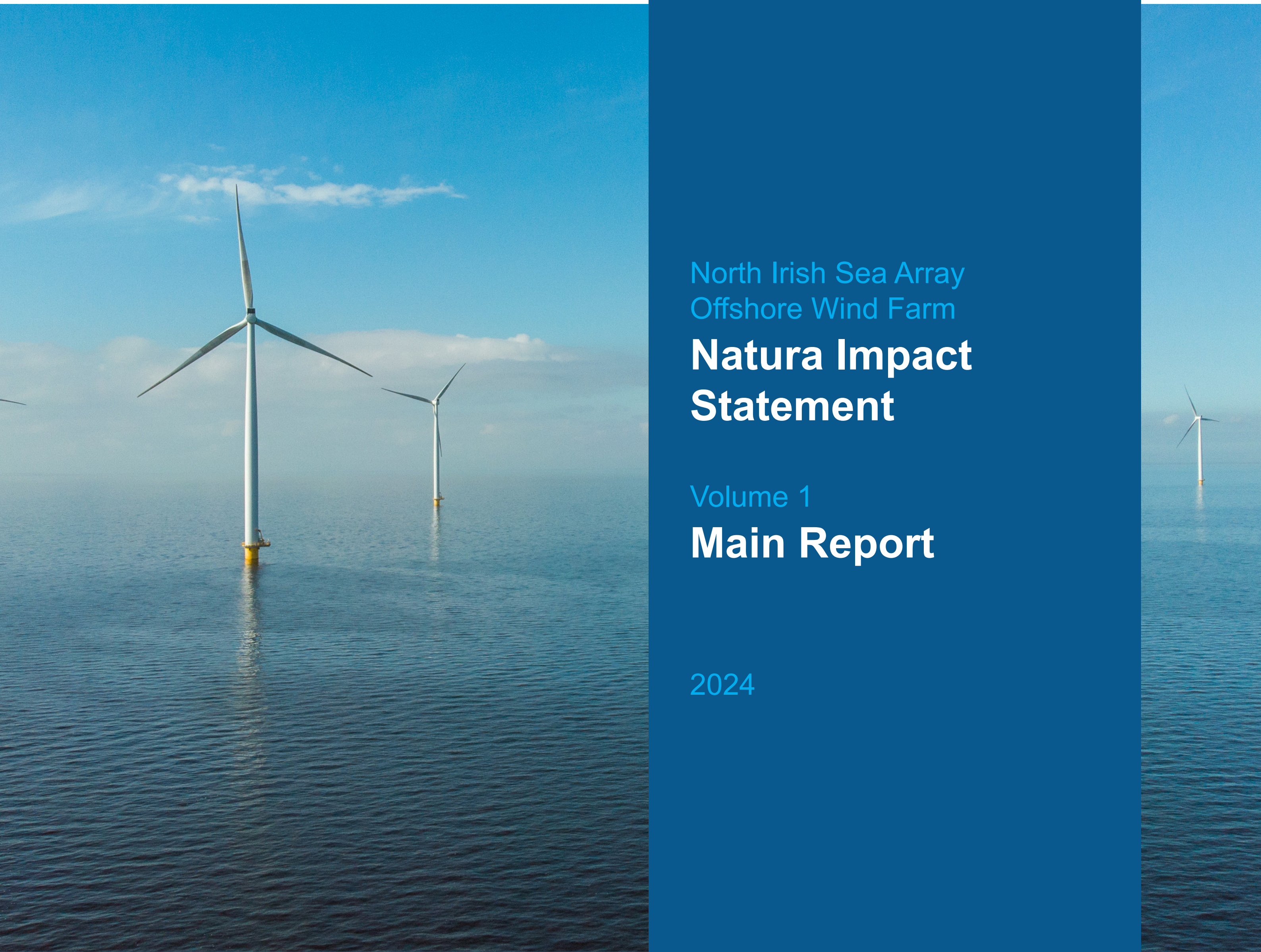
NISA

North Irish Sea Array



North Irish Sea Array
Offshore Wind Farm

Natura Impact Statement

Volume 1

Main Report

2024

Contents

Figures

Abbreviations

Term, Abbreviation or Acronym	Description
AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
AEoI	Adverse Effect on Integrity
AHV	Anchor Handling Vessel
AON	Apparently Occupied Nest
BDMPS	Biologically Defined Minimum Population Scale
BTO	British Trust for Ornithology
BWI	Bird Watch Ireland
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CIV	Cable Installation Vessel
CO	Conservation Objective
CGR	Counterfactual Population Growth Rate
CPS	Counterfactual Population Size
CRM	Collision Risk Modelling
cSAC	Candidate Special Area of Conservation
cSPA	Candidate Special Protection Area
CSIP	Cetacean Strandings Investigation Programme
CTV	Crew Transfer Vessel
CV	Coefficient of Variance
DAHG	Department of Arts, Heritage and Gaeltacht
DAS	Digital Aerial Survey
dB	Decibel
DBT	Dibutylin
DCC	Dublin City Council
DDV	Drop-down Video
DEB	Dynamic Energy Budget
DECC	Department of Environment, Climate and Communications
DEHLG	Department of Environment, Heritage and Local Government

Term, Abbreviation or Acronym	Description
DTAG	Digital Acoustic Recording Tag
EC	European Commission
ECC	Export Cable Corridor
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EIAR	Environmental Impact Assessment Report
EMF	Electro-magnetic fields
EMP	Environmental Management Plan
EOD	Explosive Ordnance
ESAS	European Seabirds at Sea
FCC	Fingal County Council
FCS	Favourable Conservation Status
FPV	Fall Pipe Vessel
HDD	Horizontal Directional Drilling
HF	High Frequency
HLV	Heavy Lift Vessel
HVAC	High Voltage Alternating Current
HWM	High Water Mark
Hz	Hertz
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
JUV	Jack Up Vessel
LAT	Lowest Astronomical Tide
LCI	Lower Confidence Interval
LSE	Likely Significant Effect
LWM	Low Mean Water
MAC	Maritime Area Consent
MARA	Maritime Area Regulatory Authority
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MERP	Marine Ecosystems Research Programme

Term, Abbreviation or Acronym	Description
MMF	Mean Maximum Foraging range
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MU	Celtic and Irish Seas Management Unit
NAF	Nocturnal Activity Factor
NBHF	Narrow-Band High Frequency
NIS	Natura Impact Statement
NISA	North Irish Sea Array
NOAA	National Oceanic and Atmospheric Administration
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority
NWIS	North West Irish Sea
O&M	Operation and Maintenance
OMF	O&M Facility
OREDP	Offshore Renewable Energy Development Plan
ORESS	Offshore Renewable Energy Support Scheme
OSP	Offshore Substation Platform
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic (The Oslo Paris Convention)
OSV	Offshore Supply Vessel
OWEZ	Offshore Wind Farm Egmond aan Zee
OWF	Offshore Wind Farm
Pa	Pascal
PAH	Polycyclic Aromatic Hydrocarbons
PCOD	Population Consequences of Disturbance
PSA	Particle Size Analysis
PTS	Permanent Threshold Shift
QI	Qualifying Interest
RAMS	Risk Assessment and Method Statement
RIAA	Report to Inform Screening for Appropriate Assessment
ROV	Remotely Operated Vehicle

Term, Abbreviation or Acronym	Description
SAC	Special Area of Conservation
SCADA	Supervisory Control and Data Acquisition
SCI	Special Conservation Interest
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SISAA	Supporting Information for Screening for Appropriate Assessment
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SOV	Service Operational Vehicle
SPA	Special Protection Area
SPL	Sound Pressure Level
SPM	Suspended Particulate Matter
SSC	Suspended Sediment Concentration
TBT	Tributyltin
THC	Total Hydrocarbon Concentration
TJB	Transition Joint Bay
TOC	Total Organic Carbon
TTS	Temporary Threshold Shift
UCI	Upper Confidence Interval
UK	United Kingdom
UXO	Unexploded Ordinance
VHF	Very High Frequency
WFD	Water Framework Directive
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Glossary

Term	Glossary
An Bord Pleanála (ABP)	The competent authority under the Planning Acts to determine the planning application and carry out the AA of the proposed development.
Annex I Species	Annex I of the Birds Directive (Directive 2009/147/EC) lists 193 bird species and sub-species which are: i) in danger of extinction, ii) vulnerable to specific changes in their habitat, iii) considered rare because of small populations or restricted local distribution and / or iv) require particular attention for reasons of the specific nature of habitat.
Annex I Habitats	Habitat types, listed in Annex 1of the Habitats Directive (Directive 92/43/EEC), whose conservation requires the designation of Special Areas of Conservation. Priority habitats, which are in danger of disappearing within the EU territory, are highlighted with an asterisk in Annex I.
Annex II Species	Animal and plant species, listed in Annex II of the Habitats Directive, whose conservation requires the designation of Special Areas of Conservation.
Annex IV species	Animal and plant species listed in Annex IV of the Habitats Directive that are in need of strict protection from killing, disturbance or destruction of them or their habitat.
Appropriate Assessment (AA)	The statutory process as set out in Article 6 of the Habitats Directive
Array area	The area within the offshore development area within which the WTGs, the OSP and inter-array cable(s) will be located
Belcamp substation	The existing operational substation where the 220kV underground onshore cable will connect to the national high voltage electricity transmission system
Birds Directive	The Birds Directive (formally known as Council Directive 2009/147/EC on the conservation of wild birds) is a European Union directive adopted in 2009. It aims to protect all European wild birds and the habitats of listed species, in particular through the requirement for member states to designate of Special Protection Areas.
Bremore Substation	The new 220 kV substation to be constructed as part of the proposed development located adjacent to the compensation substation. Bremore substation will be connected to the compensation 220kV substation and the Belcamp substation by means of the onshore cables.
Cable Duct	The cable ducts will be durable plastic conduits into which the cables will be installed.
Clupeid	Any species of the family Clupeidae (such as herring and sprat).
Compensation substation	The compensation substation is situated within the grid facility and will be connected to the Bremore substation by means of a 220 kV underground cable.
Conservation Objective (CO)	The specification of the overall target for the species and/or habitat types for which a site is designated in order for it to contribute to maintaining or reaching favourable conservation status. The National Parks and Wildlife Service (NPWS) produce the Conservation Objectives for all European sites in the Republic of Ireland.
Construction Phase	The processes and activities on or off site that contribute or are instrumental to the construction of the Proposed Development towards, and finally to, the Operational Phase
Design Flexibility Opinion (DF Opinion)	The Developer sought an opinion from An Bord Pleanála on design flexibility under section 287A of the Planning Acts. In 2024, An Bord Pleanála issued its opinion on design flexibility, (the "DF Opinion"). Full detail regarding the DF Opinion and how this is reflected in the EIAR is provided in Sections 2.7 and 2.8 of Chapter 2 (EIA and Methodology for the preparation of an EIAR).
Designated Sites	Selected sites designated with the aim to conserve habitats and species of conservation concern.
Developer	North Irish Sea Array Windfarm Limited (Ltd). The Developer is a 50/50 joint venture between Statkraft Ireland Ltd and Copenhagen Infrastructure Partners P/S.

Term	Glossary
Proposed development boundary	The area within which the proposed development will be located (includes onshore and offshore aspects) and is defined by the planning boundary (shown as "red line" on planning drawings) and the infrastructure boundary for offshore aspects.
EirGrid Group	Transmission system operator on the Island of Ireland and transmission asset owner for offshore electrical infrastructure at transmission voltage levels in Ireland. Referred to as EirGrid.
Environmental Impact Assessment Report (EIAR)	A report of the effects if any, which the proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directive.
European site	European sites are defined in the Habitats Directive as Special Area of Conservation (SAC), candidate SAC (cSAC), Special Protection Area (SPA), candidate SPA (cSPA) and Site of Community Importance (SCI). 'European site' is also deemed to include possible SACs and potential SPAs.
Export Cable Corridor	Offshore export cable corridor which is the area within which the offshore export cables will travel from the offshore substation platform (OSP) to the landfall.
Favourable Conservation Condition	Favourable Conservation Condition is determined if data indicate that the conservation feature is maintaining itself on a long-term basis as a viable component of its natural habitats / species range and will continue to be maintained on a long-term basis / for the foreseeable future.
Grid Connection Point	The point where the onshore 220kV underground cable connects to the existing transmission system – at the existing Belcamp substation and the consented Belcamp extension project (F23A/0040)
Grid Facility	The grid facility comprises of the compensation substation and the Bremore substation together with ancillary infrastructure.
Habitats Directive	EU Directive on the conservation of natural habitats, wild fauna and flora (92/43/EEC), commonly known as "the Habitats Directive", was adopted in 1992, came into force in 1994 and was transposed into Irish law in 1997.
HWM	High water mark as shown on the Ordnance Survey Ireland Historic 1888 -1913 25-inch mapping
Inter-array cables	Th These are the subsea electrical cables that will link the wind turbine generators to each other and link the wind turbine generators to the offshore substation platform.
Invasive Non Native Species (INNS)	An invasive species is a plant, fungus, or animal species that is not native to a specific location.
Joint Bay	A joint bay is an underground chamber which facilitates the pulling-through of pre-installed cable ducts. These chambers will "joint" consecutive lengths of cables into one continuous overall circuit within a controlled environment.
Landfall site	The landfall site includes all infrastructure from where the offshore export cable comes onshore to where it connects to the compensation substation. This includes the area from where the offshore export cables are brought onshore, the relevant construction compound(s), TJB, HDD under the Irish Rail line, and where the onshore export cable connects to the compensation substation.
Likely Significant Effect (LSE)	Any effect that may reasonably be predicted as a consequence of a plan or project that would negatively and significantly affect the conservation objectives established for the habitats and species significantly present on the Natura 2000 site. This can result from either on-site or off-site activities, or through combinations with other plans or project.
MAC	Maritime Area Consent, the right to occupy a part of the maritime area, conditional on securing other necessary approvals
Maritime Area Consent Boundary	The MAC boundary is the boundary of the offshore area which the holder of the MAC has the right to occupy
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.

Term	Glossary
National Parks and Wildlife Service (NPWS)	The National Parks and Wildlife Service has responsibility for the protection and conservation of Ireland's natural heritage and biodiversity at national government level.
Natura 2000 sites or European sites	Sites designated under the Habitats and Birds Directives (includes SACs and SPAs)
Natura Impact Statement (NIS)	A statement for the purposes of Article 6 of the Habitats Directive, of the implications of a proposed development, on its own or in combination with other plans or projects, for one or more than one European site, in view of the conservation objectives of the site or sites.
North Irish Sea Array (NISA) Offshore Wind Farm	The North Irish Sea Array (NISA) Offshore Wind Farm refers to the construction of the offshore wind farm and its connection into the existing substation at Belcamp.
North Irish Sea Array Windfarm Limited (Ltd)	North Irish Sea Array Windfarm Limited (Ltd) is the Developer. The Developer is a 50/50 joint venture between Statkraft Ireland Ltd and Copenhagen Infrastructure Partners P/S.
Offshore export cable corridor	The specific corridor of seabed (seaward of high water mark) from the array area to the landfall site, in which the offshore export cable route will be located. Referred to as the ECC.
Offshore export cable(s)	Comprises of 2 No. subsea 220kV HVAC cables linking the offshore substation platform to the transition joint bay (TJB) within the landfall site.
Offshore infrastructure	This relates to the aspects of the proposed development located seaward of the HWM
Offshore development area	That area within the proposed development boundary located seaward of the HWM,
Offshore substation platform (OSP)	The OSP is the offshore electrical structure which contains the equipment needed to connect the WTGs to the offshore export cables.
Onshore cable route	This is the route taken by the onshore cable(s) which links the Bremore 220kV substation to the existing Belcamp 220kV substation.
Onshore cable(s)	The onshore underground 220kV HVAC cables will connect Bremore substation to the existing Belcamp substation. This will comprise of up to 6 No. power cables and 2 No. fibre optic cables.
Operation and Maintenance Facility (OMF)	The location from where the daily operations and normal repairs, replacement of parts and structural components, and other activities needed to operate and maintain the proposed development will be performed during its lifetime.
Onshore export cable(s)	Comprises onshore underground 220kV HVAC cables which will be routed from the transition joint bay at the landfall site connecting to the grid facility.
Onshore development area	That area within the proposed development boundary located landward of the HWM
Onshore infrastructure	This relates to the aspects of the proposed development located landward of the HWM
Operation and Maintenance Facility (OMF)	The location from where the daily operations and normal repairs, replacement of parts and structural components, and other activities needed to operate and maintain the proposed development will be performed during its lifetime.
Operational Phase	This phase refers to the processes and activities implemented following the Construction Phase
ORESS 1	ORESS 1 Offshore Renewable Energy Support Scheme - the first Offshore Auction run under the Government of Ireland's Renewable Electricity Support Scheme and is a pivotal component of the Programme for Government and the Climate Action Plan 2024.
Qualifying Interest (QI)	Species and /or habitat types for which a European site is designated, and which are considered during the assessments under Article 6(3) and, if required, Article 6(4) of the Habitats Directive.
Planning Acts	Planning and Development Act 2000, as amended

Term	Glossary
Project Option 1	Project Option 1 consists of 49 WTGs with 250m rotor diameter
Project Option 2	Project Option 2 consists of 35 WTGs with 276 rotor diameter
Proposed development	This refers to the overall Offshore Wind Farm project, which is the subject of the planning application, and which includes all offshore and onshore infrastructure
Salmonid	Any species of the family (Salmonidae) of elongate bony fishes (such as a salmon or trout) that have the last three vertebrae upturned (i.e. ray-finned fish).
Screening for Appropriate Assessment	Assessment to determine whether the proposed development is likely to have a significant effect (either alone or in combination with other plans or projects) on the European site(s).
SELcum	Cumulative sound exposure level
SPLpeak	Peak sound pressure level
Zone of Influence (ZoI)	An area within which environmental impact arising from a certain activity may occur.

1. Introduction

1.1 Project Background

North Irish Sea Array Windfarm Limited (Ltd), hereafter referred to as the Developer, is proposing to develop the North Irish Sea Array (NISA) Offshore Wind Farm (OWF), hereafter referred to as the proposed development. The proposed development is a combination of offshore infrastructure and onshore infrastructure, other supporting infrastructure, ancillary works and activities. The proposed development, once operational, will have the capacity to provide renewable energy for between 500,000 and 700,000 homes.

The proposed development boundary, within which the proposed development will be located, comprises the offshore development area off the coast of Counties Dublin, Meath and Louth and the onshore development area within County Dublin (Fingal and Dublin City Council administrative areas) with the interface between the two being the High Water Mark (HWM).

The Developer is the holder of a Maritime Area Consent (MAC)[1] Ref: 2022-MAC-005 granted for the occupation of a maritime area for the permitted maritime usage of the construction and operation of an Offshore Wind Farm and associated infrastructure of the proposed development. The Developer and proposed development was successful in the first Offshore Renewable Energy Support Scheme (ORESS) auction in May 2023.

The Developer has submitted an application for approval to An Bord Pleanála under Section 291 of the Planning and Development Act 2000, as amended (the “Planning Acts”) to carry out the proposed development. A high-level overview of the proposed development is provided in Section 1.3, with further detailed description of the development provided in Section 2.

Within the offshore development area, the proposed development includes two project options for consideration within the planning application. Post consent, just one option will be chosen for detailed design and construction.

[1] The MAC is a State consent, awarded to the Developer in December 2022 which allows the right to occupy a part of the maritime area and the ability to subsequently apply for development consent within that maritime area.

This approach has been taken in accordance with the "DF Opinion" provided by the An Bord Pleanála and provides a degree of flexibility for the proposed development during the post-consent procurement phase. The project options relate to offshore infrastructure only, i.e. wind turbines, foundations, offshore substation platforms, inter-array cables and export cables seaward of the HWM (see Section 2).

Where the design details are unconfirmed, ranges of parameters (with minimum and maximum values identified) and discrete design options are provided in order to capture the design flexibility awarded to the Developer by An Bord Pleanála through the DF Opinion.

The key differences between the two project options relate to Wind Turbine Generator (WTG) number, WTG dimensions, WTG layout and Offshore Substation Platform (OSP) foundation type and dimensions. A fixed WTG layout for each of the two project options is included in the application. A 500m limit of deviation for each WTG and the OSP is proposed. The precise location of WTGs and the OSP within the array area, and the export cable within the export cable corridor, will not be confirmed until detailed geotechnical site investigation surveys have been undertaken.

As part of the statutory consent application, an Environmental Impact Assessment Report (EIAR) has been compiled on behalf of the proposed Developer by a multi-disciplinary consultancy team of competent experts led by Arup with input from specialist sub-consultants including GoBe Consultants Ltd. The EIAR presents the results of a systematic analysis and assessment of the likely significant effects of the proposed development on the receiving environment.

GoBe Consultants Ltd and Woodrow have been appointed by Arup on behalf of the Developer to prepare the Natura Impact Statement (NIS) for the statutory consent application.

GoBe has been at the forefront of strategic planning, consenting and Environmental Impact Assessment (EIA) for large scale offshore wind within the UK and has been actively applying this experience to the offshore wind farm market in Ireland. GoBe staff have significant experience of the preparation of information to support Appropriate Assessments and EIA in both a UK and Irish context. Woodrow is an established and accomplished environmental consultancy operating in the terrestrial ecology sector. Woodrow's team of ecologists and environmental professionals cover specialisms that include aquatic ecology, botany, habitats, ornithology, bats, mammals and invertebrates. Woodrow's team has extensive experience in delivering Appropriate Assessments and Ecological Impact Assessment for large scale projects in Ireland. CVs and a Statement of Expertise can be found in Appendix 1.

1.2 Purpose of this Document

The Habitats Directive (92/43/EEC) and the associated Birds Directive (2009/147/EC) are transposed into Irish legislation by Part XAB of the 2000 Act (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The legislative provisions for Appropriate Assessment (AA) for planning applications are set out in Section 177U of the 2000 Act (as amended). Having regard to the 2000 Act, it is recognised by the Developer that the public authority for carrying out AA for the proposed development (the 'competent authority') is An Bord Pleanála.

In accordance with the 2000 and associated guidance, Supporting Information for Screening for Appropriate Assessment (SISAA Report) (North Irish Sea Array Windfarm Limited, 2024) and a NIS have been prepared by the Developer to provide information to An Bord Pleanála, as the competent authority. This document forms the NIS.

The SISAA Report has assessed the potential for the proposed development to have a Likely Significant Effect (LSE) on a European site, taking account of qualifying interests (QI) and site-specific conservation objectives (CO).

The NIS takes account of the QIs and COs of all relevant European sites identified within the SISAA Report, and considers whether a plan or project, alone or in combination with other plans or projects, will have an adverse effect on integrity (AEoI) of one or more European sites.

As the competent authority, An Bord Pleanála will use this information to undertake an Appropriate Assessment. The competent authority is not bound to reach the same conclusions of either the SISAA Report or the NIS.

1.3 Structure of the Document

This document comprises the NIS for the proposed development and assesses the potential for AEoI on any European sites, taking account of QIs and site specific COs.

The structure of the NIS can be summarised as follows:

- Section 1: Introduction. An overview of the proposed development, the purpose of this document, the AA process and legislative context, and the approach to the assessment.
- Section 2: Description of the proposed development
- Section 3: Screening. Sets out the results of Stage 1: Screening, including information on the European sites likely to be significantly affected by the proposed works alone or in-combination with other projects or plans. QIs of each site screened in, and the elements of the proposed works that could potentially give rise to an AEoI on sites and their qualifying interests, are provided.
- Section 4: Identification of Potential Impacts and Mitigation Measures. Identifies the potential impacts from the proposed development and the mitigation measures proposed and how these will address the potential impacts.
- Section 5: Stage 2 Appropriate Assessment - Project Alone. Provides the findings of the appropriate assessment for the project alone.
- Section 6: Stage 2: Appropriate Assessment - Project In-Combination. Provides the findings of the appropriate assessment for the project in-combination with other plans or projects.
- Section 7: Transboundary Statement. Provides information on European sites outside the jurisdiction of Ireland.
- Section 8: Conclusions
- Section 9: References

Several appendices have been submitted alongside this document as follows:

- Appendix 1: Key personnel expertise
- Appendix 2: Integrity Matrices
- Appendix 3: In-combination long list
- Appendix 4: Cable Route Benthic Survey Report
- Appendix 5: Array Area Benthic Survey Report
- Appendix 6: Underwater Noise Modelling Report
- Appendix 7: Offshore Environmental Management Plan
- Appendix 8: Onshore Construction Environmental Management Plan (CEMP)
- Appendix 9: NISA Bioenergetic Modelling
- Appendix 10: Marine Mammal Mitigation Protocol
- Appendix 11: Environmental Vessel Management Plan
- Appendix 12: Offshore and Intertidal Ornithology Technical Baseline
- Appendix 13: Offshore and Intertidal Ornithology Population Viability Analysis
- Appendix 14: Method Statement - Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects
- Appendix 15: NPWS Review of Method Statement

- Appendix 16: Method Statement Review Consultation and Justification Log
- Appendix 17: Offshore and Intertidal Ornithology Displacement Analysis
- Appendix 18: Offshore and Intertidal Ornithology Collision Risk Modelling Assessment
- Appendix 19: Offshore and Intertidal Ornithology Migratory Collision Risk Modelling
- Appendix 20: Offshore and Intertidal Ornithology Apportioning Appendix
- Appendix 21: Fish and Shellfish Ecology Baseline Characterisation
- Appendix 22: NISA/Dublin Bioenergetic Modelling; and
- Appendix 23: MRSea Modelling for Offshore Ornithology

1.4 Overview of the North Irish Sea Array Offshore Wind Farm

A high-level overview of the proposed development is provided below with a more detailed description provided in Section 2: Description of the Proposed Development.

- Offshore Infrastructure:
  - Offshore wind turbine generators (WTGs) and their associated foundations
  - Inter-array cables which will connect the WTGs to the Offshore Substation Platform (OSP)
  - An OSP and associated foundations; and
  - Offshore export cable(s) which will deliver the generated power from the OSP to HWM as defined by Ordnance Survey Ireland mapping, (the HWM being the transition point between the offshore and onshore infrastructure).
- Onshore Infrastructure:
  - Offshore export cable(s) from the HWM to the landfall transition joint bays (TJBs)
  - Transition joint bays (TJBs) where the offshore and onshore export cables are joined.
  - Onshore export cable(s) from the TJBs to the grid facility
  - A Grid Facility, comprising a compensation substation and Bremore substation, together within ancillary infrastructure.
  - Onshore cable(s) from the grid facility to the Belcamp Substation; and
  - A connection from the onshore cable(s) to the national electricity transmission network at Belcamp Substation.

The landfall will comprise both onshore and offshore infrastructure, with the HWM being the point of transition between the two. The export cables come ashore and transition to onshore cables at the TJB close to the shoreline in Bremore, north or Balbriggan, Co. Dublin.

The proposed development boundary is the area within which all offshore and onshore infrastructure will be located and is the 'red line' boundary for the purposes of the consent application. For ease of reference, within this NIS, the area within the proposed development landward of the HWM associated with onshore infrastructure is referred to as the 'onshore development area' and the area within the proposed development boundary seaward of the HWM associated with offshore infrastructure is referred to as the 'offshore development area'.

