 3) there is potential to effect Fisher's estuarine moth, via habitat loss, although the exact landfall and cable route is unknown the scoping area indicated covers the A120 and habitat along the coast, specifically Holland Haven Marshes SSSI, where records of hog's fennel and Fisher's estuarine moth have been located.

12.6.11 A further two NSIPs were identified that could impact Hamford Water SAC and Fisher's estuarine moth: Tendring/ Colchester Borders Garden Community and, improvements to the A120 to Harwich. Due to the location near the A120 the potential presence of Fisher's estuarine moth or hog's fennel in the vicinity of the A120 from desk study data and for the A120 to Harwich, the proximity to the Hamford Water SAC. All NSIPs will need to include Fisher's estuarine moth in the relevant assessments and avoid impacts on the moth as a feature of the Hamford Water SAC.

12.6.12 With the relevant mitigation in place for these two NSIPs and the low likelihood of hog's fennel/ Fisher's estuarine moth being present in the vicinity of the VE onshore ECC, due to its rarity, despite the lack of information appertaining to North Falls, the situation is likely to be similar to that of VE. Therefore, there will be no adverse effect on the integrity for Hamford Water SAC for North Falls and VE in combination.

12.6.9 The disturbance during construction for the North Falls project in localities where SPA/ Ramsar site citation species are present and using habitat regularly is considered similar to the VE project in relation to impacts on SPA features. Although, no SPA/ Ramsar site birds were found to use habitats which are to be lost to permanent infrastructure, and there is no permanent loss of habitat for SPA/ Ramsar site bird species in relation to VE. There is no risk of in combination effects on this pathway if undertaken at the same time (Scenario 1, assessment as alone). However, there is a risk associated with temporary habitat loss if the projects are undertaken in succession to VE (Scenario 2 and 3). Temporary habitat loss and disturbance of SPA/ Ramsar site birds are the main risk, although hydrology and air quality need to be considered. The same mitigation (timing nosiest works outside the non- breeding season, CoCP or similar, screening and a cold weather stand down) is also likely to be employed. If North Falls and VE were to be undertaken at the different times, the area of temporary habitat lost caused by disturbance would lead to a greater period of temporary habitat loss, through disturbance over several years at different locations (VE first and then North Falls). This would increase the time period of disturbance. Even with mitigation for both projects in place, this has the potential to undermine conservation objectives of the relevant species, especially those which are currently in unfavourable condition, and have an adverse effect on the integrity of the identified SPAs and Ramsar sites. Both projects may be undertaken simultaneously (Scenario 1- as per project alone assessment), at the current time this is unknown, due to the differences in the planning application timeline. However, as further information becomes available, the assessment will be updated. If the projects were not undertaken simultaneously, but in consecutive years, birds would be disturbed for several winters. Further information on the timing of North Falls project is required before a conclusion is reached. It would be preferable for Scenrio 1 (both North Falls and VE to occur at the same time) reducing the time period of disturbance.

12.6.10 Bradwell B new nuclear power station is located adjacent to the Blackwater Estuary, and allocation 10 is located adjacent to the Stour and Orwell Estuary. Due to the location of both identified projects/ allocations next to the estuary, disturbance of waterbirds is considered an in-combination impact. Although the Bradwell B project is 20 km from VE there is potential for qualifying interest populations to use the vicinity of the VE project as well as Bradwell B location, specifically within the non- breeding season and species associated with the Blackwater Estuary SPA/ Ramsar site. The Bradwell B project will have to consider disturbance to waterbirds associated within the nearby SPA, and appropriate mitigation will also need to be included for this project. Equally the chances of VE and Bradwell B being constructed simultaneously are unlikely. Bradwell B's submission is "*to be confirmed*" on the NSIP portal whereas, whereas VE is expected quarter three or four 2023. With both projects including mitigation to reduce the impact of disturbance and the likelihood of construction not overlapping the conservation objectives would not be undermined for the identified SPAs/ Ramsar sites. Therefore, there would be no AEoI for the identified SPAs and Ramsar sites during construction in- combination.

12.6.11 Sea link Suffolk to Kent has the potential to disturb non-breeding birds associated with the same designated sites as identified for VE, at very different locations along the coastline. If construction was to occur at the same time, construction is proposed between 2026-2030 for Sea link, there is a potential risk that birds that form part of the SPA/ Ramsar designations could be disturbed from both project locations. However, there is a gap of approximately 43 km between the projects and both will be required to ensure no AEoI with the use of suitable mitigation.

12.6.12 Allocation 10 is located 3.7 km from the ECC, this proximity means that if this allocation was to go forward, any waterfowl at this location could be disturbed from the location and if that was to occur simultaneously with the VE then there would be potential for an in-combination effect. This is currently only an allocation no planning application has been submitted. There are not adequate details to assess this properly. However, once again the timelines are likely to be different.