1.5 Appropriate Assessment Process

The European Commission's methodological guidance (EC, 2021) promotes a progressive stage by stage process, the outcome of each stage determining whether the next stage in the process is required. This process is detailed within the 2009 guidance from the Department of Environment, Heritage and Local Government (DEHLG, 2009, amended 2010). In summary, the three stages of the process are (also see Figure 1.1):

- Stage 1: Screening
- Stage 2: Appropriate Assessment
- Stage 3: Alternative Solutions and Statement of Imperative Reasons of Overriding Public Interest (IROPI).

Note that the DEHLG 2010 guidance refers to a four-stage process; Stage 3 of the EC 2021 guidance now covers Stages 3 and 4 of the original guidance.

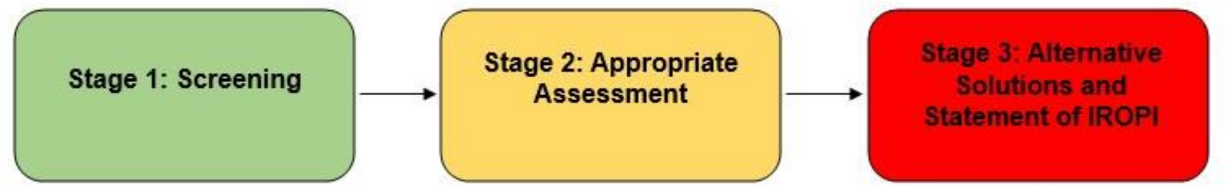


Figure 1.1: Stages in the AA process.

1.5.1 Stage 1: Screening

Screening is the first stage of the 'AA Process'. AA screening undertaken by the competent authority, identifies the potential for LSE on a European site (alone or in-combination with other projects or plans); it is an iterative process and considers an initial evaluation of a project to assess its predicted impacts against the Conservation Objectives of relevant European sites. AA screening should be undertaken without the inclusion of mitigation.

The DEHLG (2010) guidance states that screening determines whether AA is necessary by examining:

- Whether a plan or project is directly connected to or necessary for the management of the site, and
- Whether a plan or project, alone or in combination with other plans or projects, is likely to have a significant effect on a Natura 200 site in view of conservation objectives.

Sites are identified for AA screening with reference to the Zone of Influence (ZoI) which is the geographical scale over which effects could arise.

On a precautionary basis, where effects are deemed to be potentially significant, the process moves to Stage 2: Appropriate Assessment. The Developer has prepared a report to enable the competent authority to carry out its Stage 1: Screening, and this report is the SISAA Report.

1.5.2 Stage 2: Appropriate Assessment

The next stage, Appropriate Assessment, considers whether the plan or project, alone or in combination with other projects or plans, will have an AEoI of a Natura 2000 site, and includes the consideration of any mitigation measures necessary to avoid, reduce or offset negative effects.

The Appropriate Assessment Stage provides information to enable the competent authority to carry out an appropriate assessment in accordance with Part XAB of the Planning Act. Information pertaining to the Appropriate Assessment Stage is detailed within an NIS. Stage 2: AA is satisfied through the provision of this NIS.

1.5.3 Stage 3: Statement of IROPI

The potential need for Stage 3 is informed by the conclusions of Stage 2. Stage 3 examines any alternative solutions or options that could enable the plan or project to proceed without an AEoI of a European site, while still meeting the objectives of the plan or project. The process must return to Stage 2 if an alternative is identified. Where it can be demonstrated that there are no alternative solutions to the proposed development, the proposed development may still be carried out if the competent authority is satisfied that the scheme must be carried out for imperative reasons of overriding public interest (IROPI). The final part of Stage 3 is the consideration of whether adequate compensatory measures can be secured.

Should An Bord Pleanála agree to the proposal to undertake a plan or project where an adverse effect on a Natura site cannot be ruled out, they have the duty to secure compensatory measures to ensure that the overall coherence of the Natura 2000 network is maintained. In practice, practical, implementable, proportionate, and enforceable compensatory measures must be proposed and assessed by the proposed development's proponent.

1.6 The Birds and Habitats Directives

The Habitats Directive (92/43/EEC) provides the legislative framework for the protection of a wide range of rare, threatened, or endemic animal and plant species throughout the European Union (EU). The Birds Directive (Conservation of Wild Birds Directive (79/409/EEC)) aims to protect listed wild bird species naturally occurring in the European Union. Together, the two Directives have also created the Natura 2000 protected areas network.

The overall objective is to ensure the maintenance or restoration to a Favourable Conservation Status (FCS) of habitats and species designated within protected areas, known as European sites: Special Areas of Conservation (SAC) which protect terrestrial and marine habitats, including flora and fauna and Special Protection Areas (SPA) which protect birds. These sites provide for the protection and long-term survival of Europe's most valuable and threatened species and habitats.

The requirement for AA is set out in Article 6(3) of the Habitats Directive (92/43/EEC).

Article 6(3) of the Habitats Directive requires "*Any plan or project not directly connected with or necessary to the management of the site (Natura 2000 site) but likely to have a significant effect thereon, either individually or in-combination with other plans or projects, shall be subject to AA of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only having ascertained that it will not have an adverse effect on the integrity (AEoI) of the site concerned*".

Should the conclusion of the AA be that AEoI cannot be ruled out beyond reasonable scientific doubt, Article 6(4) goes on to state: "*If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted. Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for environment or, further to an opinion from the Commission to other imperative reasons of overriding public interest*".

1.7 Relevant Guidance

This report has been produced taking into consideration the following key guidance:

- Appropriate Assessment Screening for Development Management-OPR Practice Note PN01 (Office of the Planning Regulator, 2021)
- Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. Department of the Environment Heritage and Local Government (DEHLG, 2009, revised 11/02/10)

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Chartered Institute of Ecology and Environmental Management (CIEEM 2018, updated 2022)
- Offshore Renewable Energy Development Plan II: Strategic Environmental Assessment Report. Department of Environment, Climate and Communications & Sustainable Energy Authority Ireland (DECC, 2023)
- Offshore Renewable Energy Development Plan II: Principles Report. Department of Environment, Climate and Communications & Sustainable Energy Authority Ireland (DECC, 2022)
- Department of Environment Heritage and Local Government Circular NPW 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive - Guidance for Planning Authorities (DEHLG, 2010); Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities. Circular NPWS 1/10 and PSSP 2/10 (DEHLG, 2010)
- Guidance on EIS and NIS preparation for Offshore Renewable Energy Projects. Department of Communications, Climate Action and Environment (DCCAE, 2017)
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. European Commission (EC 2021)
- Guidelines for Good Practice Appropriate Assessment of Plans under Article 6(3) Habitats Directive (International Workshop on Assessment of Plans under the Habitats Directive, 2011)
- Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC. European Commission (EC, 2007)
- Managing Natura 2000 sites The provisions of Article 6 of the Habitats Directive 92/43/EEC (EC 2018);
- Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document. Prepared by National Parks and Wildlife Service. Department of Arts, Heritage and Gaeltacht (DAHG 2012)
- Guidance to Manage the Risk to Marine Mammals from Manmade Sound Sources in Irish Waters. Prepared by National Parks and Wildlife Service. Department of Arts, Heritage and Gaeltacht (DAHG 2014)
- Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. European Commission (EC, 2021)
- Wind energy developments and Natura 2000. European Commission (EC, 2011)
- The Guiding Principles for Cumulative Impact Assessments in Offshore Wind Farms, (Renewable UK, 2013) as presented in the Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects. Department of Communications, Climate Action and Environment (DCCAE, 2017); and
- Interpretation line suggested by the Commission as regards the application of Directive 85/337/EEC to associated/ancillary works.

1.8 Case Law

The AA process, including Stage 1 screening for AA, was undertaken with consideration of case law, including judgments of the Irish and European Courts. Of most significance:

No measures intended to avoid or reduce harmful effects on any European Site were considered in the screening for this NIS, as consistent with the *People Over Wind, Peter Sweetman v Coillte Teoranta (C-323/17)* ruling.

1.9 Data Collection

1.9.1 Coastal and Marine Habitats

Information on the benthic and subtidal and intertidal coastal and marine communities and habitats within the proposed development boundary was collected through a detailed desktop review of existing literature and data sources and site-specific surveys. These data have provided comprehensive coverage across large parts of the proposed development boundary. In addition, the assessments are informed by site-specific plume modelling, which provided information on the duration and dispersal pathways of sediment plumes and any associated sediment deposition.

Site-specific surveys for the proposed development have been undertaken to provide an up-to-date characterisation of the coastal and marine habitats and species occurring within the proposed development boundary. All survey methodologies were in line with the relevant guidance documentation (Cefas, 2002; Cefas et al., 2004; Davies et al., 2001 and Kenny, 2011). The surveys are summarised in Table 1.1 below.

Table 1.1: Site-specific coastal and marine survey data.

Title	Summary
NISA Benthic Ecology Baseline Cable Route Benthic Survey Report (Appendix 4).	An Intertidal Phase I walkover survey was undertaken on the 26th of September 2022 and was carried out between HWM and LWM to determine the composition and distribution of intertidal biotopes and the extent of sub-features. In areas of soft substrate, sediment characteristics were assessed with material collected from eight sites for particle size analysis (PSA) and Total Organic Carbon (TOC) content determination. Sediment samples were also collected from ten sites for infaunal analysis with sediment taken to a depth of 20-25cm and washed over a 1mm sieve with all retained fauna identified and enumerated. Biotopes/habitats were assigned and mapped by reference to the benthic community data collected and by reference to aerial imagery. The subtidal benthic survey campaign was carried out between the 27th of September – 1st October 2022 with 30 sites surveyed, of which 24 were within the ECC with the remainder directly to the south. Drop Down Video (DDV) transects were conducted at all sites to inform seabed habitat classification. Similarly, samples for infaunal analysis were collected at all 30 sites using a 0.1m2 Day Grab. Material was washed over a 1mm sieve with all retained fauna identified and enumerated. Additional sediment was collected at ten sites for PSA and TOC determination while surficial sediments were collected for chemical analyses. Turbidity measurements were collected at various depths at three sites, one measurement per site; located near shore, mid-way along the ECC assessment area and near the array area.
NISA Benthic Ecology Baseline Array Area Benthic Survey Report (Appendix 5).	A total of 40 sampling stations were selected in the vicinity of the array area and the adjacent subtidal environment, of which 11 sites were within the array area. Sites were selected with reference to existing habitat and geophysical data to ensure that all habitats present within the survey area were represented. At each station sediment was collected for physiochemical analyses (PSA, TOC, chemistry) and a single 0.1m2 Day Grab sample was taken for faunal analysis. DDV samples were collected from 12 sampling stations, five of which were within the array area distributed throughout the array. In addition, DDV data were acquired at 20 sites located to the southwest of the array area where historical data indicated the prevalence of hard substrate unsuitable for grab sampling. All survey sites were within the area covered by the Marine Area Consent (MAC)[2] for the proposed development, which has been refined since the survey was undertaken in 2022 through design development to the offshore development area.

A detailed desktop review was carried out to establish a baseline of information describing the offshore proposed development area. The baseline characterisation utilises a broad combination of datasets and provides a robust temporal analysis and validation of regional monitoring datasets. The key desk-based data sources used in the assessment are shown in Table 1.2.

[2] the MAC is a State consent, awarded to the Developer in December 2022 which allows the right to occupy a part of the maritime area and the ability to subsequently apply for development consent within that maritime area.

Table 1.2: Desk-based data sourced relevant to coastal and marine habitats.

Data sources / publications	Reference / source location, data type and summary	Temporal coverage
EMODnet broad-scale seabed habitat map of Europe (EUSeaMap, 2021).	https://www.emodnet-seabedhabitats.eu/ Interactive map of benthic data and habitat maps.	Latest data from 2021
Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR, 2021).	https://www.infomar.ie/maps/interactive-maps/seabed-and-sediment A joint project between the Marine Institute and Geological Survey of Ireland using multibeam echosounder and seabed survey data providing sediment mapping.	2006-2016
Habitats Directive Annex I habitat maps.	https://www.emodnet-seabedhabitats.eu/access-data/launch-map-viewer/ Habitat data from EMODnet Seabed Habitat maps that contains data on habitats described in Annex I of the EU's Habitats Directive.	2016
JNCC Mid Irish Sea Reefs habitat mapping report (Dalkin, 2008).	https://data.jncc.gov.uk/data/c74e7820-b959-4d2a-b235-a2a187a5fbae/JNCC-Report-411-FINAL-WEB.pdf Report written with the aim of improving the understanding of the benthic habitats and communities within the Irish Sea.	2006 – 2007
Distribution of Coastal Habitats in Ireland 2013-2018 (Marine Institute, 2019).	https://data.marine.ie/geonetwork/srv/eng/catalog.search#/metadata/ie.marine.data:dataset.3993 Specific habitats identified in the EU Habitats Directive including subtidal sandbanks, sea cliffs, estuaries and sand dunes.	1983 - 2018
Offshore Benthic Communities of the Irish Sea. In: The Irish Sea: An Environmental Review, Part 1 (Mackie, 1990).	https://gis.ices.dk/geonetwork/srv/api/records/4908b026-1ee4-4921-9a9c-ce53f802864e Data collected for Irish Sea benthic habitats were digitised into a map by JNCC. Specific habitats identified in the EU Habitats Directive including subtidal sandbanks, sea cliffs, estuaries and sand dunes.	1990
Dublin Port Maintenance Dredging 2022 – 2029 Benthic and Fisheries Assessment (Aquatic Services Unit, 2020)	https://www.dublinport.ie/information-centre/dredging/ Data and information on Maintenance Dredging campaigns. Benthic and fisheries assessment of the subtidal area of Dublin Port to support the ongoing maintenance dredging operations of the port from 2022 to 2029.	2020
Greater Dublin Drainage Scheme: Hydrographic Survey Report GEO13_GDD (Tech Works Marine, 2013)	https://assets.gov.ie/109918/2501a74e-c4af-48a9-a598-44d9026d7355.pdf Near-shore seabed surveys in two areas North of Dublin to investigate the seabed properties to ascertain their suitability for location of a marine to serve the new wastewater treatment plant (WWTP) of the greater Dublin area.	2013

1.9.2 Migratory Fish

A detailed desktop review has been carried out to inform the baseline characterisation of fish resources within the offshore proposed development area. Information was obtained on fish ecology in general and on migration, spawning and nursery behaviour and habitats of key species. The baseline characterisation utilises a broad combination of existing literature and site-specific and regional monitoring datasets. Regional monitoring datasets were used to describe the distribution of fish assemblages within the wider western Irish Sea and to characterise the receiving seabed environment. In addition, regional datasets were used to identify spawning and nursery grounds within the study area. Data collected during site-specific benthic ecology surveys undertaken across the offshore proposed development area were used to complement the characterisation. The key data and information sources used to inform the baseline characterisation for migratory fish are listed in Table 1.3.

Table 1.3: Data sources used to inform the migratory fish baseline characterisation and assessment.

Data source	Data utilisation
Site-specific Surveys	
Site-specific benthic ecology baseline surveys across the array area (Natural Power, 2022) and ECC (Natural Power, 2023).	Site-specific survey data inclusive of benthic grabs, DDV, PSA, sediment total carbon content and contaminant analysis. DDV data used to inform the fish baseline.;
Existing Data Sources	
ICES (2023a) Northern Irish Ground Fish Survey (NIGFS) (2012-2022).	Provided distribution data on ground fish in the western Irish Sea (ICES statistical rectangles 36E3, 36E4, 35E3, 35E4, 37E3, and 37E4)
ICES (2023b) Offshore Beam Trawl Survey (BTS) (2012-2022).	Provided distribution data on ground fish in the western Irish Sea (ICES statistical rectangles 36E3, 36E4, 35E3, 35E4, 37E3, and 37E4)
ICES (2022) ICES Ecosystem Overviews. Celtic Seas ecoregion - Ecosystem Overview.	Overview of the state of the ecosystem in the region.
King et al. (2011) Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish.	Details most up-to-date list of amphibians, reptiles and freshwater fish native and non-native to Ireland, listed from least concern to extinct.
Inland Fisheries Ireland (IFI) publications on the status of migrating fish populations (2018-2023).	Findings of a monitoring programme designed to assess the status of salmon populations in river catchments throughout Ireland.
Aquatic Services Unit (2020) Dublin Port Maintenance Dredging 2022 - 2029 Benthic and Fisheries Assessment.	Trawl survey data from Dublin Bay used to support the fish and shellfish baseline characterisation.
Saorgus Energy Limited, 2013. Dublin Array An Offshore Wind Farm on the Kish and Bray Banks. Environmental Impact Statement.	Environmental and ecological data collected from the Kish and Bray banks and along the ECC of the proposed Dublin Array wind farm development. Data used to support the fish and shellfish baseline characterisation.

1.9.3 Marine Mammals

The baseline characterisation for marine mammals and the assessment has been informed by numerous data sources comprising a desk-based review of existing data sources together with consideration of site-specific surveys and is detailed in Table 1.4.

Site-specific surveys for the proposed development included a combination of vessel-based and digital aerial surveys. Vessel surveys began in November 2019 and were conducted through to March 2020. For the remainder of the surveys, due to the COVID-19 pandemic, the primary survey method switched to digital aerial surveys, which were conducted monthly from May 2020 to October 2022 resulting in 29 surveys. Vessel-based surveys were also conducted again in August 2020 and June/July 2021 to help apportion the unidentified sightings from the digital aerial surveys. All surveys (vessel and aerial) covered the original Maritime Area Consent (MAC) boundary plus a 4km buffer area.

Additional baseline data were available from a variety of sources, including previous baseline surveys ObSERVE, IWDG surveys, SCANS, Irish marine mammal atlas, survey information (available in the public domain) from other wind farm areas in close proximity, MERP maps, aerial seal surveys and seal telemetry data. This data are limited by the lack of fine spatial and temporal scales surveyed, with many of the areas surveyed not directly overlapping with the offshore development area. However, they do provide a good indication of the species present in the vicinity of the proposed development and are complimented by the proposed development's site-specific surveys which provide a more contemporary estimate at both fine temporal and spatial scale.

Table 1.4: Data sources relevant to marine mammals.

Data source	Type of data	Temporal and spatial coverage
Site-specific surveys	Combination of visual boat-based surveys and digital aerial surveys	November 2019-October 2020: original NISA OWF array area (from the foreshore licence, excluding the seabed beyond 12nm) plus 4 km buffer. November 2020 onwards: MAC area (includes the seabed beyond 12nm) plus 4km buffer.
ObSERVE (Rogan et al. 2018)	Visual aerial surveys	4 surveys: summer 2015, winter 2015, summer 2016 and winter 2016. The offshore development area is entirely located within ObSERVE survey Stratum 5. Offshore waters around Ireland, within and beyond Ireland's continental shelf.
SCANS III & IV (Hammond et al. 2017, Hammond et al. 2021, Lacey et al. 2022, Gilles et al. 2023)	Aerial and vessel visual surveys	All European Atlantic waters. CWP Project located in block E (western Irish Sea) for SCANS III surveys. This block was renamed to block CS-D for SCANS IV.
SCANS II (Hammond et al. 2013)	Aerial and vessel visual surveys	June & July 2005. All European Atlantic waters. Proposed development located in block O (entire Irish Sea).
Distribution and abundance of cetaceans Wales and its adjacent waters (Evans and Waggitt 2023)	Maps of sighting rates and indicative density surface maps from aerial and vessel survey data	1990 – 2020. Wales and adjacent seas.
Irish marine mammal atlas (Wall et al. 2013)	Collation of data from IWDG, the ISCOPE I and II projects, ferry survey programme and the PReCAST surveys.	2005-2011. Irish Exclusive Economic Zone (EEZ).
IWDG Irish Sea surveys (Berrow et al. 2011)	Visual and acoustic survey	2 surveys in August 2011. Inshore surveys in 2 blocks: Block A (northern Irish Sea – including the proposed development) and Block B (southern Irish Sea).
IWDG SAC surveys (Berrow and O'Brien 2013, O'Brien and Berrow 2016, Berrow et al. 2021)	Visual and acoustic line transect surveys	1 survey in 2013. 4 surveys in 2016. 6 surveys in 2021. Rockabill to Dalkey Island SAC.
IWDG Irish coastal water surveys (Berrow et al. 2008)	Vessel based visual line transect surveys and T-POD acoustic monitoring	6 survey days between July-September 2008. 5 sites (North County Dublin, Dublin Bay, Cork coast, Roaringwater Bay SAC and Galway Bay).
IWDG Greater Dublin Drainage Project surveys (Meade et al. 2017)	Land based observations, vessel-based surveys and CPOD acoustic monitoring	24 surveys: March 2015-March 2017. Land: North-eastern cliffs of Howth Head. Vessel: waters off Loughshinny and Portmarnock area. CPODs: 3 sites: East of Loughshinny, North of Lambay Island and off Portmarnock.

Data source	Type of data	Temporal and spatial coverage
MERP maps (Waggitt et al. 2020)	Collation of data from JCP (aerial and vessel)	1980 and 2018. European Atlantic waters.
Seal counts 2017-2018 (Morris and Duck 2019)	Aerial survey	August 2017 and 2018. Entire coastline of Ireland.
Seal at-sea density (Carter et al. 2020)(Carter et al. 2022)	Seal habitat-use derived from telemetry data	2005 – 2019 UK and Ireland
Seal telemetry (Cronin et al. 2016)	Telemetry tags	Strangford Lough: 33x harbour seals (2006, 2008 & 2010). Raven Point: 19x grey seals 2013 & 2014. Great Blasket Island: 8x grey seals 2009.
Seal counts 2005 (Ó Cadhla et al. 2007)	Aerial survey	Spring & summer 2005. Entire coastline of the Republic of Ireland.
Seal counts 2017-18 (Morris and Duck 2019)	Aerial survey	August 2017 and 2018. Entire coastline of Ireland.
Seal telemetry (Cronin et al. 2016)	Telemetry tags	Strangford Lough: 33x harbour seals (2006, 2008 & 2010). Raven Point: 19x grey seals 2013 & 2014. Great Blasket Island: 8x grey seals 2009.
Codling surveys (Codling Wind Park Limited 2020)	Visual vessel surveys	April 2013 – March 2014 and again in Oct 2018 – Oct 2019. Codling Wind Park array area.
Arklow surveys (GoBe, 2023)	Visual vessel surveys Digital aerial surveys	Monthly vessel surveys: July 1996 and March 1997, and June 2000 and June 2009. Arklow Bank wind farm array area plus a 5km buffer. Monthly aerial surveys between March 2018 and February 2020. Lease Area plus a 4km buffer.

1.9.4 Ornithology

A range of data sources was used to characterise the proposed development boundary in terms of offshore and intertidal ornithology. To inform this assessment a number of site-specific surveys were undertaken as outlined in Table 1.5 below.

Table 1.5: Site-specific surveys conducted for ornithology.

Source	Date	Summary
Digital aerial survey (DAS) data	2020-2022	The original site specific DAS survey extent mirrored the array area within the foreshore licence plus a 4km buffer. The DAS survey extent was updated in November 2020 to include the entire MAC boundary (which included the small area beyond 12nm that was not within the original DAS survey extent).
Boat-based survey data	2019 - 2020	Vessel surveys were conducted by in November 2019, January 2020, March 2020, August 2020, June 2021, July 2021, and July 2022. Initial baseline characterisation was undertaken using vessel-based surveys, however these were then succeeded by DAS data collection as the main form of data collection with supplementary vessel-based surveys, as outlined in the Technical Baseline.
Landfall surveys	2021 - 2022	Intertidal bird surveys were conducted at the selected landfall site to characterise the baseline environment in terms of ornithological receptors.

Source	Date	Summary
Coastal vantagepoint surveys	2019 - 2021	Vantagepoint surveys conducted at two locations to better quantify the movements of migratory species and to supplement DAS data collection
Breeding bird surveys	2021 – 2023	To provide information on the distribution of breeding birds within or close to the onshore development area, walkover and point count surveys were undertaken at the landfall site, grid facility, Blakes Cross North and South, M1 crossing, Malahide Estuary and the existing Belcamp substation.
Wintering waterbird surveys	2021 – 2022	To determine density of use by wintering bird populations, and especially to identify any important foraging or roosting sites within sensitive locations, Irish Wetlands and Birds Survey (I-WeBS) style surveys were undertaken at the landfall site, grid facility and at Malahide Estuary.

A detailed desktop study was also undertaken to inform this assessment, covering a wide variety of published literature, including both peer reviewed scientific literature and the 'grey literature' such as wind farm project submissions and reports. The key desktop sources are outlined in Table 1.6 below.

Table 1.6: Desk-based data sources relevant to ornithology.

Source(s)	Date	Summary
Relevant literature on seabird distribution, population sizes, migration routes and foraging ranges		
JNCC Report No. 267 (Pollock et al. 1997)	1997	European Seabirds at Sea (ESAS) survey data collected between 1980 and 1997 in Irish waters, including a period of intensive surveys between 1994 and 1997, which targeted areas around Ireland with poor survey coverage. Used to provide historic context for the wider Irish Sea.
ObSERVE (Jessop et al. 2018)	2018	Visual aerial surveys of the western Irish Sea. Four surveys: summer 2015, winter 2015, summer 2016 and winter 2016. This dataset was used to classify and inform a baseline for the assessment of the offshore ECC.
Designated sites	Various dates	Information of Special Protection Areas (SPAs) and other designations relevant to Important Ornithological Features (IOFs) with potential connectivity to the proposed development. Key source of information will be Natural England designated sites portal.
Seabird Monitoring Programme (SMP) (BTO, 2023)	2015-2020	Online database of seabird colony counts in Ireland and UK – most recent data from Seabirds Count national census 2015-2020. Used to provide SPA reference populations for the EIAR.
NPWS Published Report (Cummins et al. 2019)	2019	The Status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018. Used to provide SPA reference populations for this assessment.
Birdwatch Ireland Irish Wetland Bird Survey (I-WEBS)	Annual Reports	Annual survey reports of wetland waterbirds and intertidal birds throughout the Republic of Ireland.
Regional and national bird reports and atlases	Various	Atlases covering breeding and non-breeding birds within relevant areas, e.g. Birds in Ireland (Hutchinson, 2010), North-west European waters (Stone et al., 1995) and in Europe (BirdLife international, 2004).
Review of seabird foraging ranges - Woodward et al., (2019)	2019	British Trust for Ornithology (BTO) report updating foraging ranges of seabirds. These are used to consider connectivity with both designated sites and other OWFs. This report provides an update from previous information on foraging ranges from Thaxter et al., (2012).
Literature on seabird foraging movements	Various	Various sources on seabird foraging (e.g. tracking data), including the FAME Project (Baer & Newton, 2012) and tern tracking data at Rockabill Island (Perrow et al., 2019)

Source(s)	Date	Summary
Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (regional population) – Furness (2015)	2015	Furness 2015 provides regional non-breeding season population sizes for relevant offshore ornithological receptors. Though focussed on UK waters, population sizes in UK Western Waters are considered relevant to Ireland.
The status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018 – Cummins et al (2019)	2019	NPWS commissioned report providing data on breeding seabird population sizes and trends of Ireland's breeding seabird species.
Literature on migratory bird populations and movements relevant to the proposed development	Various	Various sources on migratory birds and movements, including 'The Migration Atlas: Movements of the birds of Britain and Ireland' (Wernham et al., 2002), and literature on the risk of OWF developments to migratory birds (Wright et al., 2012).
Bird breeding ecology	Various dates	Information on the breeding ecology of various bird species e.g., Cramp and Simmons, 1977-94; Del Hoyo et al., 1992-2011; Robinson, 2005.
JNCC review of seabird demographic rates (Horswill and Robinson 2015)	2015	Information on demographic rates of seabirds, used to inform the assessment.
eBird[3] citizen science data	Various dates	Information on bird observations in relevant areas was used to supplement vantagepoint surveys (e.g., data from Clogher Head[4] to compare recorded species distributions)/
Relevant literature on the vulnerability of birds to OWFs		
Potential impacts of offshore windfarms on birds	Various dates	Various peer reviewed scientific literature regarding the potential impacts from OWF e.g. (Garthe and Hüppop, 2004; Drewitt and Langston, 2006; Stienen et al., 2007; Speakman et al., 2009; Langston, 2010; Band, 2012; Cook et al., 2012; Furness and Wade, 2012; Wright et al., 2012; Furness et al., 2013; Johnston et al., 2014a,b; Cook et al., 2014; Dierschke et al., 2017; Jarrett et al., 2018; Leopold & Verdaat, 2018; Mendel et al., 2019);
Potential impacts resulting from highly pathogenic avian influenza (HPAI)	Various	Various literature regarding the impacts of HPAI on seabird species is considered in relation to potential additional impacts on ornithological receptors assessed in this NIS. These include: Paradell et al., (2023), Lane et al., (2023), Pearce-Higgins et al., 2022). Available information on HPAI from sources such as Birdwatch Ireland and the BTO is also considered wherever relevant.

1.10 Consultation

Consultation by the Developer has been ongoing since 2021 and will continue after the planning application submission stage.

At a very early stage in the design of the proposed development, the Developer initiated a stakeholder engagement campaign with prescribed bodies, the public and other relevant bodies and organisations. The Developer has been committed at an early stage to provide information throughout all development phases of the proposed development.

[4] https://ebird.org/barchart?r=L7333978&yr=all&m=

To this end, the Developer established a systematic, documented process to manage the stakeholder consultation requirements from the outset of the development process to bring forward proposals that are suitable and appropriate in the context of the local area.

The proposed development team have conducted wider stakeholder consultation throughout the development process to include NPWS, Fingal, Dublin City, Meath and Louth County Councils, relevant statutory bodies, fisheries organisations and other interested coastal and marine bodies, utility and service providers, landowners as well as residents and business within proximity to the proposed development.

Where practicable and appropriate, the information and advice received from the consultation process was subsequently incorporated into the design of the proposed development.

A summary of consultation undertaken to date for the proposed development relevant to the receptor groups is provided within the SISAA Report.

1.11 Transboundary Consultation

It is anticipated that An Bord Pleanála will undertake transboundary consultation. It should be noted that the SISAA Report included screening for appropriate assessment for all European sites and QIs within the Zone of Influence (ZoI) for the proposed development, regardless of the countries within which they occurred; where transboundary sites are screened in for LSE, these are included within the NIS. During the pre-application period, notifications of the Developer's intent to submit a planning application were issued on 27th February 2024 to the following transboundary consultees:

- The Isle of Man – The Department of Infrastructure
- Northern Ireland – The Department for Infrastructure Planning
- Wales– Planning Directorate
- Scotland – Strategic Environmental Assessment Gateway and Database; and
- The United Kingdom - Department for Levelling Up, Housing and Communities - Environmental Assessment, Planning Reform and Housing Quality.

This NIS provides the information necessary for transboundary consultation on AA matters through the identification of transboundary sites where LSE applies and the determination of AEoI alone and in-combination. A summary of transboundary sites is provided in Section 7.

1.12 Approach to the Assessment

Within this document, the approach to the assessment follows that provided in DCCAE (2017).

Using the results from Stage 1 of the Appropriate Assessment process in the SISAA, European sites located within the zone of influence of the proposed development, and therefore where there is the potential for LSE, are identified.

Where potential for LSE on a European site is identified, whether those effects would adversely affect the integrity of the site in view of its conservation objectives is considered.

Integrity of the site relates to its qualifying interest(s), conservation objectives and the condition of the site. Ecological integrity has been defined in Managing Natura 2000 sites (EC, 2000) as "*the coherence of the site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or populations of species for which the site is classified*". Integrity relates to the quality of the whole habitat or species. In changing and evolving marine ecosystems, a high degree of integrity is where the European site is resilient, has the capacity to repair and renew with minimum management, and can achieve the stated conservation objectives.

To minimise the potential for repetition, the determination of AEoI is made on a receptor-by-receptor basis, with the relevant sites (and their QIs) identified for each receptor, together with the relevant effects.

No SACs designated for terrestrial habitats or species have been screened in due to the distance from the proposed development to the sites being beyond the ZoI for terrestrial habitats and species.

Sites that are designated for intertidal habitats have been considered as coastal sites and are assessed under the Coastal and Marine Habitats receptor group, as listed below.

The information is presented within this NIS according to the following receptor groups:

- Coastal and Marine Habitats
- Migratory Fish
- Marine Mammals
- Ornithology

For each receptor group, European sites screened in for potential LSE are tabulated, along with the relevant QIs, and the potential impacts from construction, operation and decommissioning to be assessed. For each QI, detailed COs are provided.

Potential impacts are then considered in relation to the two project options for the offshore infrastructure included within the planning application with the option which has the greatest potential for a likely significant effect (e.g. depending on the impact, largest footprint, greatest source noise) taken forward within the appropriate assessment. For the onshore infrastructure included within the planning application, a precautionary approach has been taken forward, at an appropriate scale, to assess likely significant effects within the appropriate assessment. The precautionary approach provides an assessment of AEoI where there is any uncertainty over the precise nature and/or magnitude of a LSE.

For each European site, the nature of each impact is discussed (e.g. in terms of scale, duration, frequency etc) drawing on the description of the proposed development and results of site-specific surveys, and utilising relevant technical guidance and existing industry data and literature.

The potential for an effect pathway, i.e. a pathway between the impact and a receptor (in this case a QI of a European site), is then considered, taking account of any mitigation employed. If it is concluded that no effect pathway exists and therefore no impact can occur, then a conclusion of no AEoI is drawn.

Where an effect pathway is identified, the sensitivity of a QI to the impact is considered with reference to the COs for the European site. As part of this process, further mitigation measures may be proposed, including the period during which they are required, with the aim of mitigating any significant effects on the environment or the European site. For each QI, a conclusion as to whether or not the project would adversely affect the integrity of any European site is provided.

A detailed assessment approach and criteria for each receptor are provided within Section 5 (project alone) and Section 6 (project in-combination).

Integrity matrices were created as a summary of the assessment and can be seen in Appendix 2.

1.13 In-Combination Assessment

1.13.1 Overview

Article 6(3) of the Habitats Directive requires the Competent Authority to make the AA alone and / or in-combination with other plans or projects, where these are not directly connected with the management of the site. As set out in the European Commission's 2021 Guidance (EC, 2021), "*significance of the effects will vary depending on factors such as magnitude of impact, the type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned*".

In line with guidance outlined in Section 1.7, plans or projects which are completed, approved but uncompleted, or proposed have been considered. EC (2021) specifically advise that "*as regards other proposed plans or projects, on grounds of legal certainty it would seem appropriate to restrict the in-combination provision to those which have been actually proposed, i.e. for which an application for approval or consent has been introduced*".

1.13.2 Screening in Process

When screening in LSE, there is a presumption that where a potential for LSE has been identified for the proposed development alone, then potential LSE in-combination applies. For sites where no LSE was identified alone but a pathway for effect remained, these sites were screened through to AA for in-combination consideration except where the project alone assessment identified a negligible impact risk (i.e. the quantum of impact attributed to the proposed development was so small that it would make no material contribution to the in-combination effect). In those circumstances, no LSE in-combination could also be concluded, and these sites were not screened through to AA.

Where potential LSE in-combination has been identified, it follows that relevant plans and projects need to be identified as it is these that would need to be considered in-combination with the proposed development within the Stage 2 assessment.

Projects that are built and operational at the time of baseline characterisation, and no more works or licenced activities are permitted or anticipated, are classified as part of the baseline conditions and therefore have not been considered further unless they have ongoing effects not captured within the baseline, for example ongoing ornithological collision risk.

For those projects that were only partially constructed at the time that baseline characterisation was undertaken, or those that were only recently completed during the development of the baseline characterisation, the full extent of the impacts arising from the development(s) may not be reflected in the baseline. Therefore, such projects have been screened into the assessment.

Accordingly, the following types of plans or projects have been screened in:

- Those under construction
- Those projects that are only partially constructed at the time that baseline characterisation is undertaken.
- Projects in operation that have ongoing effects, e.g. collision risk.
- Projects that were only recently completed and so the full extent of the impacts arising from the development(s) may not be reflected in the baseline.
- Those plans and projects which may have consent or licences to undertake further work, such as maintenance dredging or notable maintenance works which may arise in additional effects.
- Permitted application(s), but not yet implemented.
- Submitted application(s), but not yet determined.
- Projects on the An Bord Pleanála website including those at pre-application stage.
- Identified in the relevant development plan (and emerging development plans - with appropriate weight given as they move closer to adoption) recognising that much information on any relevant proposals will be limited; and
- 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.

Due consideration has been given to establishing the maximum suite of projects with potential to contribute to an in-combination effect with the proposed development. Each topic has considered their receptors and have taken into account species range and mobility as well as the pathways for effects. This process has been informed by expert judgement and from precedents set by jurisdictions and countries with established offshore renewable energy sectors and where comprehensive guidance has been developed.

The long list of projects has then been established by taking both the receptor led approach and associated distances into account, and utilising established ecosystem boundaries that cover the ZoI of potential impacts. This allows for a meaningful and comprehensive list of projects to be generated using desk-based resources.

The ecosystem boundaries that have been utilised (in ascending order of size) are the ICES Ecoregion subsection 7a; ICES Ecoregion section Celtic Sea (which incorporates 7a); and the JNCC Celtic and Greater North Seas Marine Mammal Management Unit.

The long list in-combination matrices are provided in Appendix 3.

1.13.3 Short-listing Process

For each individual topic within the NIS, the full list of projects, plans and activities have been screened for consideration, to identify those relevant to individual receptor groups.

The full short list of projects for each receptor group is provided in Section 6; the short lists were compiled taking into account:

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

The establishment of the short lists involved consideration of multiple lines of evidence that establish whether projects create a pathway for an effect to arise through a temporal and/or spatial overlap with the effects identified for the proposed development. This includes projects that result in effects that have an immediate temporal overlap or those that run sequentially over a period of time that may extend beyond the construction, operation and maintenance and decommissioning phases as defined within Section 2.

The consideration of spatial effects has been considered at a scale appropriate to the receptor to ensure the assessment considers fragmentation of relevant habitats across an appropriate scale but also the consideration of ex situ habitats that support QIs outside of the boundaries of SACs and SPAs.

The outcome of this short-listing process for onshore and offshore projects is provided in the in-combination matrices in Appendix 3.

1.13.4 Assessment Tiers

Given the location and nature of the proposed development, a tiered approach to establishing the list of other existing and/or approved projects has been used when undertaking the in-combination assessment. The tiering of projects is not a hierarchical approach nor based on weighting.

The following tiers include:

Tier 1: this is the proposed development plus an Operation and Maintenance Facility (OMF). The OMF does not form part of this planning application and will be developed by others. It is not yet a "permitted/consented" development.

The OMF will be required to service the offshore wind farm throughout the operational phase of the proposed development. Whilst the OMF will be subject to separate planning/permitting consents and is not included within this planning application for consent, it is considered within the cumulative impact assessment of the EIAR. The OMF will be located onshore at a suitable location in the vicinity of the proposed development and will comprise an O&M building and associated storage facilities as well as a number of berths, for the vessels required to access the wind farm. Approximately 40 people will be employed at the OMF.

The current OMF option is to adapt and lease part of an existing port facility at Greenore. The existing Greenore site covers an area of approx. 150,000m^2, and it is proposed to be adapted to provide three OMFs, with the proposed development leasing just one.

The OMF will comprise the following:

- OMF building including a control room, offices, welfare facilities such as mess hall, kitchen, bathrooms, technicians washing and drying facilities, plant & equipment room.

- Warehouse and workshop (approx. $1000m^2$)
- External storage area (approx. $1000m^2$)
- Berthing facilities to support 3-4 Crew Transfer Vessels (CTVs)
- Vessel bunkering services for fuel and potable water
- Storage tanks for marine fuel and waste oil
- Additional supporting infrastructure such as lighting, perimeter security fencing, access control gates & Close-circuit television (CCTV).

Tier 2: these are the east coast Phase One Projects (proposed offshore renewable energy projects) located off the east coast of Ireland which are Oriel Windfarm, Codling Wind Park I and II, Arklow Bank II and Dublin Array. The proposed development is also a Phase One Project. Whilst none of these other Phase One Projects have submitted applications to the planning authority (ABP) at the time of writing of this NIS, they have been included in the in-combination assessment given the location and nature of these projects, given that they have all been awarded Marine Area Consent (MAC) and have more certainty of proceeding through the consenting process at the same time as the proposed development and given feedback from ABP during pre-application consultations.

Sceirde Rocks Windfarm, located off the Connemara coast in County Galway, is also a Phase One offshore wind farm however, due to the distance between it and the east coast Phase One Projects it is less likely to present cumulative effects for multiple topics and so has been included within Tier 3.

Tier 3: All other relevant projects, plans and programmes that have been identified in the long list search and then screened in for assessment.

This includes ORESS 2.1[5], a plan-led approach and greater certainty as regards to identification of sites will be available upon publication of the relevant Designated Maritime Area Plans (DMAP). It is noted that the draft DMAP for ORESS 2.1 has been published[6], however it is currently out for consultation and not yet actioned. It is considered that all future projects being developed will follow in the DMAP process.

The proposed tier assessment is presented in Table 1.7.

Table 1.7: In Combination Tiers for Assessment.

Stage	Assessment undertaken	
1	Tier 1	The proposed development plus Operation and Maintenance Facility (OMF)
2	Tier 1 and Tier 2	All projects included in Tier 1 plus east coast Phase One OWF Projects
3	Tier 1 and Tier 2 and Tier 3 (all tiers)	The above plus projects and relevant plans and programmes that have been screened in for assessment

1.13.5 Phase One Collaboration and Data Sharing

During pre-application consultation with An Bord Pleanála it was advised that the proposed development and other Phase One Projects should, where practicable, undertake a collaborative approach to data sharing and assessment.

[5] The Irish Government aims to generate 5GW of renewable electricity from offshore by 2030, rising to 20GW by 2040. ORESS 1 awarded licenses to two projects off the east coast (2.6GW) and one off the west coast (450MW). ORESS 2.1 will take place off Ireland's south coast and will procure up to 900MW of offshore wind.

[6] gov - Public Consultation on the Draft South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP) (www.gov.ie)

Collaboration was undertaken by the five east coast Phase One Projects (Oriel Wind Park; North Irish Sea Array Wind Farm; Dublin Array Offshore Wind Farm; Codling Wind Park; and Arklow Bank Phase 2) for the following activities:

- Preparation of an ornithology joint method statement, submitted to NPWS (Reference)
  - All assessment methods proposed by the Projects have been agreed within a collaborative forum and will be undertaken following an evidence-led process, and current industry best-practice and guidance. This Note aimed to facilitate agreement between projects, and with regulators and stakeholders on the process and contents detailed below.
- Impact assessment methodology workshops between project technical specialists to discuss approach and receptor sensitivities and establish alignment where practicable. This included identification of impacts for ornithology; fish and shellfish; marine mammals and cumulative effects assessment.
- Data sharing for the purposes of in-combination assessments for:
  - Offshore Ornithology; and
  - Marine Mammals.
- Collaboration between the proposed development and Dublin Array Offshore Wind Farm including data sharing, for the purposes of a Dynamic Energy Budget modelling exercise to establish the potential for likely significant effects on the Rockabill to Dalkey Island SAC.

2. Description of Development

2.1 The proposed development

The proposed development comprises both offshore and onshore elements.

The offshore elements of the proposed development comprise the following:

- Array area - where the following infrastructure will be located:
  - Offshore WTGs
  - OSP
  - Substructures and associated seabed foundations (for WTGs and OSP); and
  - Offshore inter-array cables.
  - The array area covers approximately 89km^2. At its closest point, the array area is located approximately 11.3km from land in water depths of approximately 30m to 63m below lowest astronomical tide (LAT), with the closest WTG situated approximately 12.3km from the coastline.
- Offshore Export Cable Corridor (ECC): where the offshore export cables will be routed from the OSP to landfall. The ECC covers an area of approximately 36km^2.
- Landfall site (in part): the proposed development at the landfall site traverses the HWM and consists of both onshore and offshore infrastructure. The offshore infrastructure consists of the transition of the two offshore export cables coming ashore to the onshore export cables.

The onshore elements of the proposed development comprise the following:

- Landfall site (in part): this is where the 220 kV high voltage alternating current (HVAC) offshore export cables come onshore. The landfall site will be in the townland of Bremore, north of Balbriggan, Co. Dublin. In terms of onshore infrastructure, the landfall will comprise of infrastructure landward of the HWM as follows:
  - Offshore export cables from the HWM to the transition joint bays (TJBs);
  - TJBs, which are the point at which the offshore (subsea) export cables transition to the onshore export cables; and
  - Onshore export cables from the TJBs to the grid facility.
- Grid facility: The onshore export cables terminate at the grid facility, which is located in Bremore, just north of Balbriggan and is comprised of two distinct substations on the same site: the compensation substation and the Bremore substation. When the onshore export cables enter the grid facility, they are connected to the compensation substation. A connection is then made between the compensation substation and the Bremore substation. Power leaves the Bremore substation via the onshore cable route.
- Onshore cable route: 220kV HVAC cables (in two cable circuits) will be laid underground from the grid facility to the grid connection point at the existing substation at Belcamp. Each cable circuit will comprise the electrical cables, earthing and communications cables. The onshore cable route is approximately 33-35km in length.

Figure 2.1 illustrates the onshore and offshore elements of the proposed development and their interface.

Figure 2.2. shows the location and boundaries of the proposed development.

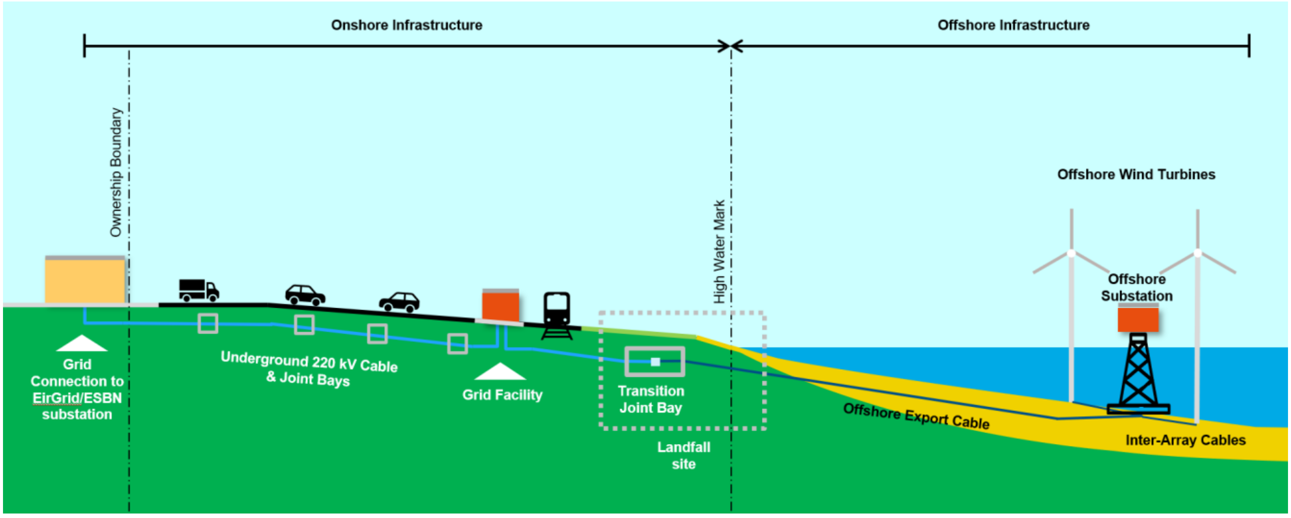
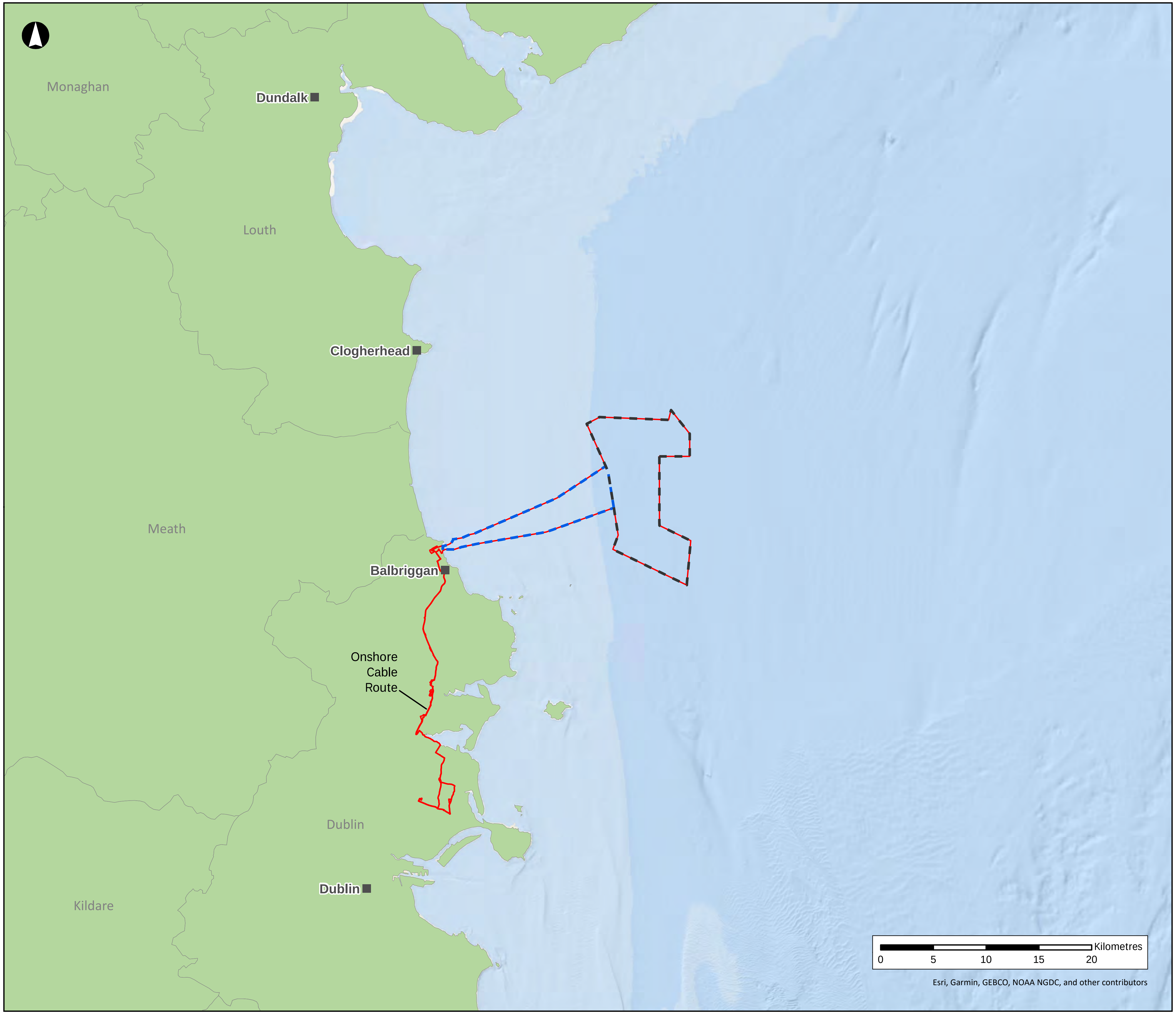


Figure 2.1: Proposed Infrastructure of the onshore and offshore elements of the proposed development (not to scale).



Proposed Development Boundary (including Onshore Cable Route)
Array Area
Offshore Export Cable Corridor

NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Location and Boundaries of the Proposed Development

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:350,000 @A3	2.2
Status: Issue	

2.2 Offshore Infrastructure

2.2.1 Design Flexibility Options

On 2 February 2024, the Board issued its opinion on design flexibility, signed 30 January 2024 (the "DF Opinion"). The DF Opinion was issued pursuant to section 287B of the Planning Acts, following conclusion of the Developer's pre-application consultations with the Board. This DF Opinion was subsequently clarified by way of letter dated 4 April 2024 and updated by way of decision pursuant to Section 146A of the Planning Acts on 16 April 2024.

The DF Opinion confirms the details of the proposed development which design flexibility has been accepted and may therefore be confirmed after the Developer's proposed application under section 291 of the Planning Acts has been made. The DF Opinion confirmed flexibility for the following aspects of the proposed development:

- Turbines – model, number, and dimensions (tip height, rotor diameter, rotor swept areas, nacelle height and hub heights)
- Turbine foundations – type and pile dimensions
- Offshore substation platform – foundation type and dimensions (height above sea level, length and width)
- Siting of infrastructure – fixed location with limit of deviation (turbines, foundations, export cable and offshore substation platform location); and
- Offshore cabling – subsea cable size and subsea cable length.

To enable this flexibility, the proposed development is including two project options for consideration in relation to offshore infrastructure: Project Option 1 and Project Option 2.

At detailed design post-consent stage, just one option will be chosen as the preferred option and subsequently constructed. An overview of the key parameters of the two project options is provided in Table 2.1.

Table 2.1: High Level Overview of the two project options for the proposed development.

Parameter	Project Option 1	Project Option 2
Number of WTGs	49	35
WTG tip height (m above LAT)	290	316 outside aviation restricted zone 311 inside aviation restricted zone*
Rotor Diameter (m)	250	276
Foundation type	Monopiles	Monopiles or multi-leg pin piled jackets (hereafter referred to as 'jackets')
Number of OSPs	1	1
Offshore export cable length (km)	18	18
Inter-array cable length (km)	111	91

*An aviation restricted zone (of 312m LAT) has been identified by the Developer due to the partial overlap of the array area with a Dublin Airport controlled airspace meaning 13 turbines will have a 5m reduction in tip height due to being within the aviation restricted zone.

2.2.2 Offshore Wind Turbine Generators (WTGs)

The offshore elements of the proposed development will comprise one of the following two project options:

- Project Option 1: 49 WTGs with 250m rotor diameter; or
- Project Option 2: 35 WTGs with 276m rotor diameter.

For both project options, the WTGs considered will follow the traditional offshore WTG design with three blades and a horizontal rotor axis. The blades will be connected to a central hub, forming a rotor which turns a shaft connected to the generator or gearbox. These are connected to the nacelle situated adjacent to the rotor hub, supported by a tower structure affixed to the transition piece or foundation. The nacelle will rotate or 'yaw' on the vertical axis in order to face the oncoming wind direction.

The design parameters for the two WTG models are outlined in Table 2.2.