12.6.13 A number of projects were located further inland, Tendring / Colchester Border Garden community, Rivenhall IWMF and energy centre and Bramford Twinstead Electrical Line. In addition, some allocations and planning applications are also highlighted further inland, specifically 1 to 3 and 5 to inclusive. The main species of waterbird that could be impacted by disturbance in relation to the more inland projects are Brent geese, curlew, dabbling ducks and lapwing, as these species utilise inland habitat.

12.6.14 Brent geese only use inland habitat within 5 km of designated sites (MacKay *et al*., 2001), the Tendring/ Colchester Border garden community and North Falls scoping area are within 5 km from SPAs that have Brent geese in the designation, as are projects/ allocations: 2,5,7,8,9 and 10. All projects will need to assess use of habitat by Brent geese within the individual red line boundary, a buffer that will be impacted by disturbance and apply suitable mitigation to ensure there are no impacts on SPA/ Ramsar site citation species. Equally the identified projects are unlikely to be under construction simultaneously. Therefore, the conservation objectives of the identified SPAs and Ramsar sites will not be undermined in relation to Brent geese and there will be no AEoI of the identified designated sites.

12.6.15 Non- breeding curlew do use inland habitat, however this is most frequently up to 2 km inland (Mander *et al*., 2022), North Falls is the only project that has potential to impact non- breeding curlew, without information on the cable route a full assessment is not possible.

12.6.16 Lapwing use a vast area of inland arable habitat during the non-breeding season. The use is dependent on arable practices and management (manure spreading and sugar beet production) (Gillings *et al*., 2007) and therefore the areas used change year to year. Within the east of England there is considerable arable habitat for lapwing to use. Habitat will be available for lapwing, despite development occurring at VE and potentially in combination projects identified. In-combination effects will not undermine conservation objectives and therefore there will be no AEoI of the Stour and Orwell estuaries SPA/ Ramsar site.

12.6.17 Overall, the projects identified are likely to exacerbate any effects identified in the assessment and therefore it means more emphasis is required on incorporating the mitigation outlined to prevent any AEoI.

OPERATION AND MAINTENANCE

12.6.18 After construction the cable route will be reinstated, during routine scheduled O&M, there will be little activity along the onshore ECC. Scheduled monitoring visits to above ground infrastructure will occur once annually. These will be comparable to pedestrian/ a single vehicle access and will not be undertaken in periods of extreme cold weather as per the alone assessment mitigation. Scheduled maintenance and operation, when undertaken with the mitigation recommended in the alone assessment are considered to have no pathway to undermine conservation objectives in-combination with other identified projects and will have no adverse effect on the integrity of the identified designated sites.

12.6.19 Unscheduled maintenance has the potential to cause disturbance to avian features if required within Holland Haven Marshes SSSI or the intertidal area, as discussed in the assessment alone. The instances of unscheduled maintenance are considered so low that it would not impact SPA / Ramsar site designated species, alone. Projects that would cause disturbance at the nearby intertidal area or within Holland Haven Marshes SSSI only are considered for the in-combination assessment; this was considered to be North Falls only. There is not enough information to conclude the in combination effect of this project at this time.

13 Transboundary statement

13.1.1 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).

13.1.2 Consultation on Transboundary Screening was undertaken by PINS, with the following countries notified:

- The Netherlands;
- Germany;
- Belgium;
- Denmark;
- Norway;
- France;
- Iceland;
- Republic of Ireland; and
- Sweden.

13.1.3 Therefore, consultation has included all countries for which a designated site has been screened in. No transboundary comments have been received to date (December 2023).

13.1.4 Consideration of the potential for an AEoI alone has been addressed in Section 11.3 for marine mammals, including in relation to the above sites where marine mammals are highlighted, with all conclusions being no AEoI. The assessment in-combination with other plans or projects (including transboundary projects) has been addressed in Section 12.3 for marine mammals, with all conclusions similarly being no AEoI.

13.1.5 It can therefore be concluded that no AEoI exists for a transboundary effect from VE alone and/ or in-combination.

14 CONCLUSIONS OF THE ASSESSMENT

14.1.1 A summary of the assessments is presented below in Table 14.1, which identifies the designated site, relevant feature(s), and the conclusion on AEoI alone and in-combination.

14.1.2 As reflected in the table, there will be a requirement to progress beyond HRA Stage 2, based on a RIAA conclusion of an AEoI for the following sites: Alde-Ore Estuary SPA and Alde-Ore Estuary Ramsar. In response to consultation undertaken (Section 6) and in line with the requirements of PINS Advice Note Ten, the Applicant intends to provide a draft Derogation Case (HRA Derogation Case) with this RIAA for DCO. This draft/ shadow document will provide the necessary information to inform the SoS's HRA derogation process, as required under Article 6(4) of the Habitats Directive.