Table 2.2: WTG Design Parameters

PARAMETER	PROJECT OPTION 1	PROJECT OPTION 2
Number of WTG	49	35
WTG tip height at LAT (m above lowest astronomical tide (LAT))	290	316 outside aviation restricted zone 311 inside aviation restricted zone*
Hub height (m above LAT)	165	178
Rotor diameter (m)	250	276
Blade tip clearance (m above LAT)	40	40 outside aviation restricted zone 35 within aviation restricted zone*
Blade Width (m)	7	7.5
Pitch (degrees)	3.6-5.6	3.6-5.6
Operational time (%)	95	95
Total swept area (m^2)	49,087	59,828
Nacelle and Hub		
Length (m)	31	35
Breadth (m)	15	18
Height (m)	15	18
Tower Diameter (m)	9	10
Rotor rotational speed (rpm)	3 – 8.3	3 – 7.5
Foundation type (See sections 2.2.3 and 2.2.4 below for further details)	Monopiles	Monopiles or jackets

2.2.3 Offshore Substation Platform

An OSP is a hub where all the energy produced by the WTG is brought together via 66kV or 132kV inter-array cables and stepped up by transformers to a high voltage transmission of 220kV High Voltage Alternating Current (HVAC) for export onshore via the offshore export cables.

The OSP is typically unmanned, however it will be designed for temporary refuge or shelter in the event of an emergency. The dimensions of the OSP topside and substructures are listed in Table 2.3. Each project option could have any of the three OSP foundation options.

Table 2.3: OSP Design Parameters

Item	Parameter
Number of OSP (s)	1
Height of Topside above sea level (m above lowest astronomical tide)	47
Height of Communications Mast above sea level (m above lowest astronomical tide)	67
Topside dimensions (m)	45 x 45
Foundation Option 1: Jacket	
Number of Jacket Legs	4
Jacket Footprint, centre distance between legs at seabed level (m)	40 x 40
Number of Piles per Jacket	4
Pile Diameter (m)	6
Seabed Penetration (m)	60
Foundation Option 2: Two Monopile	
Number of Monopiles	2
Pile Diameter (m)	12.5
Seabed Penetration (m)	60
Foundation Option 3: One Monopile	
Number of Monopiles	1
Pile Diameter (m)	12.5
Seabed Penetration (m)	60

2.2.4 Substructures and Foundations

Foundations are required to support WTG and the OSP. These structures are fixed to the seabed and are required to withstand wave and wind forces and a wide range of meteorological conditions in the offshore environment.

The foundation types that are being considered include:

- WTG foundations:
  - Project Option 1: monopiles; and
  - Project Option 2: monopiles or jacket foundations (three or four leg configuration, with pin piles).
- OSP foundations (for Project Option 1 and 2) (see Table 2.4):
  - A four-legged jacket foundation with pin piles
  - One monopile; and
  - Two monopiles.

As determined in the DF Opinion, the final selection of foundation type will depend on detailed design.

Table 2.4: Monopile Design Parameters

Item	Parameter	
	Project Option 1	**Project Option 2**
Number of WTG Monopiles	49	35
Number of OSP Monopiles	1 or 2	1 or 2
Monopile Diameter (m)	12.5	
Seabed Penetration (m) (WTG)	50	
Seabed Penetration (m) (OSP)	60	
Scour Protection diameter (m) (WTG)	56.25	56.25
Scour Protection diameter (m) (OSP)	78	78

Table 2.5: Jacket Design Parameters (Applicable to Project Option 2 for WTG and both Project Options for OSP)

Item	WTG Parameter	OSP Parameter
Number of Jackets	35	1
Number of Legs per Jacket	3 or 4	4
Jacket Footprint, centre distance between legs at seabed level (m)	40 x 40	40 x 40
Number of Piles per Jacket	3 or 4	4
Pile Diameter (m)	6	6
Sub-Seabed Penetration (m)	60	60
Scour protection diameter (m)	77	78

2.2.4.1 Foundation Installation

Both the monopile and piled jacket foundations will require installation of piles into the seabed. The foundations will be either piled or drilled depending on the seabed conditions at the final WTG locations. The installation method will be determined following detailed site investigation surveys and detailed design. The options being considered are:

- Project Option 1 (monopiles):
  - All monopiles at all locations are fully driven.
  - 25% of monopiles are fully driven and 75% of monopiles are a) fully drilled or b) driven until refusal then drilled and driven.
- Project Option 2 (monopiles):
  - All monopiles at all locations are fully driven.
  - 100% of monopiles are a) fully drilled or b) driven until refusal then drilled and driven.
- Project Option 2 (jacket foundations):
  - All jackets at all locations are fully driven.
  - All jackets at all locations are fully drilled.

2.2.5 Scour Protection

If left unprotected, scouring of the seabed may occur which can reduce the effectiveness of the foundation. To prevent scouring of the seabed, scour protection may be required to be installed around the base of the foundation.

Scour protection is laid around the base typically in the form of rock, with a filter layer of smaller graded rocks sometimes placed underneath, to reduce any seabed erosion caused as water current passes around the foundation structure. Whilst rock is the most common form of scour protection, concrete mattresses can also be used. A description of the two types of scour protection being considered for both project options is provided below:

- Rock placement: This would comprise a single layer or double layer of graded stone placed on and/or around structures to inhibit erosion. Alternatively, rock filled mesh fibre bags may be used which adopt the shape of the seabed/structure as they are lowered on to it.
- Concrete mattresses: These are typically several metres wide and long and comprise of articulated concrete blocks which are linked by a polypropylene rope lattice. These prefabricated components are then placed on and/or around structures to stabilise the seabed and inhibit erosion.

The scour protection diameter varies by foundation type. For monopiles, a diameter of 44m will be required, a diameter of 77m will be required for jacket foundations for WTG, and a diameter of 78m for the OSP.

2.2.6 Navigation, Colour, Marking and Lighting

The proposed development will be designed and constructed as per International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), Irish Aviation Authority (IAA), Commissioners of Irish Lights (CIL) (in line with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)) and Irish Coastguard requirements. These will consist of navigation aids such as buoys, markers, navigation lights and sound signals in addition to aviation warning and search and rescue (SAR) lights.

Navigation for marine traffic will be permitted across the offshore development area with 50m advisory safety zones around fixed assets.

During the construction phase, temporary lighting will be used to mark any sea surface piercing structures.

The colour scheme for nacelles, blades and towers is generally RAL 7035 (light grey) or similar and foundation steelwork is generally in RAL 1023 (traffic light yellow) or similar above the waterline. All structures will also be equipped with relevant aviation SAR lights and blade markings.

Lighting will comply with the requirements of the authorities named above. During operation, lighting on the WTG and OSP will be installed for use when personnel need to access the WTG in low light conditions. When not being accessed, the only lights visible will be navigation lights. The lighting regime will vary depending on the location of periphery structures in line with IALA and IAA guidelines.

All structures will also be equipped with relevant aviation Search and Rescue lights and blade markings.

2.2.7 Offshore Inter-Array Cables

In order to carry the electricity generated by the WTGs, inter-array cables will link a group of WTGs together into strings within the array area and connect these strings to the central OSP. Inter-array cables will have a nominal operating voltage of between 66kV and 132kV between WTGs. In total, the inter-array cables are 111km in length for Project Option 1 and 91km for Project Option 2 and will link the WTGs within the array area in strings with connect with the OSP.

Cables will be buried in a trench, where practicable, to protect them. Burial depth will be determined on a risk-based approach using a Cable Burial Risk Assessment which will be available post consent once detailed cable routes are known. Assumed burial depths are between 1 and 3m.

Where burial is not practicable, additional cable protection techniques will be used, such as concrete mattressing and/or rock armour protection. It is anticipated that approximately 20% of the cable may require additional cable protection while the rest will be buried to the design burial depth or deeper.

Cable protection will be 5m wide and 2m high, with a sloped profile across the seabed. Assumed rock size of 450mm is anticipated in the instances where rock armour protection is utilised.

No third-party cabling or pipelines are charted or identified within the offshore development area in the surveys conducted to date. The inter-array cable layout will be designed to avoid cable crossing where practicable. However, if inter-array cable crossing is unavoidable cable crossing protection will be required involving the use of a pre-lay and post lay berms. The pre-lay berm will be 5m wide, 15m in length and 0.5m in depth. The cable to cross will then be laid across this, at an angle of 90 degrees. This cable will then be covered by a second post lay berm of 5m width and 2m height, over a length of 100m. The post lay berm ensures that the cable remains protected and in place.

The inter-array cables will transition from the buried trench to WTG and OSP foundations via J-Tubes or I-Tubes (hollow steel tubes that hang from the substructures in the shape of a "J" or "I") or an aperture in the monopile wall and an assortment of bend stiffeners, outer shells known as a Cable Protection System. The Cable Protection System may be supported with additional placement of rock to protect and support the system and prevent against cable movement and potential damage.

2.2.8 Offshore Export Cables

In order to bring electricity ashore, two 220kV HVAC offshore export cables will be routed from the OSP to the landfall site. The offshore export cables will be located within the ECC. The cables will be brought to the shoreline at the landfall site where they will connect to the onshore export cables at the TJBs. The length of the offshore export cables from the OSP to the landfall site is 18km and the separation distance between the two offshore cables is assumed to be between 50m and 200m. The flexibility in the final selection of cable size and route for these offshore export cables within the ECC is part of the DF Opinion as described in Section 2.2.1.

The offshore export cables will be buried where practicable to protect them. The offshore export cables are buried in a trench with a design burial depth between 1 and 3m. Cable installation methodology, as well as burial depth and any requirement for cable protection measures, will be defined by a Cable Burial Risk Assessment (CBRA). The installation techniques will consist of one or a combination of trenching, dredging, jetting, ploughing, vertical injection, and rock cutting.

When burial is not practicable, additional cable protection techniques will be applied. No third-party cabling, pipelines or subsea infrastructure are charted or identified within the offshore development area in the surveys conducted to date. Therefore, no crossing of third-party assets is anticipated. However, if cable crossing is unavoidable, cable protection measures will be implemented. For both project options, approximately 43,200m^3 of cable protection will be required for the offshore export cables.

The proposed construction method for connection of the two 220kV offshore export cables to the two onshore TJBs will be via HDD. The principle of HDD is to drill a bore underground between two points, into which an electrical cable can be installed without needing to excavate an open trench along the route. The HDD will require a drilling fluid or 'mud', to cool and lubricate the drill head. Drilling muds are typically bentonite based, and generally comprise of 92% water and 8% bentonite powder. Bentonite drilling muds are non-toxic, inert substances, with widespread use across drilling operations in the marine environment.

The subtidal HDD exit pits will be at least 20m wide, 30m long orientated perpendicular to the coastline. Each exit pit is 2.5 m at the seaward end reducing to 1.5m at the landward end.

2.2.9 Landfall Site

The offshore export cables will come ashore within the offshore part of the landfall site.

2.3 Onshore Infrastructure

2.3.1 Landfall Site

The onshore infrastructure of the proposed development within the landfall site includes:

- An underground crossing of the offshore export cables underneath the beach via a Horizontal Direct Drilling (HDD) technique.
- Transition Joint Bays (TJBs) – located close to the shoreline and installed once the offshore export cable HDD has been completed – which will contain the connections between the offshore export cables and the onshore export cables.
- From the TJBs, the onshore export cables will be trenched through agricultural fields, cross under the Dublin-Belfast railway line (via HDD) to the R132 and then trenched onwards to connect to the grid facility.

2.3.2 Onshore Export Cables

Two 220kV HVAC underground onshore export cables (comprising of 3 cores each) will connect the TJBs to the compensation substation within the grid facility. The cables will be contained within protective ducting. Each onshore export cable will also include a fibre optic cable to support the operation and control of the electrical infrastructure, and an earthing cable contained within the same ducting.

The onshore export cable route commences at the TJBs with the cables routed through private lands including an underground HDD crossing of the Dublin-Belfast railway line and an open cut trench crossing of the R132 to connect to the compensation substation within the grid facility. This section of the cable route, from the TJBs to the compensation substation is approximately 1km to 1.5km long, depending on the final landfall TJBs location.

2.3.3 Grid Facility

The grid facility will be located across two fields currently under agricultural use, in the townland of Bremore, Co. Dublin. The function of the grid facility will be to receive power delivered from the offshore substation platform via the offshore and onshore export cables and process it so that it is suitable for feeding into the electricity grid.

The grid facility will be comprised of two separate elements as follows:

- The compensation substation will be contained within a rectangular compound approximately 100m by 190m.
- The Bremore substation will be contained within a smaller adjacent rectangular compound approximately 50m by 115m.

Both the compensation station and Bremore substation compounds will include a building of approximately 17m in height (plus 3m lightning rods).

2.3.4 Onshore Cable Route

From the proposed grid facility, two 220kV HVAC cable circuits will be laid underground from the proposed Bremore substation to the existing substation at Belcamp, in either a single trench arrangement (one trench accommodating all electrical cables, fibre-optic and earthing cables) or in twin-trench arrangement (with each cable circuit contained within its own trench). Joint bays will be required to be installed along the cable route to facilitate cable pulling through pre-installed ducts. These will be underground chambers which will "joint" consecutive lengths of cables into one continuous overall cable.

The onshore cable route runs for approximately 33-35km; the majority of the route – approximately 29km out of the 33km – is contained within the footprint of existing roads including the R132, the R106 and other local roads. The cable route will cross a number of watercourses, as well as the M1 Motorway and various utilities along its length.

2.3.5 Grid Connection

The two 220 kV HVAC onshore cable circuits will connect to the existing transmission network at Belcamp 220kV substation.

The connection will be made to either/both of the existing substation or the consented substation extension (a planning application from EirGrid to expand the existing substation at Belcamp was granted in 2023 which includes an expansion of the substation infrastructure into land to the north of the existing substation).

The onshore cable route into the substation will follow the existing access road and will connect to a spare 220kV bay within either/both of the existing substation compound and the planned the Belcamp extension.

2.4 Construction

2.4.1 Offshore Construction Programme

Subject to obtaining statutory consent (i.e., planning approval) and the relevant permits and licences, construction of the offshore elements of the proposed development is expected to commence in 2027, with completion expected in 2029, as demonstrated in Table 2.6 below. The contracting and delivery of specific work packages may differ between the two project options however, the overall programme of construction will remain the same.

Construction offshore will take place up to 24 hours per day, 365 days per year. Commissioning and pre-commissioning may also take place 24 hours per day, seven days per week. The overall duration of construction is dependent on factors such as supply chain, including fabricators and component suppliers, port and vessel availability, weather conditions and progress made throughout.

Table 2-6: Construction Timeline

Activity Name	Year 1 – 2027				Year 2 – 2028				Year 3 - 2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Pre construction activities												
Landfall												
Offshore Export Cables Installation Period												
Foundation Piling (WTG and OSP) (monopile)												
Foundation pre-piling (WTG and OSP) (jackets) Substructure Installation (WTG and OSP) (jackets)												
Offshore Substation Topside Installation												
Array Cable Installation Period												
WTG Installation period												

Offshore construction is assumed to be undertaken following the indicative sequence below, although it should be noted that some activities may be undertaken simultaneously. The sequence is as follows:

- Detailed site investigations
- Pre-construction surveys
- Seabed preparation
- Landfall Horizontal Direction Drilling (HDD) for export cable
- Offshore export cable installation and cable protection installation
- Foundation installation and scour protection installation
- Inter-array cable installation and cable protection installation
- OSP installation; and
- WTG installation.

2.4.2 Offshore Construction Vessels

Construction will require a variety of different vessels dependent on the final WTG, foundation, construction port, and construction strategy adopted. Vessels will generally use Dynamic Positioning (DP) to maintain their location, thus avoiding any disturbance of the seabed. Vessels used will comprise:

- Jack Up Vessels (JUV) to install the foundations, transition pieces, tower, nacelle, and blades.
- Heavy Lift Vessels (HLV) typically used for transportation and installation of jackets and monopiles for offshore wind turbines.
- Service Operational Vessels (SOVs) used for crew transfers, offshore accommodation, commissioning, and safety monitoring.
- Crew Transfer Vessels (CTV) used to transfer the crew from shore to wind turbine or between vessels.
- Transportation barges and towing vessels used to transport foundations, transition pieces, tower, nacelle, and blades to site.
- Dredging vessels used to excavate or move sediments like silt, sand, rocks, dirt, and other debris from the seabed with a dredger. Dredging vessels are also used for flattening of sand waves and levelling of seabed
- Fall Pipe Vessels (FPV) used for installing scour protection and other rock armour protection (e.g. cable protection);
- Cable Installation Vessels (CIV) used for inter-array and export cable installation. The vessels are optimised for the cable lay operation as well as the burial of the cable in the seabed; and
- Offshore Supply Vessels (OSV) used for grouting, towing and equipment transfer.
- Support Vessels used to support a range of other activities, including surveys, diving activities, Anchor Handling Vessels (AHV) and guard vessels.

The maximum number of vessels and return trips are shown in Table 2.7.

Table 2-7: Maximum construction vessel traffic numbers

Vessel/Helicopter Requirements for WTG Installation			
Vessel / Helicopter type	**Number of vessels / helicopters**	**Number of return trips per vessel / helicopter type (Project Option 1)**	**Number of return trips per vessel / helicopter type (Project Option 2)**
Installation vessel (e.g. JUV, HLV)	2	15	10
Personnel support vessels (e.g. CTV)	6	90	70
Component transport vessels (e.g. barges, towing vessel)	2	45	30
Helicopter support	1	10	7
Vessel Requirements for Foundation Installation			
Vessel Type	**Number of vessels**	**Number of return trips per vessel (Project Option 1)**	**Number of return trips per vessel (Project Option 2)**
Installation vessels (e.g. JUV, HLV)	2	8	6
Personnel support vessels (e.g. CTV, SOV)	3	49	35
Component transport vessels (e.g. barges, towing vessel)	3	8	6
Scour protection vessels	2	75	50
Dredging vessels (Project Option 2 only)	1	0	9
Vessel for placing template for pre-piling (Project Option 2 only)	1	0	35
OSP Installation Vessel Requirements			
Vessel Type	**Number of vessels**	**Number of return trips per vessel (Project Option 1)**	**Number of return trips per vessel (Project Option 2)**
Installation vessels (e.g. JUV, HLV)	1	2	2
Component transport vessels (e.g. barges, towing vessel)	2	2	2
Personnel support vessels (e.g. CTV, SOV)	2	250	250
Transport vessel	1	50	50

Vessel Requirements for Inter-Array Cables			
Vessel Type	**Number of vessels**	**Number of return trips per vessel (Project Option 1)**	**Number of return trips per vessel (Project Option 2)**
Main laying vessels	1	4	3
Main burial vessels	1	7	6
Personnel support vessels (e.g. CTV, SOV)	1	120	100
Component transport vessels	1	5	5
Vessel Requirements for Export Cable Installation			
Vessel Type	**Number of vessels**	**Number of return trips per vessel (Project Option 1)**	**Number of return trips per vessel (Project Option 2)**
Main laying vessels	1	2	2
Main burial vessels	1	3	3
Support vessels (e.g. CTV, SOV)	1	2	2
Work boats/ rigid inflatable boats for pull in operation - 24h	12	2	2
Work boats for landfall HDD installation	1	30	30
Small JUV for landfall HDD installation	1	2	2
Guard vessels for HDD and Cable installation	1	20	20
Guard Vessel Requirements for the Construction Phase of the Proposed Development			
Vessel Type	**Number of vessels**	**Number of return trips per vessel (Project Option 1)**	**Number of return trips per vessel (Project Option 2)**
Guard vessel	4	64	52
Observation vessel	5	64	52
Personnel Transport vessels (CTVs)	2	45	45

2.4.3 Offshore Construction Ports

The WTG and foundation components described above will be brought to site via a construction port. All components are anticipated to be transported via sea transport and delivered to the construction port. Transportation and delivery of large components (e.g. WTG blades) to the construction port via roads is not anticipated. At the construction port, the components will be stored and, in some instances, assembled before being transferred to the offshore development area using the vessels described above.

There are a number of suitable ports under consideration by the proposed development, both on the island of Ireland and Great Britain. A multi-port approach may be taken to remove the risk of a single point of failure to the proposed development. Development of Irish ports targeting the offshore wind industry will be considered.

2.4.4 Onshore Construction Programme

Subject to obtaining planning consent and the relevant permits and licences, construction of the onshore elements of the proposed development is anticipated to commence in 2026/27, with completion expected in 2028/29 (circa 24 months of construction).

Onshore construction activities will comprise:

- Horizontal directional drilling (HDD) of the offshore export cables from the HWM (transition between offshore and onshore) to the location of the landfall transition joint bays (TJBs), including HDD contractor compounds and associated works.
- Construction of the landfall TJBs and the jointing of the offshore and onshore export cables; and ancillary infrastructure such as an access track, entrance, and marker posts.
- Laying of the onshore export cables via open cut trench from the location of the TJBs to the grid facility, including an HDD crossing of the Dublin-Belfast railway line, joint bays, HDD contractor compounds and associated works.
- Construction and commissioning of the grid facility (including landscaping).
- Cable trenching, duct laying and reinstatement for the onshore cables, including HDD / open cut trenching at watercourses and road crossings.
- Onshore cable installation and jointing; and
- Connection to the Belcamp substation, including duct laying and cable jointing.

2.5 Operation and Maintenance

2.5.1 Offshore Operation and Maintenance

The operation strategy will commence following commissioning. It is anticipated that the proposed development will be managed from a local onshore facility for the lifecycle of the proposed development.

The operational lifespan of the proposed development is anticipated to be 35 years. Asset condition and operation will be monitored remotely from the control room at the operation and maintenance facility via the SCADA and condition monitoring systems. The SCADA system will enable the remote control of individual WTGs, the offshore infrastructure in general, as well as remote interrogation, information transfer, storage and the shutdown or restart of any WTG if required. The OMF will also provide a base for parts, storage and crew transfer for maintenance activities.

The operation and maintenance strategy proposes the following types of maintenance:

- Regularly scheduled monitoring and maintenance: The inspection, testing, investigation, and rectification of any minor faults to prevent major faults. This primarily applies to inspection and work on parts susceptible to failure or deterioration in between scheduled system overhauls. Scheduled maintenance is likely to occur annually, bi-annually, or quarterly as necessary.
- Scheduled system overhauls: These are carried out in accordance with the turbine manufacturer's instructions or warranties. They are scheduled in advance and planned for appropriate periods of the year primarily during suitable weather conditions such as the summer months.
- Unscheduled maintenance: Works required outside of the planned maintenance strategy, in response to unforeseen issues or breakdowns. These maintenance activities can range from small defects to the replacement of main components.

The overall operation strategy will be finalised once the onshore operation and maintenance facility (OMF) location and technical specifications of components are known, such as WTG model and number, foundation type, cable type and layout.

Once operational, it is anticipated that the inter-array and export cables will require minimal maintenance. As with any offshore wind farm, unplanned remedial works (e.g. cable repairs and reburial) are sometimes required in the event of an unforeseen fault or defect in components. If a cable defect were to occur, an isolated portion of the cable would to be cut, lifted to the surface for repair, and replaced in or on the seabed. Reburial is the preferred option once repaired, but placement of cable protection materials (e.g. rock armour) will be used where burial is not practicable. Operation and maintenance activities will require similar vessels and machinery to that used for the installation works.

Anticipate O&M activities are provided in Table 2.8.

Table 2.8: Anticipated Outline of O&M Activities

Activity	Description	Methodology	Frequency
WTG Foundations			
Routine Inspections	Inspection of the WTG foundation, including the ancillary structures and transition pieces, both above and below sea level	2-3 technicians accessing the WTG by CTV.	Twice yearly for 2 years then annually for remaining lifetime.
Replacement of corrosion protection anodes	Remove and replace the anodes used for corrosion protection of the foundations	Divers or ROV from support vessel (e.g., DP vessel)	Four per year per windfarm
Modification or replacement of ancillary structures	Remove and replace or modify the ancillary structures, such as J-tubes, ladders etc, where required	Divers or ROV usually deployed from a DP vessel	Once every 5 years
Scour protection repair and maintenance	The repair, maintenance and/or replacement of scour protection, where required	Same as installation methodology	Once every 10 years
Painting	The preparation of the surface and application of coatings (such as paint), to protect the WTG foundation from both internal and external corrosion	2-3 Technicians accessing WTG by CTV	Once every 3 years per WTG
Removal of guano	Removal of guano from the foundation, transition piece, and access ladders	Pressure washer from CTV /support vessel	Every two years per WTG
Removal of marine growth	Removal of marine growth from the foundation, transition piece, and access ladders	Pressure washer from CTV /support vessel	Every two years per WTG
Repairs and/or replacement of navigation equipment	Repairs and/or replacement of the electrical equipment used for navigation, such as transponders, fog horns, and lighting	2-3 Technicians accessing WTG by CTV	Every two years for the proposed development lifecycle
Geophysical surveys	Geophysical survey to monitor the position and condition of the assets and seabed	Survey vessel or Unmanned Surface Vessels	Twice yearly for 1st year then annually for remaining lifetime.
OSP Foundations			
Routine Inspections	Inspection of the OSP foundation, including the ancillary structures and transition pieces, both above and below sea level	2-3 technicians accessing the WTG by CTV.	Twice yearly for 2 years then annually for remaining lifetime.
Replacement of corrosion protection anodes	Remove and replace the anodes used for corrosion protection of the foundations	Divers or ROV usually deployed from a DP vessel	1 every 5 years

Activity	Description	Methodology	Frequency
Modification or replacement of ancillary structures	Remove and replace or modify the ancillary structures, such as J-tubes, ladders, boat landings etc, where required	Divers or ROV usually deployed from a DP vessel	1 every 5 years
Scour protection repair and maintenance	The repair, maintenance and/or replacement of scour protection, where required	Same as installation methodology	1 every 10 years
Painting	The preparation of the surface and application of coatings (such as paint), to protect the OSP foundation from both internal and external corrosion	2-3 Technicians accessing WTG by CTV	Every year
Removal of guano	Removal of guano from the foundation, transition piece, and access ladders	Pressure washer from CTV /support vessel	Every 2 years
Removal of marine growth	Removal of marine growth from the foundation, transition piece, and access ladders	Adhoc pressure washer from CTV/SOV	Estimated removal occurring on every OSP twice over the lifecycle of the project
Geophysical surveys	Geophysical survey to monitor the position and condition of the assets and seabed	Survey vessel or Unmanned Surface Vessels	Twice yearly for 1st years then annually for remaining lifetime.
WTGs			
Routine Inspections	Inspections of the WTGS (both internal and external)	2-3 technicians accessing the WTG by CTV.	Twice yearly per WTG
Minor repairs and replacements	Minor repairs and/or replacements of internal equipment, such as circuit breakers, pumps, fuses etc)	2-3 technicians accessing the WTG by CTV.	Twice yearly per WTG
Major component replacement	Remove and replace the major WTG components, such as the gearbox, blades, yaw rings etc	Jack-Up vessel or floating crane vessel	Once every 5 years per WTG
Painting	The preparation of the surface and application of coatings (such as paint), to protect the WTG from both internal and external corrosion	2-3 technicians accessing the WTG by CTV.	Yearly
Replacement of consumables	The replacement of the consumables used within the WTG, such as oil, lubricants, filters etc	2-3 technicians accessing the WTG by CTV.	Twice yearly per WTG
OSP			
Routine Inspections	Inspections of the OSP (both internal and external)	2-3 technicians accessing the WTG by CTV.	Monthly
Minor repairs and replacements	Minor repairs and/or replacements of internal equipment, such as circuit breakers, pumps, fuses etc	2-3 technicians accessing the WTG by CTV.	4 times per year
Major component replacement	Remove and replace the major OSP components, such as the switchgear, transformers etc	Jack-Up vessel or floating crane vessel	Once every 5 years

Activity	Description	Methodology	Frequency
Painting	The preparation of the surface and application of coatings (such as paint), to protect the OSP from both internal and external corrosion	2-3 technicians accessing the WTG by CTV.	Once per year
Inter-array cables			
Routine Inspections	Inspections of both the inter-array cables and cable protection including inspection at the J-tube entry point.	Survey vessel or Unmanned Surface Vessels	Annually for first 3 years then every 3 years
Geophysical surveys	Geophysical survey of the inter-array cable, cable protection, and seabed	Survey vessel or Unmanned Surface Vessels	Annually for first 3 years then every 3 years
Repair and/or replacement	The repair and/or replacement of the inter-array cable	Cable Vessel	Once every 5 years
Reburial	The reburial of any section of the inter-array cable which has become exposed.	Cable vessel or support vessel	Once every 5 years
Cable protection replacement/reinstatement	The reinstatement and/or replacement of any cable protection that may have been disturbed due to external factors (such as third-party damage, or seabed mobility)	Cable vessel or support vessel	Once every 5 years
Offshore Export Cable			
Routine Inspections	Inspections of both the offshore export cable and cable protection including inspection at the J-tube entry point.	Survey vessel or Unmanned Surface Vessels	Annually for first 3 years then every 3 years
Geophysical surveys	Geophysical survey of the offshore export cable, cable protection, and seabed	Survey vessel or Unmanned Surface Vessels	Annually for first 3 years then every 3 years
Repair and/or replacement	The repair and/or replacement of the offshore export cable	Cable Vessel	Once every 5 years
Reburial	The reburial of any section of the offshore export cable which has become exposed.	Cable vessel or support vessel	Once every 5 years
Cable protection replacement/reinstatement	The reinstatement and/or replacement of any cable protection that may have been disturbed due to external factors (such as third-party damage, or seabed mobility)	Cable vessel or support vessel	Once every 5 years

2.5.2 Onshore Operation and Maintenance

The onshore infrastructure will require ongoing maintenance during the operational lifetime of the proposed project.

Maintenance of the cables at the landfall will comprise an inspection, typically once every year, by means of the link box and communication chambers located at the TJBs and any other joint bays on the onshore export cable. Maintenance / repairs of cables will be required on an ad-hoc basis in the event of a cable fault occurring.

Both substations at the grid facility will be unmanned and operated remotely. It is expected that one or two vehicles may attend each substation every four weeks for an inspection.

Each inspection will be approximately four hours and will occur within normal working hours, however it may be necessary for maintenance personnel to access the site on an ad-hoc basis if required, for example in the event of an electrical fault or outage. Additional annual maintenance will be required throughout the operational phase of the proposed development.

Maintenance of the onshore cables will comprise an inspection, approximately once every two years or ad-hoc whenever needed in response to a cable fault or issue, by means of the link box and communication chambers, which will be located at every joint bay. Where joint bays are located off road a permanent access track to the joint bay will be provided.

2.5.1 Operation and Maintenance Facility

An OMF will be required to service the proposed development throughout the operational phase of the proposed development. Whilst the OMF will be subject to separate planning/permitting consents and is not included within this planning application for consent, it is considered within the in-combination assessment.

The OMF will be located onshore at a suitable location in the vicinity of the proposed development and will comprise an OMF building and associated storage facilities as well as a number of berths, for the vessels required to access the wind farm.

2.6 Decommissioning

2.6.1 Offshore Decommissioning

The Maritime Area Planning Act 2021 sets out an obligation for the holder of a MAC to decommission or re-use offshore infrastructure as part of its rehabilitation of the maritime area that is the subject of the MAC, once the proposed development has reached the end of its operational life. It is anticipated that all structures above the seabed will be completely removed.

The exact approach to decommissioning will meet any statutory requirements or guidance set out In the forthcoming Maritime Area Planning Act secondary legislation. The approach to decommissioning has been documented in a Rehabilitation Schedule (see SISAA Report) which will be subject to consultation with the Maritime Area Regulatory Authority and relevant stakeholders as required. The Rehabilitation Schedule will also form part of the MAC for the proposed development following the grant of development permission. The Rehabilitation Schedule will be prepared taking into consideration the latest technological advances as well as legislative and environmental requirements at the time of decommissioning. Any licences or authorisations that might be required would be identified and obtained prior to decommissioning.

2.6.2 Onshore Decommissioning

The infrastructure from the Bremore substation to the existing existing Belcamp substation will be under the ownership of ESB Networks and operated by EirGrid, forming part of the wider Transmission System, and therefore will not be decommissioned.

The compensation substation at the Grid Facility will be decommissioned when the proposed development ceases operation: however, the 220 kV Bremore substation will not be decommissioned as it will form part of the wider transmission network owned by EirGrid.

When it becomes appropriate to decommission the proposed development, all above ground structures (i.e. access track, marker posts, link) between the TJBs at the landfall and the grid facility will be removed, and the sites will be returned to their previous state. It is not proposed to remove any planting. The cabling will be removed but below ground ducting will remain in place.

Items / equipment which are decommissioned will be removed for appropriate management, based on the waste regulations at the time of decommissioning.

3. Screening

3.1 Approach to Screening

The screening stage has been characterised by European Commission Guidance (EC 2021) as a four-step process. These steps are:

- Step 1: Ascertain whether the plan or project is directly connected with, or necessary to, the management of a Natura 2000 site.
- Step 2: Describe the plan or project and its impact factors.
- Step 3: Identify which Natura 2000 sites may be affected by the plan or project.
- Step 4: Assess whether likely significant effects can be ruled out in view of the site's conservation objectives; and
- Conclusions: decision based on the outcome of the screening.

When each of these steps has been worked through there are three potential outcomes:

- The proposed development is directly connected with or necessary to the management of a European site(s) and therefore does not require AA (Stage 2);
- One or more LSEs on designated QIs of European sites are identified and the proposed development requires an AA; and
- No LSEs on designated QIs of European sites are identified as there is no pathway by which such effects could occur, or they can be excluded on the basis of objective information and therefore there is no requirement for an AA.

In order to determine whether the proposed development is capable of resulting in one or more LSEs on a European site(s) it is necessary to understand the activities associated with the construction, operation and decommissioning of the proposed development (e.g. the use of piling hammers during monopile installation), the potential changes that may occur in the environment as a result (e.g. the production of construction noise), and the effects that this may have on designated QIs of European sites (e.g. disturbance of marine mammals resulting in increased energy expenditure and reduced energy intake resulting in potential lower survival and productivity rates).

Through the use of this source-pathway-receptor (s-p-r) concept, it is possible to identify European sites (and their QIs) that may be subject to LSEs through the determination of a series of search parameters. These search parameters can then be extended to identify the other plans and projects that require consideration within the assessment of in-combination effects.

3.2 Screening Outcomes

The results of the screening process are presented in the Supporting Information for Screening for Appropriate Assessment report (SISAA).

49 SACs and 41 SPAs have been considered for the potential for LSE to arise via the identified source-receptor-pathways. Of these sites, the screening process found that it is not possible to discount LSE with respect to 44 SACs and 29 SPAs. These sites are therefore assessed within this NIS to support the Stage 2 AA.

3.3 Use of Proxy Conservation Objectives

In order to determine whether AEoI is likely to occur in relation to an SAC or SPA, the predicted effects must be measured against each CO for the site.

For some sites designated for marine mammal receptors, e.g. sites within French jurisdiction and sites where marine mammal QIs have recently been designated, COs have not been published. In these cases, where no site-specific COs, the assessment has been assessed against proxy site-specific COs from nearby sites with the same QIs.

Where available, specific COs and QI target attributes that define Favourable Conservation Condition for a particular habitat or species at a given site have been considered. These are detailed in Section 5.

4. Identification of Potential Impacts and Mitigation Measures

As all terrestrial European sites were discounted prior to assessment at Stage 1 Screening, the potential impacts set out in this section relate only to coastal and marine European sites, despite some impact pathways originating from a terrestrial source i.e. from terrestrial works/activities.

Where the latter is the case, any potential impacts arising from a terrestrial/ onshore source, have been set out under an onshore subheading in the relevant sections below. Where there is no onshore subheading, no potential terrestrial originated impacts have been identified for the relevant receptor.

Although a number of potential impacts are considered in this assessment, not all are relevant to every QI/SCI and European Site. To avoid unnecessary repetition, an overview of the impacts screened in and those relevant receptors has been provided below.

For the purposes of this report, impacts during the decommissioning phase are considered likely to be the same or less significant to those outlined for the construction phase.

4.1 Physical Habitat Loss and Disturbance – Coastal and Marine Habitats

For coastal and marine habitats, physical habitat loss and disturbance was screened in for further assessment and is therefore considered below.

4.1.1 Construction

Temporary habitat disturbance has the potential to occur as a result of construction and seabed preparation prior to foundation installation, drilling, dredging at foundations, jack up and anchoring operations and the installation of inter-array and export cables and decommissioning activities. Temporary habitat loss/disturbance will be restricted to discrete areas only within the proposed development boundary.

4.1.2 Operation and Maintenance

Physical habitat loss could result during the operational phase of the proposed development through the presence of WTG and OSP foundations and associated scour protection and cable protection (if installed). Loss of habitats will be restricted to discrete areas within the development boundary.

4.2 Suspended Sediment and Deposition – Coastal and Marine Habitats and Migratory Fish, Ornithology

For coastal and marine habitats, migratory fish and ornithology, suspended sediment and deposition and disturbance was screened in for further assessment and is therefore considered below.

4.2.1 Construction

4.2.1.1 Offshore

Construction activities involving physical disturbance of the seabed/surface substrate can lead to the suspension and redistribution of surface sediment. This can then lead to increased turbidity where finer particles remain suspended in the water column. The rate of dispersion of finer particles depends on tidal energy with particles being rapidly dispersed in high energy environments.

Increased turbidity can lead to impacts on sessile filter feeders from smothering and can reduce underwater visibility for mobile species, including migratory fish, resulting in potential adverse effects on foraging, and predator prey interactions. Physical disturbance of the seabed/surface substrate and suspension and redistribution of sediment in the water column can lead to smothering where sediment is re-deposited in areas where habitats and species that are sensitive to smothering are present.

4.2.1.2 Onshore

In terms of potential increases in suspended sediment on marine and coastal habitats and migratory fish from the onshore elements of the proposed development, sediment transfer through surface water run-off has the potential to affect downstream European sites via hydrological connectivity, including intertidal and marine habitats occurring below the HWM. Consequently, fauna present below the HWM and utilising these intertidal and marine habitats have the potential to be affected. For example, Special Conservation Interest (SCI) wintering birds are vulnerable to surface-water run-off, which could disperse hydrocarbons and other contaminants, potentially affecting wintering and or staging birds through direct contact, or indirectly through affecting their roosting and/ or feeding habitat.

4.3 Accidental Pollution – Coastal and Marine Habitats, Migratory Fish, Marine Mammals, Ornithology

For coastal and marine habitats, migratory fish, marine mammals and ornithological receptors, accidental pollution was screened in for further assessment and is therefore considered below.

4.3.1 Construction

4.3.1.1 Offshore

Physical disturbance of the seabed during cable and foundation installation could potentially result in the release of contaminated materials. There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation to be released into the water column, leading to an effect on receptors. The re-suspension of contaminated sediment or release of contaminated substances from the seabed can have adverse effects on habitats and species that are sensitive to contamination and reductions in water quality.

In addition to the potential for resuspension of contaminants, as part of construction and decommissioning activities, substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment resulting to impacts from reduced water quality.

4.3.1.2 Onshore

In terms of potential impacts on marine and coastal habitats, migratory fish, marine mammals and ornithological receptors from onshore elements of the proposed development, accidental pollution to these receptor groups could occur through accidental discharge to watercourses and has the potential to impact QI habitats occurring below the HWM and QI and SCI species that utilise such downstream intertidal and marine habitats.

4.3.2 Operation and Maintenance

As part of operation and maintenance activities, substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment resulting in impacts to European sites from reduced water quality.

4.4 Introduction of Invasive Species – Coastal and Marine Habitats

For coastal and marine habitats, introduction of invasive species was screened in for further assessment and is considered below.

4.4.1 Construction

During all stages of the proposed development, the movement of vessels in and out of the offshore development area has the potential to contribute to the risk of introduction or spread of marine Invasive Non-Native Species (INNS) through ballast water discharge. Activities will be undertaken within an area already heavily transited by vessels. The movement of commercial, recreational and fishing vessels is common throughout the region. This provides an existing and potentially more likely method of transport for marine INNS due to the high variety of ports and passage routes.

Permanent structures on the seabed would increase the amount of hard bottom habitat available to benthic algae, invertebrates, and fish in areas that were previously soft sediment habitats. This could attract fish and invertebrate species (including biofouling organisms) that would not normally exist within the offshore development area. Marine fouling communities developed on offshore wind monopiles have been found to be significantly different from the benthic communities on adjacent hard substrates (Wilhelmsson et al., 2006; Wilhelmsson and Malm, 2008).

Terrestrial INNS listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011 (as amended) were not identified within the onshore development area. Adjacent European sites comprise of intertidal habitats, habitats which would not support terrestrial INNS. As such there is no potential for spread of terrestrial INNS to European sites.

4.4.2 Operation and Maintenance

During operation, there is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by marine INNS that otherwise may not have had a suitable habitat available. The colonisation of structures may also serve as 'stepping-stones' and extend the impact beyond a local scale; based on current scientific knowledge it is not possible to predict whether such a spread will occur and to what extent and which species, if any, this may involve.

4.5 Changes to Physical Processes – Coastal and Marine Habitats

For coastal and marine habitats, the potential for changes to physical processes was screened in for further assessment and is considered below.

4.5.1 Construction

During the construction phase, seabed preparation, foundation installation, and cable laying and protection each have the potential to affect the morphology, hydrodynamics and sediment transport at the nearshore area and may lead to short-term and localised periods of seabed disturbance, the scale of which depends on the methods employed. Where this disturbance includes fine sediments then sediment plumes are anticipated which have the potential to spread by tidal advection and dispersion with material settling remote from the location of disturbance.

4.5.2 Operation and Maintenance

During the operational phase, individual offshore structures have the potential to interfere with passing waves and flows with the scale and type of such effects depending on the shape and size of the structure. Cable protection could also present an obstacle to sediment transport, trapping sediment locally and thereby impacting down-drift locations through a reduction in sediment supply.

4.5.3 Decommissioning

During the decommissioning phase, the removal (or partial removal) of any buried infrastructure could also lead to localised seabed disturbance which are likely to develop short-term periods of sediment plumes comparable (similar sediment but with less volumes involved) to those experienced during the construction phase Underwater Noise – Marine Mammals and Migratory Fish.

For migratory fish and marine mammals, the potential for underwater noise was screened in for further assessment and is considered below.

4.5.4 Construction

Underwater noise from the proposed development could arise from installation during the construction phase, primarily from piling for foundations and monopiles and other project infrastructure and seabed preparation works such as pre-construction surveys and UXO clearance.

Use of underwater noise in the marine environment by mobile species includes communication, hunting and predator avoidance amongst other uses. As such, anthropogenic sound sources which overlap with the frequencies used by marine life may interrupt or alter the use of sound by marine organisms.

For marine mammals, the primary impacts are mortality, a temporary threshold shift temporary threshold shift (TTS) in hearing, and a Permanent Threshold Shift (PTS) in hearing, the latter of which is typically regarded as injury. This can occur from impulsive or non-impulsive sources. Impulsive sound sources, such as impact pile driving and UXO detonation, are transient and brief (less than a second), broadband and typically consist of high peak pressure with rapid rise time and decay, and non-impulsive sound sources, such as dredging, trenching, and shipping, can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak pressure with rapid rise time. There is also a risk of disturbance, which can result in the loss of access to foraging grounds and breeding grounds, impacting on the wider population viability.

For fish, effects range from behavioural changes to physiological responses, TTS, physical injury and mortality. These effects can occur from impulse sounds such as those generated during piling and UXO detonation. Non-impulse sounds are unlikely to cause mortal injuries but may result in temporal TTS in hearing and behavioural reactions.

4.6 EMF – Migratory Fish and Marine Mammals

For migratory fish and marine mammals, the potential for Electric and magnetic fields (EMF) was screened in for further assessment and is therefore considered below.

4.6.1 Operation and Maintenance

EMF are produced as a result of power transmission in the inter array cables and the export cables to shore. These fields have the potential to affect fish and marine mammal receptors that use electric or magnetic senses for foraging, navigation, or communication. Of those species sensitive to EMF, some are electro-sensitive, some are magneto-sensitive, and some are thought able to detect both.

Artificial EMF are generated by electric currents that pass through power cables. Two types of EMF are produced directly by subsea cables: electric fields (E-fields), which are generated by static electric charges of the cable, and magnetic fields (B-fields), which are produced by moving electric currents. A third type of EMF, induced electric fields (Ie-fields), is generated indirectly from B-fields. All cables will contain industry standard shielding, which prevents E-fields from passing into the marine environment; however, sensitive receptors may still be affected by B-fields and/ or Ie-fields.

4.7 Vessel Disturbance – Marine Mammals and Ornithology

For marine mammals and ornithological receptors, the potential for vessel disturbance was screened in for further assessment and is therefore considered below.

4.7.1 Construction, Operation and Maintenance

Increased vessel traffic during construction, operation and decommissioning has the potential to result in disturbance for marine mammal and ornithological receptors. Disturbance from vessel noise is only likely to occur where increased noise from vessel movements associated with the proposed development is greater than the background ambient noise. The magnitude and characteristics of vessel noise varies depending on ship type, ship size, mode of propulsion, operational factors, and speed with vessels of varying size producing different frequencies, generally 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.

4.8 Vessel Collision Risk – Marine Mammals

For marine mammals, the potential for vessel collision risk was screened in for further assessment and is therefore considered below.

4.8.1 Construction, Operation and Maintenance

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

Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al., 2001; Lusseau, 2003; and Lusseau, 2006). The majority of vessels used during construction will be large vessels that are 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.

4.9 Changes to Prey –Marine Mammals and Ornithology

For marine mammals and ornithology, the potential for changes to prey was screened in for further assessment and is therefore considered below.

4.9.1 Construction, Operation and Maintenance

The loss of habitats and the loss/disturbance of invertebrate species and displacement of fish from fishing grounds (and associated effects on reproductive success and survival) could affect food availability for a range of species in particular birds and marine mammals. Whilst it is considered that alternative feeding areas may be available to species, the array area and ECC may create a net loss of feeding area. There may also be a knock-on effect on adjacent fish populations arising from increased competition for prey species in adjacent areas (AECOM, 2010).

4.10 Disturbance at Haul Out – Marine Mammals (Seals)

For marine mammals, the potential for disturbance at haul out sites was screened in for further assessment and is therefore considered below.

4.10.1 Construction, Operation and Maintenance

Increased vessel traffic during construction, operation and decommissioning has the potential to result in disturbance to seals, including when they are hauled out of the water. Disturbance from vessels includes physical presence and generated noise, and noise disturbance is only likely to occur where increased noise from vessel movements associated with the construction, operation and decommissioning of the proposed development is greater than the background ambient noise. The magnitude and characteristics of vessel noise varies depending on ship type, ship size, mode of propulsion, operational factors, and speed with vessels of varying size producing different frequencies, generally 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.

4.11 Displacement and Barrier Effects – Ornithology

4.11.1 Construction, Operation and Maintenance

For ornithological receptors, the potential for displacement and barrier effects was screened in for further assessment and is therefore considered below.

4.11.1.1 Offshore

Displacement as a result of disturbance can pose a potential ecological threat to seabirds as it can result in habitat loss, in the form of foraging or rafting areas. For adaptive species this may not be a problem, but for less adaptive or constrained species/individuals (e.g. during breeding season) this may result in ecological and/or population level consequences.

In relation to offshore wind farm development, Furness et al. (2013) define displacement as ‘a reduced number of birds occurring within or immediately adjacent to an offshore wind farm’. Displacement, as an effect, may occur both in the area of the disturbance or development and to some distance beyond it – known as a ‘buffer’ (e.g. Mendel et al., 2014). The degree of displacement, both in terms of length of time and proportion of the original source population affected, may vary seasonally and between species.

Birds that would have previously passed through the footprint of the disturbance area to a more distant feeding, resting or nesting area, but now choose either to stop short or detour around the location are said to be affected by barrier impacts. A barrier is a physical factor that limits the migration, or free movement of individuals or populations, thus requiring them to divert from their intended path in order to reach their original destination.

4.11.1.2 Onshore

Disturbance impacts affecting onshore, intertidal and SCI birds that utilise inland feeding sites can arise from construction works associated with onshore elements of the proposed development. These disturbance incidents are likely to occur where onshore construction works take place in close proximity to European sites, i.e. at the landfall site, grid facility and Malahide Estuary, and arise from an increased presence of machinery and construction personnel, noise impacts, vegetation clearance, lighting impacts and the overall construction works.

4.12 Turbine Collision Risk – Ornithology

For ornithological receptors, the potential for turbine collision risk was screened in for further assessment and is therefore considered below.

4.12.1 Operation and Maintenance

There is potential for possible injury or mortality to seabirds from direct collision with offshore WTG in particular moving blades. These effects are likely to be more significant where offshore wind farms are located on migration routes or in/near to key foraging or roosting areas where there is likely to be a high level of daily activities/flight movements. The potential for these effects to occur depends on several factors including the number of flights through an area (passage rates), the length of a flight and the height above water at which flight occurs. The potential for collision to occur also depends on individual species and their avoidance response. The risk of collision is likely to increase where there are several offshore wind developments in one location as opportunities for avoidance are reduced. The risk of collision could lead to species displacement or habitat avoidance (as described at 4.12 above).

4.13 Air Quality Impacts and Dust Distribution – Coastal and Marine Habitats and Ornithology

For coastal and marine habitats and ornithological receptors, the potential for air quality impacts and dust distribution was screened in for further assessment and is therefore considered below.

4.13.1 Construction

4.13.1.1 Onshore

Dust generation and deposition during construction has the potential to degrade habitats within several hundred metres of the onshore development area, however, the majority of dust deposition would be small and very local to the construction activity. As such it is considered that only the nearest European sites would be a at risk from air quality impacts arising from dust, i.e. at the landfall site, grid facility and Malahide Estuary.

The same conclusion would apply to potential impacts from (exhaust) fumes emitted by vehicles and machinery during construction.

4.14 Impacts Arising from Artificial Light – Ornithology

4.14.1 Construction, Operation and Maintenance

4.14.1.1 Onshore

The presence of artificial lighting during construction of the onshore infrastructure has the potential to alter seabird and wintering waterbird behaviour. The nearest proposed onshore construction works to sensitive receptors for wintering waterbirds are works at the landfall site adjacent to coastline habitat on the landward side and inline works along the Estuary Road at Malahide Estuary. There will also be additional lighting used during construction and decommissioning in the offshore development area, which has the potential to effect offshore seabirds. At these locations, the presence of artificial lighting could potentially contribute to disturbance and displacement effects.

4.15 Mitigation Measures

The mitigation measures that are relevant to this document are described below in Table 4.1, including how the measures will be secured.

Where documents are detailed and secured in management plans, these are referenced and appended. The relevant management plans are:

- Appendix 7: Offshore Environmental Management Plan (Offshore EMP)
- Appendix 8: Onshore Construction Environmental Management Plan (CEMP)
- Appendix 10: Marine Mammal Mitigation Protocol (MMMP); and
- Appendix 11: Environmental Vessel Management Plan (EVMP).

For the offshore development area, a suitably qualified Offshore Environmental Clerk of Works (Offshore ECoW) will be appointed to ensure the mitigation measures outlined in this section and in the Offshore Environmental Management Plan (EMP) are implemented during the construction phase of the offshore infrastructure.

For the onshore development area, a suitably qualified Ecological Clerk of Works (ECoW) will be appointed to ensure the mitigation measures outlined in this section and in the Construction Environmental Management Plan (CEMP) are implemented during the construction phase of the onshore infrastructure.

Mitigation measures have been chosen according to their suitability, evidence-based track record of implementation, reliability, and deliverability, and have been tried and tested in other jurisdictions, for example England, Wales and Scotland. The mitigation to be implemented adopts 'Best Available Technique (BAT)', an established approach in environmental management, balancing the highest level of environmental protection against commercial affordability and practicality.