14.1.3 The HRA Derogation Case and other supporting documents have been submitted alongside this RIAA. The documents do not form part of the RIAA and instead forms the next stage of the HRA process (HRA Stage 3 as referenced in Section 4.6 of this RIAA). The relevant documents include:

- HRA Derogation Case (Volume 5, Report 5)
- Benthic and Intertidal Ecology Compensatory Measures (Volume 5, Report 5.1)
- LBBG Compensation: Evidence, Site Selection and Roadmap (Volume 5, Report 5.2)
- Kittiwake: Evidence, Site Selection and Roadmap (Volume 5, Report 5.3)
- Guillemot (and Razorbill): Evidence, Site Selection and Roadmap (Volume 5, Report 5.4)
- Lesser Black Backed Gull Implementation and Monitoring Plans (Volume 5, Report 5.6)
- Kittiwake Implementation and Monitoring Plans (Volume 5, Report 5.8)

Table 14.1 Summary of the designated sites alone and in-combination assessments conclusions.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Sites primarily designated for benthic and intertidal ecology[28]					
Margate and Long Sands SAC	Sandbanks which are slightly covered by sea water all the time	> Physical habitat loss/ disturbance; > Suspended sediment/ deposition; > INNS; > EMF; > Changes to physical processes; and > Accidental pollution.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Essex Estuaries SAC	Estuaries Mudflats and sandflats not covered by seawater at low tide Salicornia and other annuals colonizing mud and sand	> Physical habitat loss/ disturbance; > Suspended sediment/ deposition; > INNS; > EMF; > Changes to physical processes; and > Accidental pollution.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

[28] Where other features are relevant, these are addressed under the relevant receptor group