Table 4.1: Mitigation Measures

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
Coastal and Marine Habitats				
Adverse effects on sensitive habitats, biogenic reefs or protected species	Project Design	Construction	Presence of sensitive habitats will be identified through a review of the latest available benthic datasets. Proposed development infrastructure will avoid protected habitats wherever reasonably practicable to an extent not resulting in a hazard for marine traffic and Search & Rescue capability.	Cable installation measures within the Offshore Environmental Management Plan (EMP).
	Pre-construction survey	Pre-construction	Where necessary, before works commence and following reinstatement, a topographical survey of the nearshore subtidal area will be carried out to identify and map the contours of the subtidal HDD exit pit to ensure a profile similar in nature to the profile recorded during the pre-construction survey is reinstated, as far as practicable.	Included, along with cable installation measures, within the Offshore EMP.
Indirect disturbance of benthic species from EMF generated by inter-array and export cables during operation.	EMF shielding of cables	Operation	Where practicable cables will be buried to minimise the requirement for additional cable protection. Cable burial also reduces the impacts of EMF on sensitive receptors.	Included, along with cable installation measures, within the Offshore EMP.
Marine Invasive Non-native Species (marine INNS) introduction/spread	Biosecurity measures	Construction, operation, and Decommissioning	Any vessels used for the delivery of materials to site will adhere to industry legislation, codes of conduct and/or best practice to reduce the risk of introduction or spread of invasive non-native species. This will be achieved through implementation of the 'International Convention for the Control and Management of Ships' Ballast Water and Sediments' (BWM Convention) and Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species.	Included within the Offshore EMP.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
Sediment disturbance (marine habitats)	Cable burial	Construction	Cable installation measures will minimise adverse impacts to potentially sensitive receptors. It will also set out appropriate cable burial depth in accordance with industry good practice, reducing the risk of cable exposure and based on a cable burial risk assessment. Cables will be buried to a sufficient depth to ensure that they are not exposed by sandwave movements. Where target cable burial depth cannot be achieved during the cable installation process (for any of inter-array, interconnector or export cables), cable armouring will be implemented (e.g. mattressing, or rock placement etc). The suitability of installing rock or mattresses for cable protection will be investigated, based on (inter alia) the seabed current data at the location of interest and a risk assessment of the potential for cable damage to occur. Cable installation measures are captured in the Offshore Environmental Management Plan (EMP)	Included within the Offshore EMP; Cable Burial Risk Assessment (CBRA).
Direct disturbance to intertidal receptors	Landfall HDD	Construction	The installation of the offshore export cables at landfall will be undertaken by HDD beneath the intertidal zone which will prevent any direct disturbance to intertidal receptors. The HDD exit pits will be located within the ECC seaward of the LWM at a point where cable installation vessels can operate.	Project design and included within the Onshore Construction Environmental Management Plan (CEMP).
Disturbance to benthic receptors from pollution and vessel related outputs	Implementation of Environmental Management Plan	Construction	An Offshore EMP will be developed and will include details of: Marine pollution contingency measures to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out below the HWM. A chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance. Marine biosecurity measures to address the risk of introduction and spread of invasive non-native species; Waste management and disposal arrangements; The appointment and responsibilities of a company fisheries liaison officer (FLO).	Included within the Offshore EMP.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
Water pollution	Discharge protocol	Construction	For the HDD at the landfall, any ground water or rainwater that collects in the HDD drilling pit will be pumped away. It will then be discharged onto the adjacent land, not directly into a waterway, and through a filter medium. This will avoid the build-up of silt, as some granular material will, inevitably, be pumped out with the water from the trench.	Included within the Onshore CEMP.
Loss of onshore habitat	Pre- and post-construction surveys	Pre-construction, Operation, Decommissioning	The Developer will work with key stakeholders and regulatory authorities to identify any future monitoring programmes considered necessary. An effective monitoring programme will outline thresholds to be established for receptor indicators which, if exceeded, will trigger an appropriate and clearly documented set of actions to be taken, thus ensuring mitigation measures are measurable and working.	Included within the Onshore CEMP.
	Micrositing	Pre-construction, Construction	The collection of up to date data sets on the presence of ecological features and species allows micrositing of infrastructure post consent. Data will be collected from onshore topographic surveys and will facilitate micro siting as far as practical around sensitive habitats such as Annex 1 habitats.	Included within the Onshore CEMP.
Adverse effects on marine sediment quality	Pollution protocol for vessels	Pre-construction, Operation, Decommissioning	Vessels used for installation will be compliant with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations. These regulations cover the prevention of pollution from accidents and routine operations.	Implementation of the VMP; included within the Offshore EMP.
Downstream water quality impacts arising from surface water run-off and accidental pollution spill	Implementation of CEMP	Construction	A full suite of water quality protection measures are included in the Onshore CEMP. These will include best practice guidelines for the control of water pollution from construction sites, best practice in-stream and near-stream works, control of hydrcarbons and contaminates, protection of watercourses, protection from HDD operations and frac-out, and sets out the application of buffers to watercourses and waterbodies, where applicable.	Included within the Onshore CEMP
Dust Deposition	Preparation and maintaining of the site	Construction	Plan construction compound layout so that machinery and dust causing activities are located away from receptors, as far as is possible. Erect a 2m minimum site hoarding around all construction/ contractor compounds. Keep site fencing, barriers and scaffolding clean using wet methods. Cover, seed or fence stockpiles to prevent wind whipping.	Included within the Onshore CEMP

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
Dust Deposition	Construction Plant Operations	Construction	Ensure an adequate water supply on the working areas for effective dust/particulate matter suppression/mitigation. Use enclosed chutes where practicable and conveyors and covered skips. Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate. Ensure equipment and spill kits are readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	Included within the Onshore CEMP
Dust Deposition	Measure Specific to Earthworks	Construction	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable. Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. Only remove the cover in small areas during work and not all at once.	Included within the Onshore CEMP
Dust Deposition	Measure specific to Track-out	Construction	Ensure no mud or debris accumulates on the public road and public roads are clean of any mud, dust or debris by suitable means. Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. Ensure vehicles entering and leaving sites are covered when transporting materials that are likely to generate dust to prevent escape during transport. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Included within the Onshore CEMP
Dust Deposition	Measure specific to the grid facility construction activities	Construction	Dust generation and dermal exposure during site construction works will be controlled by appropriate dust control measures e.g., water sprays Where the asphalt layer is removed at the grid facility site this will occur in a phased basis and will be replaced with granular hardcore as soon as possible to prevent the generation of windblown dust.	Included within the Onshore CEMP

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
Migratory Fish				
Mortality and potential mortal injury, recoverable injury, TTS and behavioural changes from piling	Soft start / ramp up procedures	Construction	The installation of each foundation will commence with a soft start of a maximum of 20% of the maximum hammer energy for a duration of 30 minutes. The hammer energy will then ramp-up in steps until the levels required to install the pile are reached or up to the maximum hammer energy. The hammer energy will not be increased above the hammer energy required to complete each installation – i.e., if ground conditions are such that a lower than maximum hammer energy is sufficient to complete installation, then hammer energy will not be unnecessarily ramped up to full hammer energy.	Included within the Piling Mitigation Methodology in the MMMP
Mortality and potential mortal injury, recoverable injury, TTS and behavioural changes from UXO clearance	UXO detonation strategy	Pre-construction, construction	If UXO detonations are required for clearance, detonations will not occur within the same 24-hour window as piling operations. Where there may be clusters of UXO requiring detonation, these UXO would not be detonated within the same 24-hour window.	Included within the Offshore EMP
Mortality and potential mortal injury, recoverable injury, TTS and behavioural changes from UXO clearance	UXO Management measures	Pre-construction, construction	The clearance of UXO will follow a mitigation hierarchy, with micro-siting of subsea infrastructure around UXO where practicable. Where avoidance is not possible, relocating the UXO to a safe place and leaving in situ will be considered. Where clearance of UXO is required (i.e. avoidance or relocation is not practicable), removal of the UXO from the site or low order clearance at the UXO location will be adopted where feasible However, removal of the UXO through low order deflagration are not always possible and are dependent upon the individual situations surrounding each UXO. Therefore, a high order detonation of the UXO might be required. A case-by-case risk assessment will be undertaken following dedicated geophysical and ROV surveys during the construction phase.	Included within the Offshore EMP and the UXO Mitigation Methodology in the MMMP
Mortality and potential mortal injury, recoverable injury, TTS and behavioural changes from UXO clearance	Noise Abatement System (NAS) during high order UXO clearance	Pre-construction, construction	Where auditory injury impact ranges for marine mammals from the use of high order detonations are greater than what can be mitigated using MMP/PAM watch and ADD (e.g., > 7.5 km; e.g. 120kg UXO charge weight plus donor weight), noise abatement will be used to reduce the noise propagated through the water column during detonations.	Included within the UXO Mitigation Methodology in the MMMP
Accidental Pollution	Marine pollution contingency measures	Pre-construction, construction, operation, decommissioning	Marine pollution prevention and contingency measures will be implemented as part of the Offshore Environmental Management Plan (Offshore EMP) to manage the risk of accidental pollution from offshore operations relating to the proposed development The Marine Pollution	Included within the Offshore EMP

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
			Contingency Procedure will include the following control measures and procedures: A chemical risk review with information regarding how and when chemicals (including vessel fuels) are to be used, stored and transported in accordance with recognised best practice guidance and national and international regulations and commitments; Navigational safety measures (e.g., guard vessels, safety buoys, lighting of active working zones) to reduce the likelihood of collision events; and Emergency response methods and procedures to deal with any spills and collision incidents. Implementation of these measures will reduce the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on potentially sensitive migratory fish species.	
Accidental Pollution	Offshore Waste Management Procedure	Pre-construction, construction, operation, decommissioning	An Offshore Waste Management Procedure setting out waste management and disposal procedures will be implemented as part of the Offshore EMP. The Waste Management Procedure will include the following measures: Application of the waste hierarchy (prevention, re-use, recycle, recovery, and disposal) to minimise the amount of waste produced, and reduce, as far as possible, the amount of waste that is disposed of in landfill; Waste disposal procedures, ensuring all waste that cannot be reused, recycled or recovered will be kept onboard vessels and safely disposed of onshore in a suitable licensed waste facility; and Code of conduct for vessel operators with respect to the discharge of wastewater and handling and storing of hazardous materials. Implementation of these measures will reduce the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on potentially sensitive migratory fish species.	Included within the Offshore EMP.
EMF	Proposed development design - cable specifications	Operation	Where practicable cables will be buried to minimise the requirement for additional cable protection. Cable burial also reduces the impacts of EMF on sensitive receptors.	Included within the design of Project Option 1 and Project Option 2.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
EMF	Cable protection measures	Operation	Cable installation will make two passes where practicable to bury cables before cable protection is used. Where cables cannot be buried due to ground conditions, additional cable protection measures such as rock placement or mattressing will be applied to achieve adequate cable protection. Up to 20% of cable length is expected to need protection either during initial installation, or throughout the operational phase of the proposed development. Surface-laid cable protection will move the cables further from electro- and magneto-sensitive receptors, thereby reducing the EMF field strengths receptors will be subjected to.	Included within the design of Project Option 1 and Project Option 2.
General	Assessment of impacts and best practice environmental management	Decommissioning	Prior to decommissioning a study of the potential environmental impacts to fish and shellfish receptors from the proposed decommissioning activities will be undertaken, taking into account the baseline environment at the pre-decommissioning stage. All measures will be captured within a Rehabilitation Schedule and the Offshore EMP.	Rehabilitation Schedule and Offshore EMP.
Marine Mammals				
Auditory PTS from foundation installation (piling and drilling) on marine mammals	Acoustic Deterrent Devices (ADDs)	Construction	ADDs will be used where practicable and required during piling activities. One ADD will be deployed from the platform/vessel deck, with the control unit and power supply on board. Verification of ADD operations will be required before piling commences. The deployment procedure will be determined with the foundation installation contractor and will adhere to safe, standard practices, using experienced/trained staff to ensure proper ADD equipment use within varying vessel layouts. The duration of ADD deployment will be calculated based on assumed swimming speeds to ensure that marine mammals are safely outside the mitigation zone when piling begins. A trained and dedicated ADD operator will be responsible for ADD maintenance, operation, and reporting.	Implementation of the Piling Marine Mammal Mitigation Protocol (MMMP). The Piling MMMP will be specific to the proposed piling activities. Piling measures included within the Offshore Environmental Management Plan (EMP).
Auditory PTS from Unexploded Ordnance (UXO) clearance on harbour porpoise, etc			When an ADD is used during UXO detonation, one ADD will be deployed from the vessel, with the control unit and power supply on board in safe positions. Verification of ADD operations will be required before pre-detonation activation. The deployment procedure will be determined with the UXO contractor and will adhere to safe, standard practices, using experienced/trained staff to ensure proper ADD equipment use within varying vessel layouts.	Implementation of the UXO MMMP. UXO measures included within the Offshore EMP.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
			The duration of ADD deployment will be calculated based on assumed swimming speeds to ensure that marine mammals are safely outside the mitigation zone when UXO works begin. A trained and dedicated ADD operator will be responsible for ADD maintenance, operation, and reporting.	
Auditory PTS from foundation installation (piling and drilling) or UXO clearance	Soft start / ramp up procedures	Construction	Following the pre-piling deployment of the ADDs and the marine mammal observer pre-piling watch, the installation of each foundation will commence with a soft start of a maximum of 20% of the maximum hammer energy for a duration of 30 minutes. The hammer energy will then ramp-up in steps until the levels required to install the pile are reached, or up to the maximum hammer energy. The hammer energy will not be increased above the hammer energy required to complete each installation – i.e., if ground conditions are such that a lower than maximum hammer energy is sufficient to complete installation, then hammer energy will not be unnecessarily ramped up to full hammer energy.	Implementation of the Marine Mammal Mitigation Protocol (Piling). UXO measures within the Offshore EMP.
Collision with vessels	Marine Mammal Observers (MMO)	Construction, Operation, Decommissioning	The MMO will undertake visual marine mammal observations within the defined mitigation zone around the piling location from a suitable elevated platform. The marine mammal observer will record all periods of marine mammal observations, including start and end times. Details of environmental conditions (sea state, weather, visibility, etc.) and any sightings of marine mammals around the piling vessel will also be recorded as per JNCC marine mammal recording forms and guidelines. In addition, any obvious responses of animals to the ADD activation will be recorded (e.g. a change in behaviour from milling or bottling to directed travel away from the ADD at the onset of ADD activation). If, during the marine mammal observer pre-piling watch, a marine mammal is detected within the mitigation zone, the ADD will be checked to ensure correct operation, and soft-start will be delayed until it is assessed by the MMO that the marine mammal has vacated the mitigation zone. The marine mammal observer will continue to note detections and observations on animal behaviour during the soft-start period.	Implementation of the Environmental Vessel Management Plan (EVMP).
Ornithology				
Collision risk to bird species	Raised air draft	Construction and Operation (Design consideration)	All turbines in Project Option 1 will have an air draft of 40m LAT. Turbines in Project Option 2 will have an air draft of 40m LAT except	Included within the design of Project Option 1 and Project Option 2.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
			where they are in the aviation restriction zone where the air draft will be 35m LAT. The number of birds at collision risk height at 40m is considerably reduced compared to 22m. For example, the number of common tern flying at collision risk height is reduced by 90.6% between 22m and 40m. Likewise, kittiwake have a reduction of birds at collision risk height of 82.2% between 22m and 40m, and gulls show a reduction of approximately 65%.	
Disturbance and displacement of offshore seabirds	Array refinement	Construction, Operation, Decommissioning	There has been a considerable reduction in the footprint of the array area from the original MAC boundary. This process considered hotpots of auks, the most abundant species within the survey area, using species heatmaps from raw observations and a modelled approach using MRSea. This method uses environmental variables to provide an alternative way of predicting habitat use and abundance within the survey area. This process was undertaken for the proposed development, with the array area of the project being reduced by 64% from the MAC boundary of 195.9km^2 to refined array area of 88.5km^2.	Included within the design of Project Option 1 and Project Option 2.
Disturbance from vessels	Vessel routing	Construction, Operation, Decommissioning	Use of established navigation routes, especially in the nearshore environment - Vessel movements will follow, where practicable, existing navigation routes enroute to the array area and offshore export cable, where the densities of divers and seaducks are typically relatively low due to regular vessel presence compared to the wider inshore area.	Included within the EVMP.
	Environmental Vessel Management Plan (EVMP)	Pre-construction, construction, operation and decommissioning	During all phases of the proposed development, an EVMP will be adhered to which will reduce any potential disturbance responses to ornithological receptors (as outlined predominantly in Section 9).	Included within the EVMP
	Vessels to avoid rafting birds where practicable	Pre-construction, construction, operation and decommissioning	Vessels accessing the offshore development area during construction are where practicable to seek to avoid ‘rafts’ of birds and feeding aggregates to minimise disturbance and displacement.	Included within the EVMP
	Avoidance of over-revving engines	Pre-construction, construction, operation and decommissioning	Vessels will seek to avoid over-revving engines, where practicable , in order to minimise noise disturbance.	Included within EVMP

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
	Briefing of vessel crew	Pre-construction, construction, operation and decommissioning	Vessel crew will be briefed on the purpose and implications of the vessel management practices outlined.	Included within EVMP
	Reduction of vessel activity in sensitive months	Operation	During the operational phase the proposed development will reduce vessel activity in the ECC during the most sensitive months for coastal divers (November to March 1st inclusive), where practicable. Outside of the period November to March 1st, disturbance within the nearshore environments will continue to be minimised as far as practicable during maintenance work, as these areas are where density of seaducks and divers are highest. Potential effects on designated sites (e.g. North-west Irish Sea cSPA) have been avoided through early consideration of vessel movements and project design including disregarding Operation and Maintenance Facility (OMF) options inshore of the array area.	Included within EVMP
Disturbance to wintering waterbirds from noise impacts	Noise attenuation barriers and implementation of CEMP for onshore works at the landfall site and HDD compound	Construction, Decommissioning	There will be noise barriers on the northerly, easterly and southerly perimeters of the landfall HDD compound, to reduce noise levels in these directions. For construction activities occurring above the HWM, the use of noise-attenuation barriers, solid hoarding or other acoustic barriers will reduce in-air noise propagation and conceal human activity. Disturbance to important populations of non-breeding birds along the onshore cable route, grid facility and at the onshore infrastructure (landfall site and Malahide Estuary) will be reduced. Where practical, in areas where disturbance to significant numbers of non-breeding waterbirds may occur, fencing/ hoarding will be used during the winter months to provide visual and acoustic screening of active working areas. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of wintering waterbirds at the landfall site and at Malahide Estuary.	Included within the Onshore CEMP.
	Noise attenuation barriers and implementation of CEMP for onshore works at Malahide Estuary and Estuary Road	Construction, Decommissioning	Avoid works along the Estuary Road during the period September to March when wintering birds are present Where this is not practicable, for works at Malahide Estuary during the period September to March, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats.	Included within the Onshore CEMP.

Impact	Measure	Phase	Mitigation measure details	How the measure will be secured
			Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of wintering waterbirds at the landfall site and at Malahide Estuary. The temporary noise barriers at the landfall site and along the Estuary Road will act as a visual barrier and reduce disturbance impacts and potential likely effects on wintering waterbirds. An ECoW will be present during all works along the Estuary Road.	
Disturbance to wintering waterbirds from lighting impacts	Code of construction protocol and implementation of CEMP	Construction, decommissioning	Construction lighting used during months August to March will be reviewed by the project ECoW. Construction lighting in areas at the landfall site and Malahide Estuary will be kept to a minimum where practicable and will be directed away from habitats utilised by wintering waterbirds to minimise light spill and avoid disturbance. Mitigation measures will be employed to reduce light spill where necessary, including: The use of sensor / timer triggered lighting. LED luminaires to be used where practicable due to their sharp cut-off, lower intensity, good colour rendition and dimming capability. Column heights to be considered to minimise light spill. Accessories such as baffles, hoods or louvres can be used to reduce light spill and direct it only where needed; and Where night-time works are required, the appointed contractor will liaise with the ECoW and implement measures outlined in the bullet points above to mitigate the impact of such works on wintering birds.	Included within the Onshore CEMP.
Indirect water quality impacts on wintering waterbirds	Code of construction protocol and implementation of CEMP	Construction, decommissioning	Water quality mitigation measures mentioned under coastal and marine habitats are also relevant to wintering waterbirds.	Included within the Onshore CEMP.
Impact to wintering waterbirds during sensitive periods	Timing of works to remove or reduce impact in sensitive periods and implementation of CEMP	Construction, decommissioning	Scheduling of work, where practicable, to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, see measures set out for disturbance from noise.	Included within the Onshore CEMP.

5. Stage 2 Appropriate Assessment – Alone

As defined in Section 1.2, 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 COs. The information for all European sites screened in is presented below according to the following receptor groupings:

- Coastal and Marine Habitats
- Migratory Fish
- Marine Mammals; and
- Ornithology.

5.1 Coastal and Marine Habitats

5.1.1 Approach

The assessment process for coastal and marine habitats is in line with the relevant guidance as outlined in Section 1.7 and the process outlined in Section 1.5. The sensitivities of different biotopes and community complexes have been classified by The Marine Life Information Network (MarLIN) on the Marine Evidence based Sensitivity Assessments MarESA four-point scale (high, medium, low and not sensitive). This methodology applied to ecological groups which are found in the Irish Sea is based on species characteristic of offshore, circalittoral biotopes (Tillin and Tyler-Walters, 2014) and to biogenic habitats. The scale takes account of the resistance and recoverability (resilience) of a species or biotope in response to a stressor. Specific benchmarks (duration and intensity) are defined for the different impacts for which sensitivity has been assessed (e.g. smothering, abrasion, habitat alteration etc.).

Detailed information on the benchmarks used and further information on the definition of resistance and resilience can be found on the MarLIN website. The MarESA methodology is based on scientific evidence, that has been used to inform assessments on biotope sensitivity to pressures. This has therefore been deemed the most appropriate method to assess biotope sensitivities.

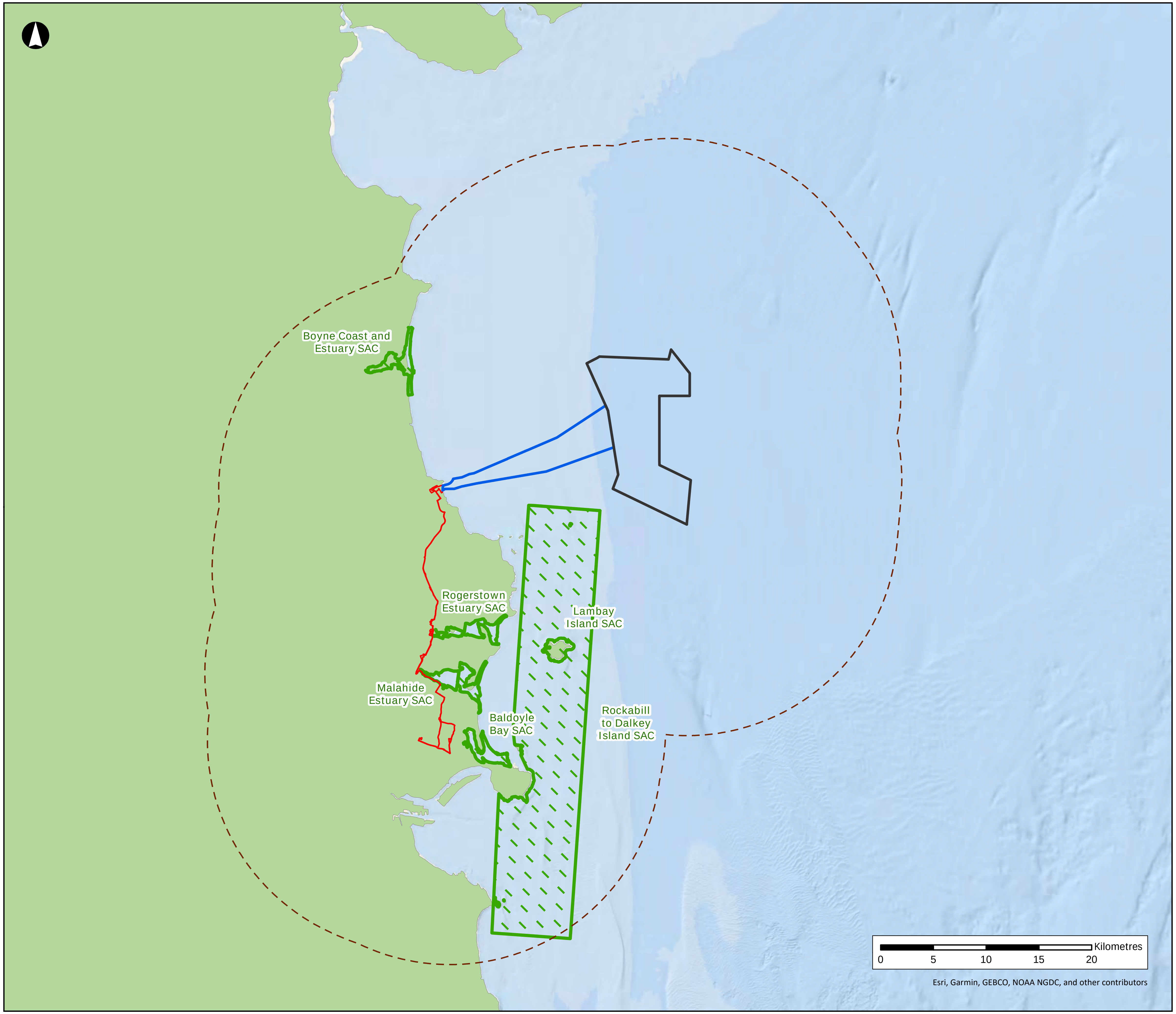
The coastal and marine sites screened in for assessment and potential impacts are summarised in

Table 5.1 while their distribution is shown in Figure 5.1.

Table 5.1: Sites Screened in for Coastal and Marine Habitats QIs for the Proposed Development Alone and In-Combination.

European site name	Qualifying Interest	Impacts screened in for construction and decommissioning	Impacts screened in for operation
Malahide Estuary SAC	Annex I habitats: Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.	Onshore and offshore suspended sediment / deposition; Onshore and offshore accidental pollution; Marine INNS; and Onshore Dust deposition	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical processes; and Marine INNS.
Rogerstown Estuary SAC	Annex I habitats: Estuaries; Mudflats and sandflats not covered by seawater at low tide;	Onshore and offshore suspended sediment / deposition;	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical

	Salicornia and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.	Onshore and offshore accidental pollution; Marine INNS; and Onshore Dust deposition	processes; and Marine INNS
Baldoyle Bay SAC	Annex I habitats: Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.	Onshore and offshore suspended sediment / deposition; and Onshore and offshore accidental pollution.	None
Rockabill to Dalkey Island SAC	Annex I habitats: Reefs.	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical processes; and Marine INNS.
Boyne Coast and Estuary SAC	Annex I habitats: Estuaries; Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; and Atlantic salt meadows	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical processes; and Marine INNS.
Lambay Island SAC	Annex I habitats: Reefs.	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical processes; and Marine INNS.



Array Area
Offshore Export Cable Corridor
Onshore Cable Route
Special Areas of Conservation

NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Sites Screened in for Coastal and Marine Habitats

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No: 5.1
Scale: 1:350,000 @A3	
Status: Issue	

5.1.1.1 Project Option 1 and Project Option 2 Determination of Greatest Effects

For coastal and marine habitats an assessment has been completed to determine which of the two project options (Project Option 1 or Project Option 2) presents the greatest potential for AEoI on designated sites. Table 5.2 shows the outcome of this assessment. The onshore development area does not have project options as the associated onshore infrastructure and works will be the same for both project options.