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Spartina swards (*Spartinion maritimae*) Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruitocosi*) Sandbanks which are slightly covered by sea water all the time				
Sites primarily designated for Marine Mammals					
Berwickshire and North Northumberland Coast SAC	Grey seal	> Underwater noise (disturbance/TTS, PTS and barrier effect); > Vessel collision risk (injury and disturbance); > Changes to prey; > Habitat loss;	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
		> Disturbance at haul out; and > Collision risk.			
Humber Estuary SAC	Grey seal	Underwater noise (disturbance/TTS, PTS and barrier effect); Collision risk; Changes to prey; Habitat loss; and Disturbance at haul out.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Humber Estuary Ramsar	Grey seal	Underwater noise (disturbance/TTS, PTS and barrier effect); Collision risk; Changes to prey; Habitat loss; and Disturbance at haul out.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Southern North Sea SAC	Harbour Porpoise	Underwater noise (disturbance/TTS, PTS and barrier effect); Collision risk;	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
		Accidental pollution and changes in water quality; and Changes to prey.			
The Wash and North Norfolk Coast SAC	Harbour Seal	Underwater noise (disturbance/TTS, PTS and barrier effect); Collision risk; Changes to prey; Habitat loss; and Disturbance at haul out.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Transboundary sites for seals; Bancs des Flandres SCA; Doggersbank (Netherlands) SAC Klaverbank SCI; Noordzeekustone SCI; SBZ 1 SCI; SBZ 2 SCI;	Harbour seal; and Grey seal	Underwater (disturbance/TTS, PTS and barrier effect) noise; Collision risk; Changes to prey; Habitat loss; and Disturbance at haul out.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
SBZ 3 SCI; Vlaamse Banked SCI; Vlakte van de Raan SCI; Voordelta SCI; Waddenzee SCI; and Westerschelde & Saeftinghe SCI.					
Sites primarily designated for Offshore Ornithology					
OTE SPA	Red-throated diver Little tern	> Disturbance and displacement due to work activity and vessel movements within the ECC only; and > Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Alde-Ore Estuary SPA	Lesser black-backed gull Little tern Marsh harrier	> Risk of collision; > Direct disturbance and displacement; > Risk of collision; > Barrier effects; and	No potential for AEoI alone or in-combination.	Potential for AEoI on lesser black-backed gull, in-	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Avocet Redshank Ruff	> Risk of collision on migration.		combination for collision risk.	
Alde-Ore Estuary Ramsar	Lesser black-backed gull Avocet Redshank	> Risk of collision; and > Risk of collision on migration.	No potential for AEoI alone or in-combination.	Potential for AEoI on lesser black-backed gull, in-combination for collision risk.	No potential for AEoI alone or in-combination.
Minsmere-Walberswick SPA	Little tern Marsh harrier Nightjar Avocet Bittern Gadwall White-fronted goose Hen harrier Shoveler Teal	> Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Minsmere-Walberswick Ramsar	Bittern Gadwall Teal Shoveler Marsh harrier Avocet Bearded tit	> Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Deben Estuary SPA	Avocet Dark-bellied brent goose	> Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Deben Estuary Ramsar	Dark-bellied brent goose	> Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
OTE SPA	Red-throated diver	> Risk of collision on migration.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Flamborough and Filey Coast SPA	Kittiwake Gannet Guillemot	> Risk of collision (non-breeding); and > Direct disturbance and displacement.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Razorbill				
Farne Islands SPA	Guillemot Razorbill	> Direct disturbance and displacement.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Sites primarily designated for Migratory Fish					
Vlaamse Banken	Twaite Shad	> Underwater Noise.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Sites primarily designated for Onshore Ecology					
Hamford Water SAC	Fisher's estuarine moth *Gortyna borelii lunata*	> Impacts on supporting populations, food plant and potential habitat; > Water quality: pollution from site run-off affecting habitat quality; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Hamford Water SPA	Over winter: Avocet Black-tailed godwit Dark-bellied brent goose Grey plover Redshank Ringed plover Shelduck Teal During the breeding season: Little Tern	> Loss of foraging and roosting habitat outside the SPA; > Disturbance of birds outside the SPA; > Water quality: pollution from site run-off affecting prey availability; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Hamford Water Ramsar	Important wintering populations of: Black-tailed godwit Dark-bellied brent goose Redshank Ringed plover	> Disturbance/ displacement of birds outside SPA; > Water quality: pollution from site run-off affecting prey availability; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
Stour and Orwell Estuaries SPA	Over winter: Black-tailed godwit Dark-bellied brent goose Dunlin Grey plover Knot Pintail Redshank Waterbird assemblage On passage: Redshank During the breeding season: Avocet	> Loss of foraging and roosting habitat outside the SPA; > Disturbance/ displacement of birds outside SPA; > Pollution from site run-off affecting prey availability; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Stour and Orwell Estuaries Ramsar	Important wintering populations of: Black-tailed godwit Dark-bellied brent goose	> Loss of foraging and roosting habitat outside the SPA; > Disturbance/ displacement of birds outside SPA;	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Dunlin Grey plover Knot Pintail Redshank Important passage populations of redshank. Also qualifies for: Wintering waterbird assemblage	> Pollution from site run-off affecting prey availability; > Decreases in water quantity; > Decrease in air quality; and > Impacts on supporting populations of plants and invertebrates outside the Ramsar.			
Colne Estuary (Mid-Essex Coast Phase 2) SPA	Over winter: Dark-bellied brent goose Hen harrier Pochard Redshank Ringed plover Waterbird assemblage	> Loss of foraging and roosting habitat outside the SPA; > Disturbance/ displacement of birds outside SPA; > Pollution from site run-off affecting prey availability; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	During the breeding season: Little tern				
Colne Estuary (Mid-Essex Coast Phase 2) Ramsar	Over winter: Dark-bellied brent goose Redshank Waterbird assemblage Wetland invertebrate assemblage Wetland plant assemblage Saltmarsh	> Loss of foraging and roosting habitat outside the SPA; > Disturbance/ displacement of birds outside SPA; > Pollution from site run-off affecting prey availability; > Decreases in water quantity; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Abberton Reservoir SPA	Breeding: Cormorant Non-breeding: Coot Gadwall Goldeneye	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work; > Water quality: pollution from site run-off affecting habitat quality; and	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Great crested grebe Mute swan Pochard Shoveler Teal Tufted duck Wigeon Waterbird assemblage	> Decrease in air quality.			
Abberton Reservoir Ramsar	Wintering: Gadwall Shoveler Wigeon Waterbird assemblage	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work; > Water quality: pollution from site run-off affecting habitat quality; and > Decrease in air quality.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.
Blackwater Estuary (Mid-Essex Coast Phase 4) SPA	Non-breeding: Black-tailed godwit	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work;	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Dark-bellied Brent goose Dunlin Grey plover Hen harrier Waterbird assemblage Breeding: Little tern Pochard Ringed plover	> Water quality: pollution from site run-off affecting habitat quality; > Decreases in water quantity; and > Decreases in air quality.			
Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar	Wintering: Black-tailed godwit, Dark- bellied brent goose Dunlin Grey plover Waterbird assemblage Saltmarsh	> Disturbance of birds outside the SPA, as a result or routine and non-routine maintenance work; > Water quality: pollution from site run-off affecting habitat quality; > Decreases in water quantity; > Decreases in air quality; and	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.	No potential for AEoI alone or in-combination.

Designated Sites	Relevant Features	Potential For Effect	Conclusion on Adverse Effect		
			Construction	Operation	Decommissioning
	Wetland invertebrate assemblage Wetland plant assemblage	> Impacts on supporting populations of plants and invertebrates outside the Ramsar.			

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