Table 5.2: Potential impacts and Project Option with the greatest potential for AEoI on Coastal and Marine Habitats. The Project Option that has the greatest potential for AEoI is Identified in Blue.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI on designated sites
Construction			
Increase in Suspended sediment and deposition from offshore construction activities and inputs from onshore construction activities	Total volume of suspended sediment and sediment deposition 805,292m³. WTG drill cuttings: 49 turbines foundations with 75% requiring drilling resulting in 338,233m³ of sediment. OSP foundations (array): One OSP foundation requiring seabed preparation and drill cutting resulting in the suspension of 22,089m³ of sediment. Cable trenching: Installation of 111km max of array cables resulting in the suspension of 333,000m³ of sediment. Installation of two export cables resulting in the suspension of 333,000m³ of sediment (excluding the part of the export cable within the array); and Subtidal HDD: Exit pits total volume = 3,960m³. Onshore works associated with near-stream works, and in-stream works will generate the greatest volume of suspended sediment and deposition.	Total volume of suspended sediment and sediment deposition 897,061m³. WTG foundation preparatory dredging: Dredging at the seabed in preparation for foundation placement (jacket foundations only) at 50% of locations = 133,755m³ WTG drill cuttings: 35 turbines foundations with 75% requiring drilling resulting in 356,257m³ of sediment. OSP foundations (array): One OSP foundation requiring seabed preparation and drill cutting resulting in the suspension of 22,089m³ of sediment. Cable trenching: Installation of 91km max of array cables resulting in the suspension of 273,000m³ of sediment. Installation of two export cables resulting in the suspension of 108,000m³ of sediment (excluding the part of the export cable within the array); and Landfall HDD: Exit pits total volume = 3,960m³. Onshore works associated with near-stream works, and in-stream works will generate the greatest volume of suspended sediment and deposition.	Project Option 2 represents the greatest magnitude of impact in relation to these impacts. The greatest magnitude of impact for foundation installation results from the largest volume suspended from seabed preparation. For cable installation, the greatest magnitude of impact results from the greatest volume installation using energetic means. This also assumes the largest number of cables and the greatest burial depth. A maximum of one OSP will be constructed within the order limits. Project Option 2 has a higher total volume than Project Option 1 (91,769m³ more volume of materials) and presents the greatest potential for AEoI on integrity of designated sites. Onshore works for both project options will result in the same potential for AEoI on integrity of designated sites in relation to this impact.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI on designated sites
Accidental Pollution	Total volume of suspended sediment and sediment deposition 805,292m^3.	Total volume of suspended sediment and sediment deposition 897,061m^3.	Project Option 2 represents the greatest potential for AEoI on integrity of designated sites in relation to this impact. Project Option 2 represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during construction activities.
Introduction of Marine Invasive Non-Native Species (Marine INNS)	3,008 round trips to port by construction vessels.	2,530 round trips to port by construction vessels.	Project Option 1 represents the greatest potential for AEoI on integrity of designated sites in relation to this impact. This scenario represents a larger magnitude of impact with regard to maximum number of vessel movements during construction activities.
Dust deposition	No dust will be generated from the offshore works. Dust generation and deposition will arise from the onshore works associated with the onshore infrastructure.	No dust will be generated from the offshore works. Dust generation and deposition will arise from the onshore works associated with the onshore infrastructure.	No dust will be generated from the offshore works, therefore Project 1 and Project 2 will result in the same potential for AEoI on integrity of designated sites in relation to this impact.
Operation and Maintenance			
Increase in Suspended sediment and deposition	The volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction phase (as listed under Impact 1). Repair and maintenance of scour protection for WTG and OSP foundations Once every 5 years Inter-array cable replacement, repair and reburial Once every 5 years Export cable repair and reburial Once every 5 years	The volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction phase (as listed under Impact 1). Repair and maintenance of scour protection for WTG and OSP foundations Once every 5 years Inter-array cable replacement, repair and reburial Once every 5 years Export cable repair and reburial Once every 5 years	Project Option 1 represents the greatest potential for AEoI on integrity of designated sites.in relation to this impact. The magnitude of the impact is defined by the maximum volume of sediments released into the water column during maintenance activities.
Accidental Pollution	The magnitude of the impact represents the maximum volume of sediments released during the operational and maintenance phase, as listed under Temporary increase in SSC and sediment deposition arising during maintenance activities.	The magnitude of the impact represents the maximum volume of sediments released during the operational and maintenance phase, as listed under Temporary increase in SSC and sediment deposition arising during maintenance activities.	**Project Option 1 represents the greatest magnitude of impact in relation to this impact.** The magnitude of the impact is defined by the maximum volume of sediment that are predicted to be released into the water column during the operational and maintenance phase. The risk of accidental pollution as a result of spillages or collisions will be managed through the implementation of an Offshore EMP, and therefore no design scenarios are presented for accidental contamination.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI on designated sites
Introduction of Marine Invasive Non-Native Species	Total surface area of introduced hard substrate in the water column: 414,766m^2 1,261 vessel round trips annually.	Total surface area of introduced hard substrate in the water column: 388,128m^2 1,055 vessel round trips annually.	Project Option 1 represents the greatest potential for AEoI on integrity of designated sites. in relation to this impact. This scenario has the greatest magnitude of impact with regards to maximum number of vessel movements during operational activities.
Changes to Physical Processes	The effect of flow blockage due to the array of foundations with effects at a very small scale (generally less than 0.02m/s relative to baseline conditions).	The effect of flow blockage due to the array of foundations with effects at a very small scale (generally less than 0.02m/s relative to baseline conditions).	Project Option 1 has the greatest potential for AEoI on integrity of designated sites. due to the larger number of WTG causing the potential blockage effect.
Decommissioning			
Increase in Suspended sediment and deposition	The impacts are expected to be equivalent to impact for construction apart from the structures that may remain (e.g. cables to be removed but not cable protection measures). See the Physical Processes Chapter.	The impacts are expected to be equivalent to impact for construction apart from the structures that may remain (e.g. cables to be removed but not cable protection measures). See the Physical Processes Chapter.	Project Option 2 represents the greatest magnitude of impact in relation to this impact The project option with the greatest magnitude of impact is assumed to be as per the construction phase, with all infrastructure removed in reverse-construction order. The removal of cables is considered, however the necessity to remove cables will be reviewed at the time of decommissioning.
Accidental pollution	The impacts are expected to be equivalent to those outlined for construction above.	The impacts are expected to be equivalent to those outlined for construction above.	Project Option 2 represents the greatest potential for AEoI on integrity of designated sites.in relation to this impact. This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during decommissioning activities.
Introduction of Marine Invasive Non-Native Species	The impacts are expected to be equivalent to those outlined for construction above.	The impacts are expected to be equivalent to those outlined for construction above.	Project Option 1 represents the greatest potential for AEoI on integrity of desigimpact.sites.in relation to this impact. This scenario represents a larger magnitude of impact with regard to maximum number of vessel movements during construction activities.

5.1.2 Malahide Estuary SAC

5.1.2.1 Qualifying Interests of Malahide Estuary SAC

Malahide Estuary SAC lies immediately adjacent to the onshore development area, 16.2km southwest of the offshore ECC and 20.3km from the array area. The nearest onshore works are located along the Estuary Road which is immediately adjacent to the SAC for c. 2.3km. The works at this location will include road breaking out, cable trenching and backfilling, installation of a joint bay, road resurfacing, the HDD, an HDD compound and two watercourse crossings at Seapoint Stream and Greenfields Stream. Watercourse crossing methods at these locations are in-road open cut trench or inline HDD, none of which involve in-stream works.

The following qualifying interests have been screened in for further assessment:

- Mudflats and sandflats not covered by seawater at low tide*

- Salicornia and other annuals colonising mud and sand.
- Atlantic salt meadows* (*Glauco-Puccinellietalia maritimae*); and
- Mediterranean salt meadows* (*Juncetalia maritimi*).

5.1.2.1.1 Conservation Objectives and Description of Qualifying Interest: Tidal Mudflats and Sandflats

The COs to maintain the favourable conservation condition of mudflats and sandflats not covered by seawater at low tide as defined by the following list of attributes and targets:

- Habitat Area: The permanent habitat area is stable or increasing, subject to natural processes.
- Community Extent: Maintain the extent of the *Zostera*-dominated community and the *Mytilus edulis* dominated community complex, subject to natural processes.
- Community structure (Zostera density): Conserve the high quality of the Zostera-dominated community, subject to natural processes.
- Community structure (*Mytilus edulis* density): Conserve the high quality of the *Mytilus edulis* dominated community, subject to natural processes; and
- Community distribution: Conserve the following community types in a natural condition:

Fine sand with oligochaetes, amphipods, bivalves and polychaetes community complex; Estuarine sandy mud with *Chironomidae* and *Hediste diversicolor* community complex; and

- Sand to muddy sand with *Peringia ulvae*, Tubificoides benedii and *Cerastoderma edule* community complex.

Community type: Fine sand with oligochaetes, amphipods. Bivalves and polychaetes community

This community complex occurs along the eastern boundary of the site from the Martello Tower at Balcarrick in the north to Portmarnock in the south. The sediment of this community complex is largely that of fine sand (ranging from 74% to 88.9%) with negligible amounts of coarse material (<4%). The complex is distinguished by the oligochaete *Tubificoides benedii*, the crustacean *Bathyporeia guilliamsoniana*, the bivalve *Angulus tenuis* and the polychaetes *Nephtys 72irrose*, *Hediste diversicolor*, *Scoloplos armiger* and *Scolelepis squamata*, all of which occur in moderate abundances here.

Community type: Estuarine sandy mud with Chironomidae and Hediste diversicolor community complex

This complex is recorded at Swords where the Ward River and Broad Meadow River enter the Malahide estuary. The sediment is largely that of sandy mud with silt-clay and very fine sand accounting for between 19.6% to 59.7% and 12.4% to 28.4% of the sediment fractions respectively. The remaining fractions range from 0.8% to 12.5% coarse sand, very coarse sand from 0.4% to 5.1%, medium sand from 1.6% to 27.7% and the fine sand fraction from 8.7% to 21.9%. The proportion of gravel recorded is negligible (<1%). The fauna is distinguished by unidentified Chironomidae species and the polychaete *Hediste diversicolor* which occur in high to moderate abundances here. The oligochaetes *Heterochaeta costata* and *Paranais litoralis* are also recorded here.

Community type: Sand to muddy sand with Peringia ulvae, Tubificoides benedii and Cerastoderma edule community complex

This community complex is recorded extensively within the estuary from Donabate to Malahide. The substrate here is composed largely of fine material with silt-clay ranging from 2.2% to 59.7%, very fine sand from 3.2% to 32.9% and fine sand from 6.1% to 80%. Coarse material accounts for less than 7% of the sediment fractions. The fauna is distinguished by the gastropod *Peringia ulvae*, the oligochaete *Tubificoides benedii* and the bivalve *Cerastoderma edule* which all occur in moderate abundances within this complex. The polychaete *Hediste diversicolor* and the bivalve *Scrobicularia plana* are not uniformly distributed, having their highest abundances near Malahide Point. The polychaetes *Scoloplos armiger*, *Pygospio elegans* and *Nephtys hombergii* are also recorded here.

Community type: Zostera-dominated community

The intertidal seagrass *Zostera noltii* is recorded in two discrete areas to the north of the site, on Burrow Strand at Corballis and along the shore to the east of Kilcrea. The sediment here is largely that of fine sand which accounts for 80% of the sediment fractions. Coarse material and fines fractions are negligible. The coverage of *Zostera noltii* at this site ranges from 60% in the more westerly bed to 82% in the beds on Burrow Strand. The fauna is dominated by the gastropod *Peringia ulvae* which is recorded in very high abundances; the polychaetes *Pygospio elegans* and *Scoloplos armiger* occur in high abundance here. The infauna is similar to that recorded for the "Sand to muddy sand with *Peringia ulvae, Tubificoides benedii* and *Cerastoderma edule* community complex".

Community type: Mytilus-dominated community complex

This community occurs on the intertidal expanse between the railway line and the spit at Malahide Point. The bivalve *Mytilus edulis*, with algal epibionts such as *Ectocarpus* sp. Are abundant here. Between the clumps of mussel patches of sandy mud occur in which the polychaete Arenicola marina is recorded in densities of between 3-4m^2. The bivalve *Scrobicularia plana*, barnacles and encrusting polychaetes also occur within this complex.

5.1.2.1.2 Conservation Objectives and Description of Qualifying Interest: Salicornia and Other Annuals Colonising Mud and Sand

The COs to maintain the favourable conservation condition of *Salicornia* and other annuals colonising mud and sand as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure (flooding regime): Maintain natural tidal regime.
- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the presence of species-poor communities; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur.

5.1.2.1.3 Conservation Objectives and Description of Qualifying Interest: Atlantic salt meadows

The COs to maintain the favourable conservation condition of Atlantic salt meadows as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.

- Physical structure (flooding regime): Maintain natural tidal regime.
- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the range of communities with typical species; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur.

5.1.2.1.4 Conservation Objectives and Description of Qualifying Interest: Mediterranean Salt Meadows

The COs to maintain the favourable conservation condition of Mediterranean salt meadows as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure (flooding regime): Maintain natural tidal regime.
- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the range of sub-communities with characteristic species; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur.

5.1.2.1 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore, during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning.

The onshore works for both project options are the same. Suspended material from onshore construction works may enter the estuary and marine environment through near stream or in-stream works resulting in freshwater run-off arising from the nearest onshore works. Increased suspended sediment arising from onshore works and reaching Malahide Estuary SAC via surface water will be localised to the immediate downstream area of the works, and at watercourse crossing Seapoint Stream and Greenfields Stream where near stream works are adjacent to the SAC.

As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.1.2.1.1 Mitigation

There is potential for material produced by onshore construction activities to enter the estuary and marine environment within surface runoff. However, as outlined in the Construction Environmental Management Plan (CEMP) (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

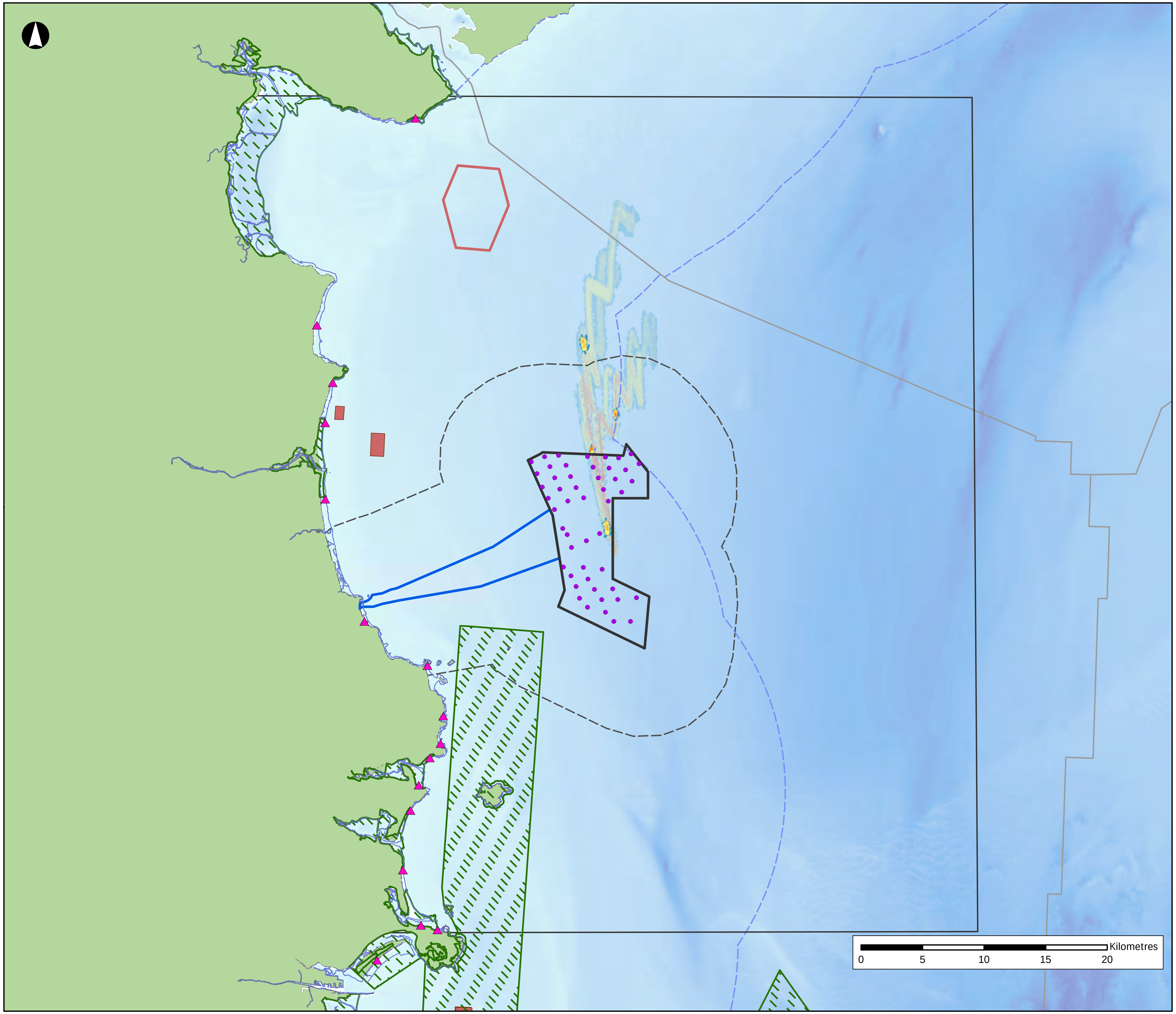
5.1.2.1.2 Assessment

Malahide Estuary SAC lies 16.2km from the offshore ECC at the landfall and lies 20.3km from the array area, and is immediately adjacent to the onshore infrastructure works along the Estuary Road for 2.3km. As detailed in paragraph 4.2, sediment plumes caused by works within the array area and ECC are anticipated to be restricted to one tidal excursion as indicated by Figures 5.2 to Figure 5.11 which show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels with subsequent deposition being undetectable above background levels. No sediment plume or deposition extends into the Malahide Estuary SAC. Similarly, with the implementation of mitigation measures the amount of sediment entering the estuary and marine environment from freshwater run-off from onshore activities will be negligible.

5.1.2.1.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Malahide Estuary SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of sedimentation entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI in relation to offshore and onshore activities would apply to Project Option 2.



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Suspended Sediment (mg/l)

- <1 (trace level)
- 1 - 2 (normal variation)
- 2 - 5 (background level)
- 5 - 10 (background level)
- 10 - 20 (background level)
- 20 - 50 (4 * background)
- 50 - 100 (10 * background)
- 100 - 200 (20 * background)
- 200 - 500 (40 * background)
- 500 - 1000 (100 * background)
- >1000 (200 * background)

Bathymetry (m)

0
200

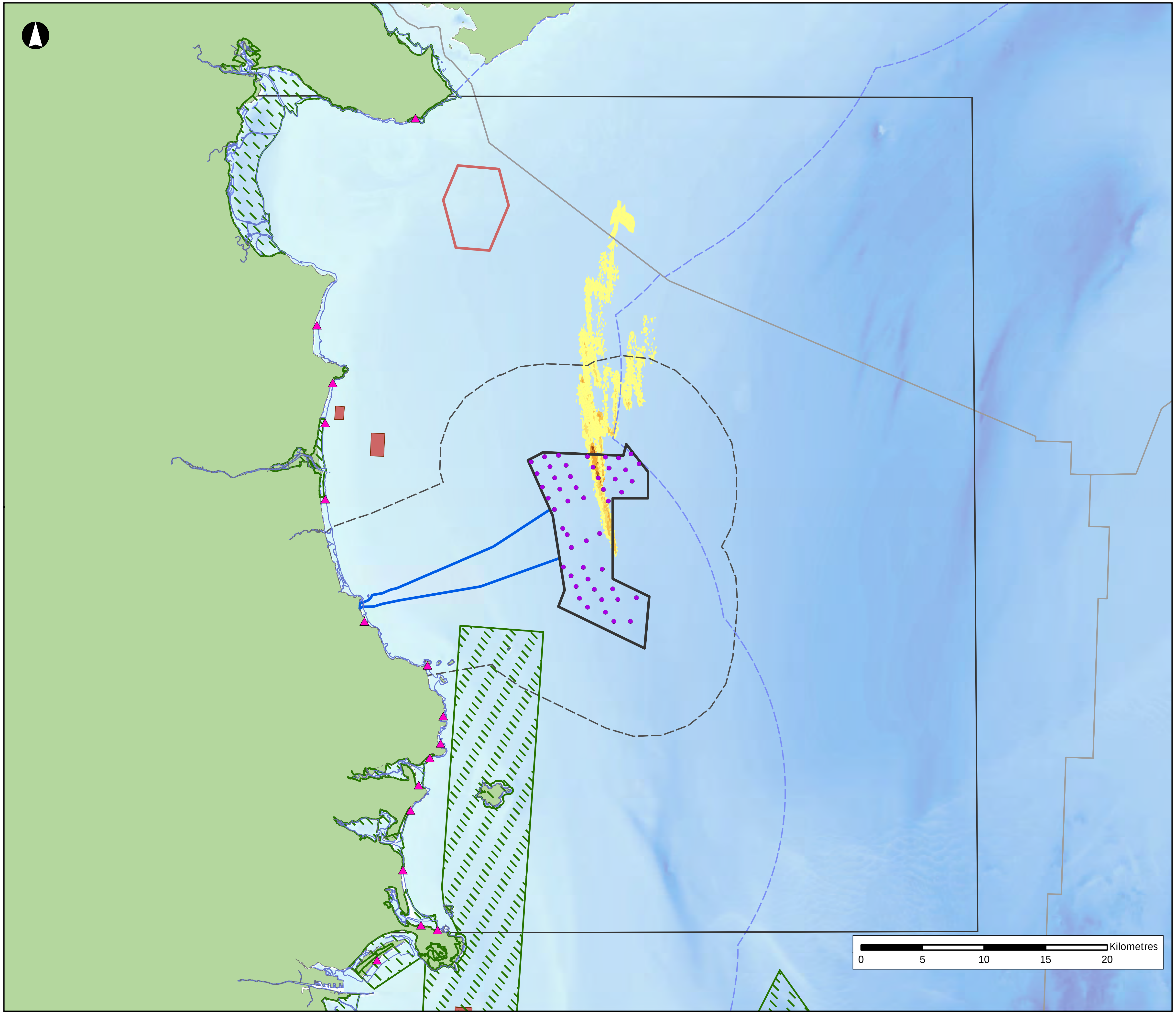
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Seabed Levelling Sediment Plumes

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.2
Status: Issue	



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Deposition (mm)
<1
1 - 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100

Bathymetry (m)
0
200

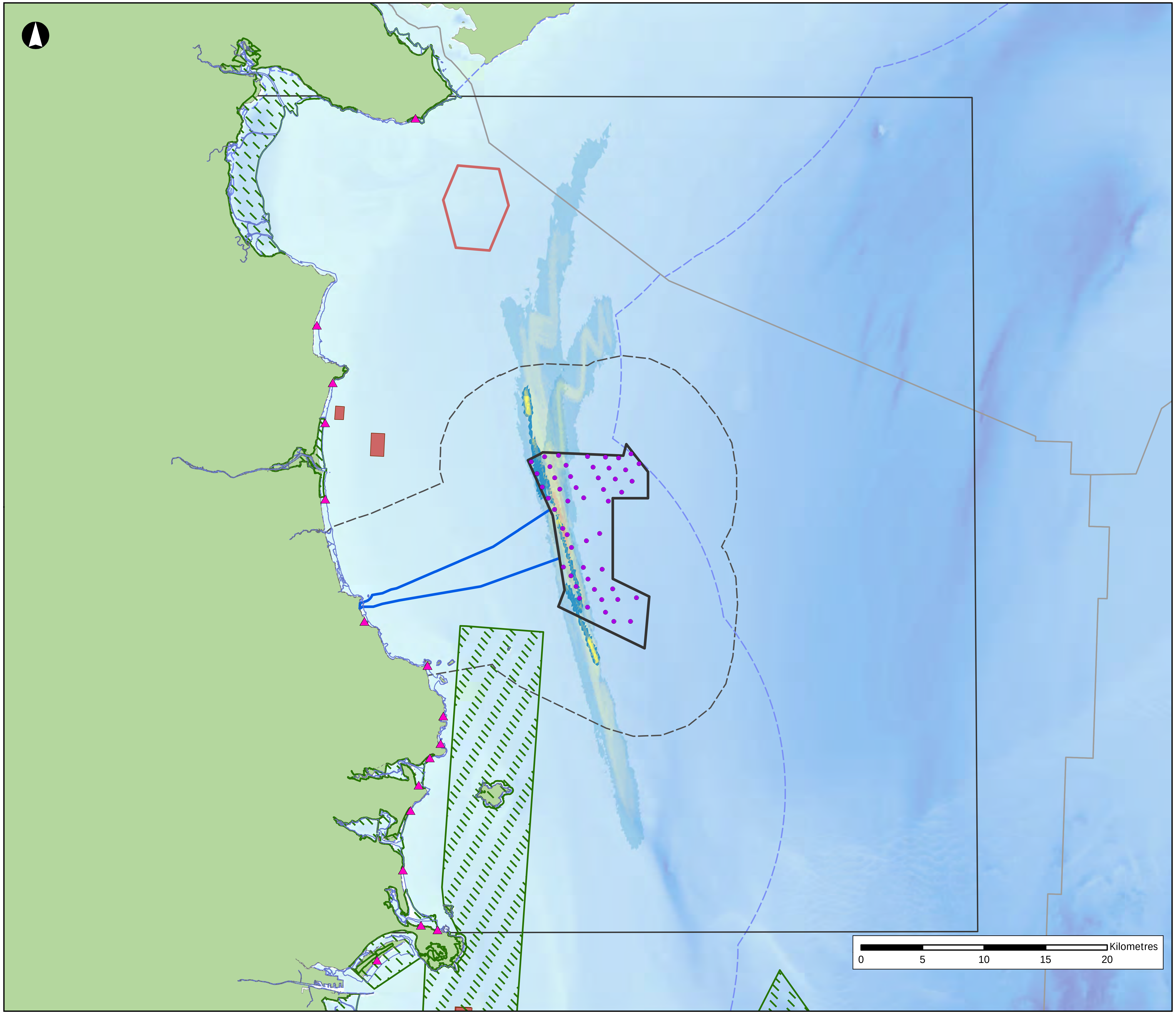
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Seabed Levelling Deposition

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.3
Status: Issue	



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Suspended Sediment (mg/l)

<1 (trace level)
1 - 2 (normal variation)
2 - 5 (background level)
5 - 10 (background level)
10 - 20 (background level)
20 - 50 (4 * background)
50 - 100 (10 * background)
100 - 200 (20 * background)
200 - 500 (40 * background)
500 - 1000 (100 * background)
>1000 (200 * background)

Bathymetry (m)

0
200

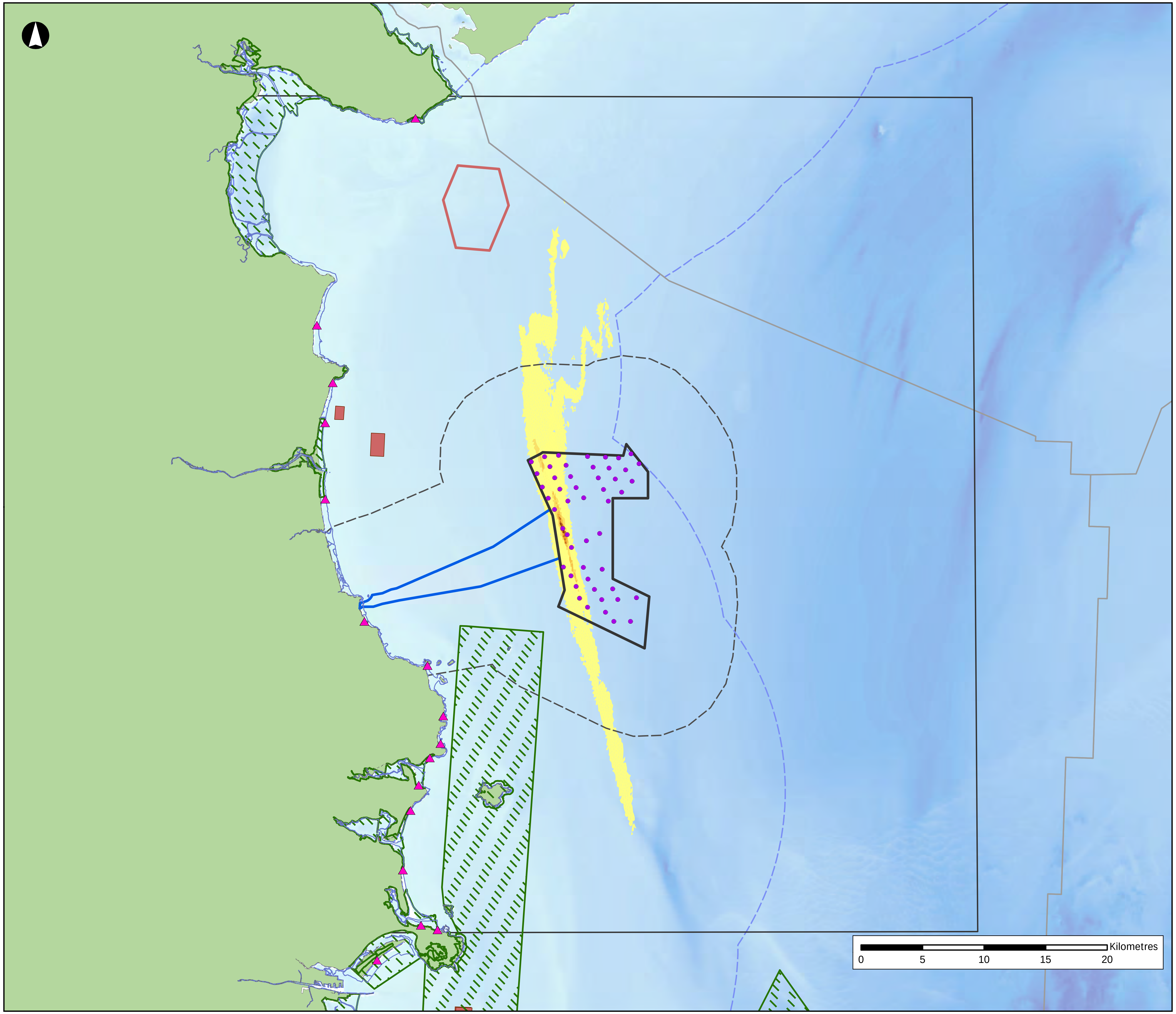
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Foundation Drilling Sediment Plumes

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.4
Status: Issue	



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Deposition (mm)
<1
1 - 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100

Bathymetry (m)
0
200

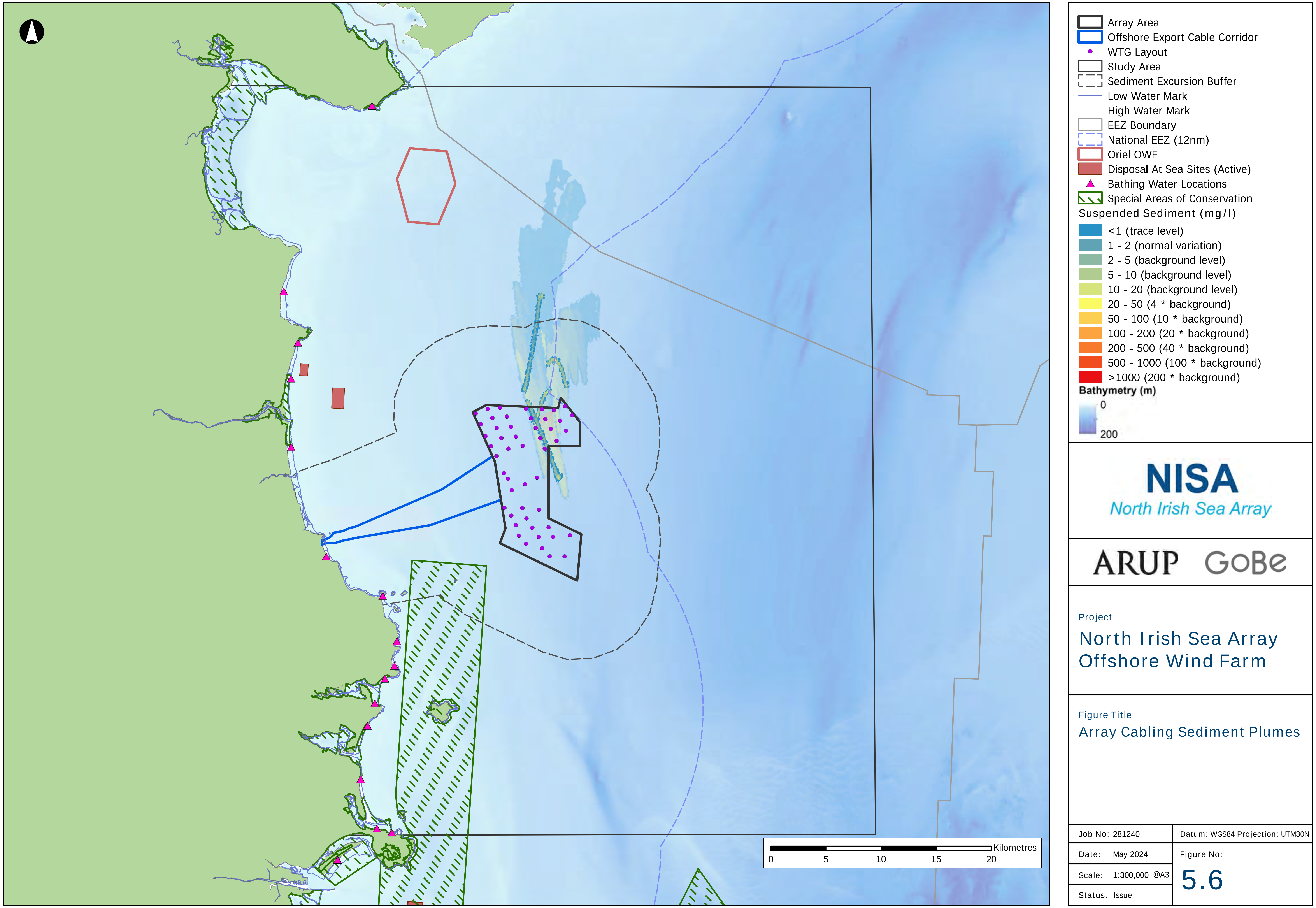
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Foundation Drilling Deposition

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.5
Status: Issue	



NISA
North Irish Sea Array

ARUP GoBe

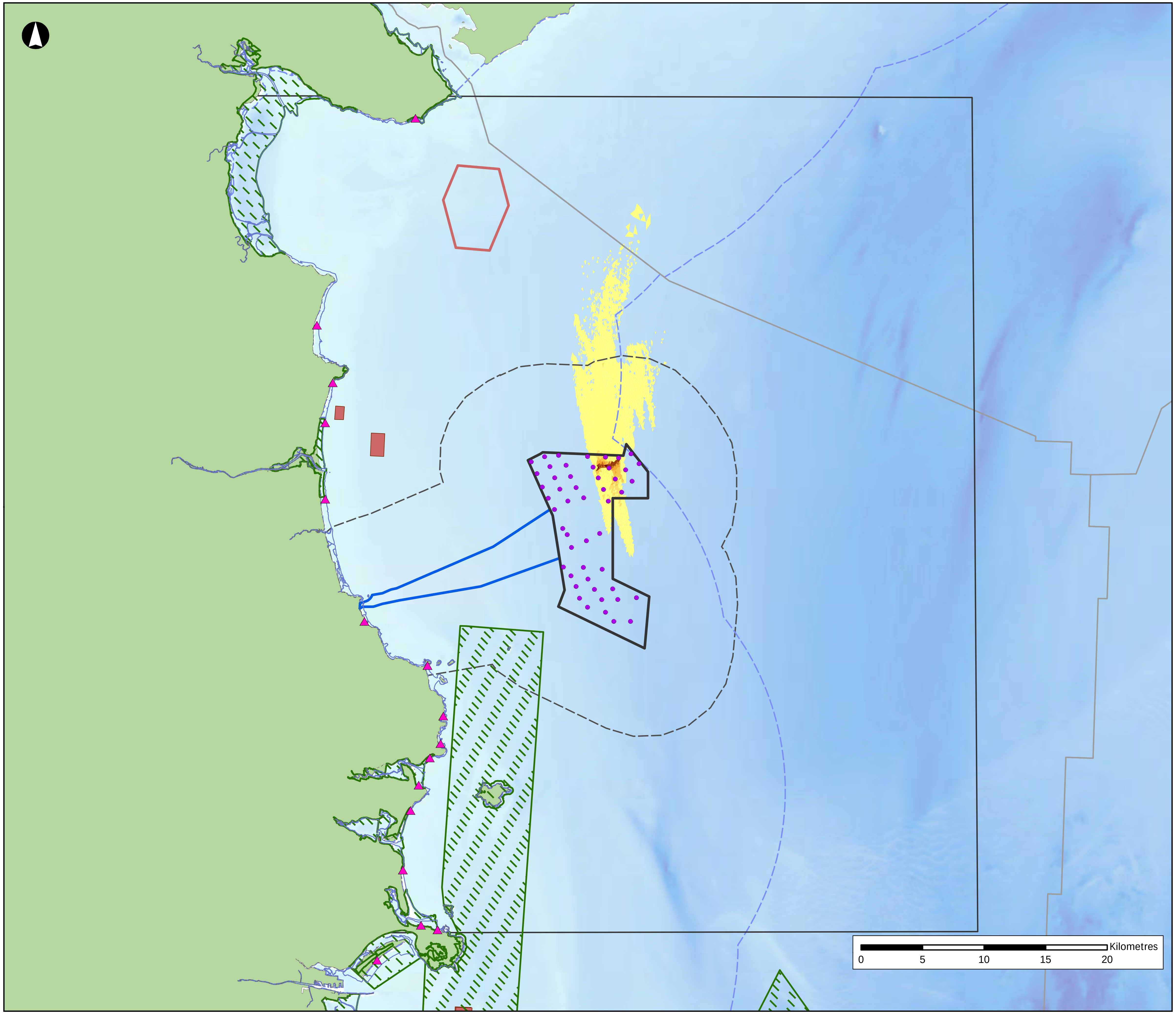
Project

North Irish Sea Array Offshore Wind Farm

Figure Title

Array Cabling Sediment Plumes

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.6
Status: Issue	



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Deposition (mm)
<1
1 - 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100

Bathymetry (m)
0
200

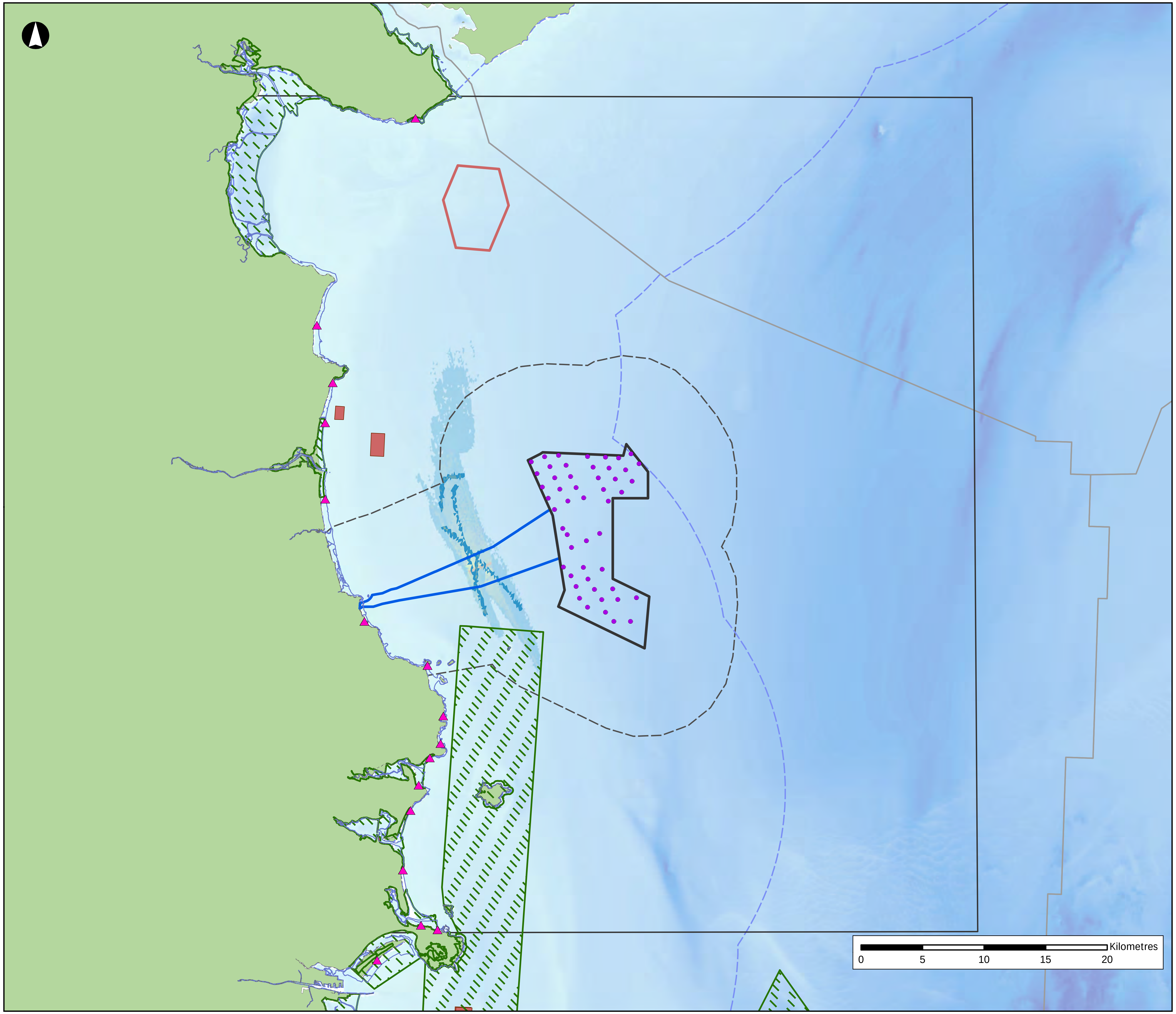
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Array Cabling Sediment Deposition

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.7
Status: Issue	



Array Area
Offshore Export Cable Corridor
WTG Layout
Study Area
Sediment Excursion Buffer
Low Water Mark
High Water Mark
EEZ Boundary
National EEZ (12nm)
Oriel OWF
Disposal At Sea Sites (Active)
Bathing Water Locations
Special Areas of Conservation

Suspended Sediment (mg/l)
<1 (trace level)
1 - 2 (normal variation)
2 - 5 (background level)
5 - 10 (background level)
10 - 20 (background level)
20 - 50 (4 * background)
50 - 100 (10 * background)
100 - 200 (20 * background)
200 - 500 (40 * background)
500 - 1000 (100 * background)
>1000 (200 * background)

Bathymetry (m)
0
200

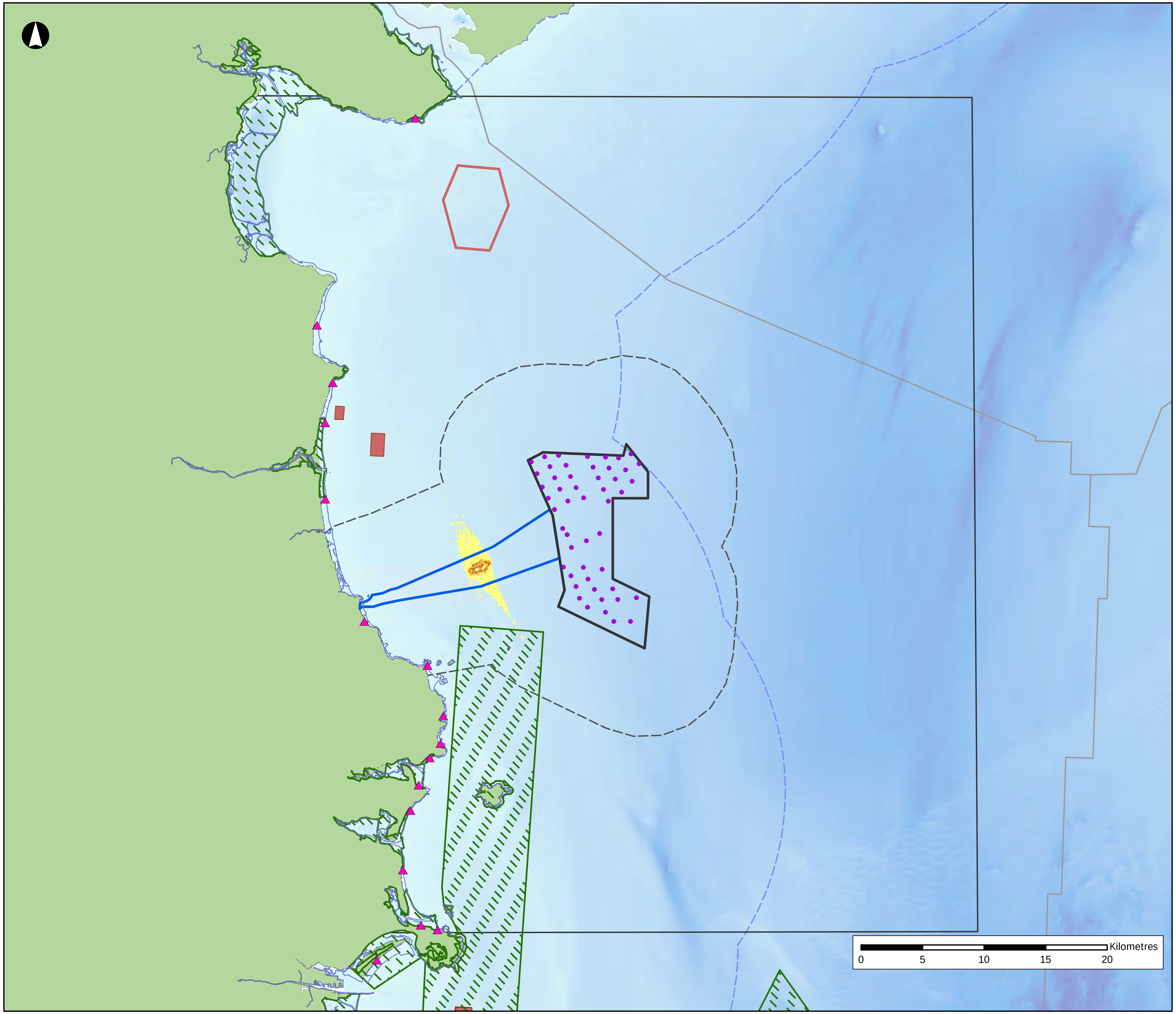
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
ECC Cabling Sediment Plumes

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.8
Status: Issue	



NISA

North Irish Sea Array

ARUP GoBe

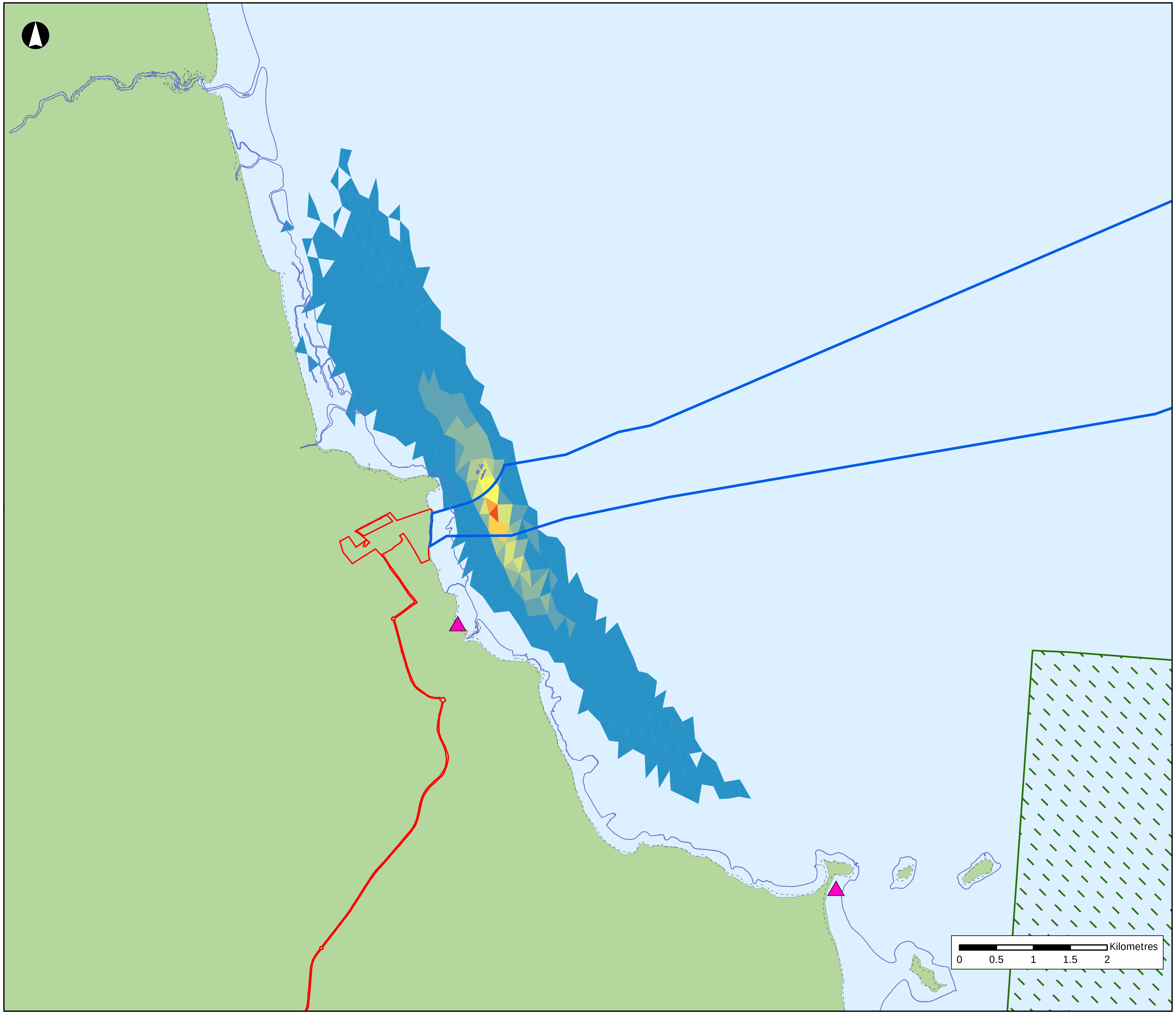
Project

North Irish Sea Array Offshore Wind Farm

Figure Title

ECC Cabling Sediment Deposition

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:300,000 @A3	5.9
Status: Issue	



Offshore Export Cable Corridor
Onshore Cable Route
Low Water Mark
High Water Mark
Bathing Water Locations
Special Areas of Conservation

Suspended Sediment (mg/l)
- <1 (trace level)
- 1 - 2 (normal variation)
- 2 - 5 (background level)
- 5 - 10 (background level)
- 10 - 20 (background level)
- 20 - 50 (4 * background)
- 50 - 100 (10 * background)
- 100 - 200 (20 * background)
- 200 - 500 (40 * background)
- 500 - 1000 (100 * background)
- >1000 (200 * background)

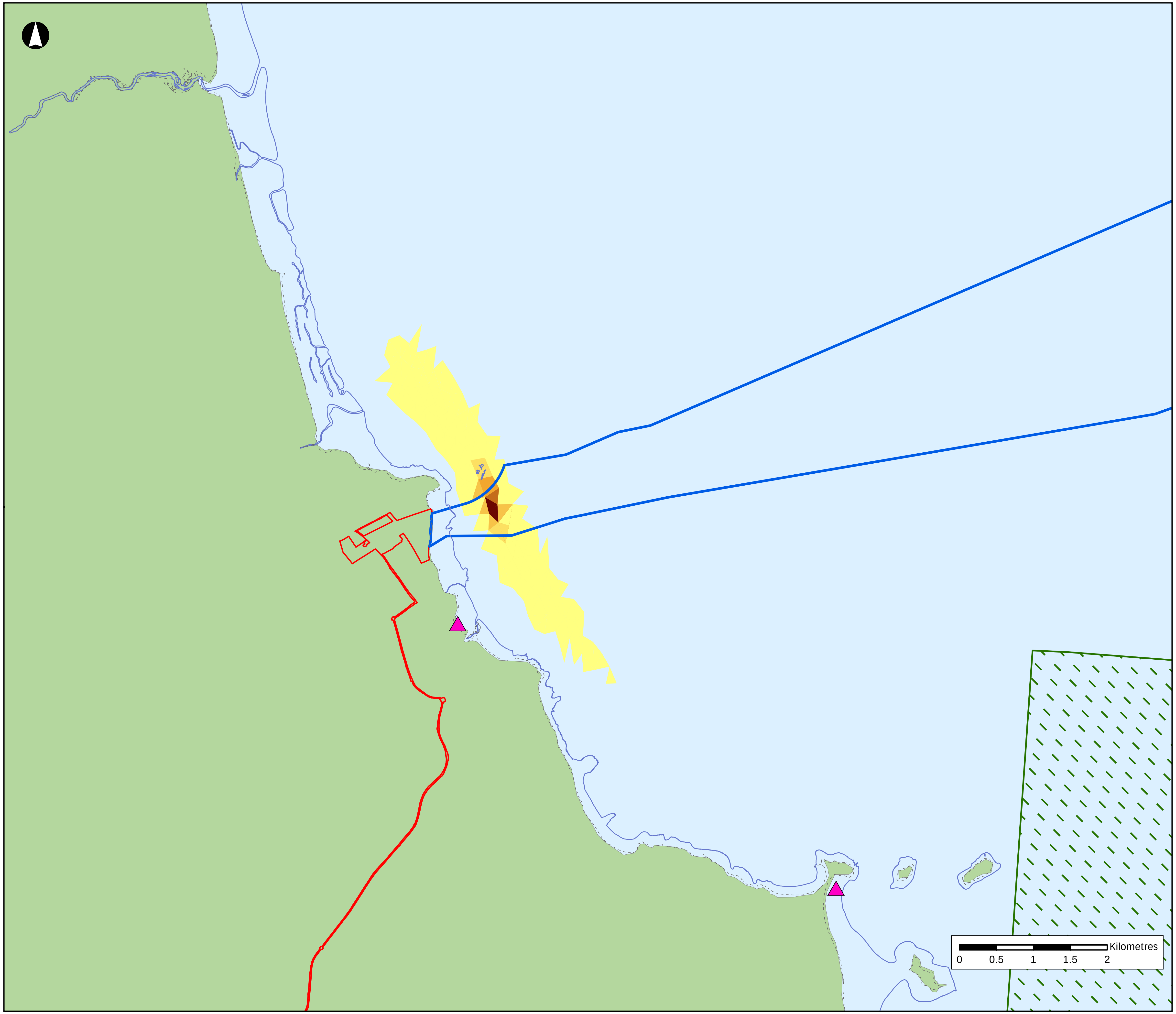
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Subtidal HDD Exit Pits Sediment Plumes

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:50,000 @A3	5.10
Status: Issue	



NISA North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Subtidal HDD Exit Pits Sediment Deposition

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:50,000 @A3	5.11
Status: Issue	

5.1.2.2 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from offshore activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling was undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations.

In addition, due to the adjacent location of the onshore cable route to the estuary, there is potential for an accidental spill to reach the estuary via surface waters and, albeit limited, potential for hydrogeological connectivity via groundwater discharge to the SAC. As groundwater flow is slow, the infiltration capacity of the soil will limit how much of an accidental spill can enter the ground. Groundwater contamination plumes develop over years of sustained release (e.g. from unlined landfills or brownfield sites).

5.1.2.2.1 Mitigation

The adoption of pollution management controls as outlined in the CEMP (Appendix 8) and Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals, restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

5.1.2.2.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Malahide Estuary SAC beyond trace levels. This, allied to the low levels of site-specific sediment bound contaminants throughout the offshore development area and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Malahide Estuary SAC. Similarly, with the implementation of mitigation measures no detectable levels of contaminants from onshore activities will enter the Malahide Estuary SAC through freshwater run-off or through accidental spillages.

5.1.2.2.3 Conclusion of AEoI

The impacts from offshore activities of accidental pollution on the QIs of Malahide Estuary SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of accidental pollution entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI in relation to offshore and onshore activities would apply to Project Option 2.

5.1.2.3 Introduction of Marine Invasive Non-Native Species (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for introduction of Marine INNS.

There is the potential for the introduction of marine INNS to result from the construction, operation and decommissioning phase of the proposed development from either the introduction of hard substrates onto the seafloor or from vessels. The introduction of hard substrates in the form of WTGs, scour and cable protection will change the type of available habitats for benthic communities. Hard substrate habitats are comparatively rare across the proposed development which is dominated by sedimentary habitats, and the colonisation of these substrates can lead to increases in biodiversity, and locally alter the biotopes that characterise the area. Such changes to the site’s biodiversity will be long term, lasting the duration of the development.

5.1.2.3.1 *Mitigation*

All vessels will implement the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[1], which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments and guidance provided in "2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species"[2].

5.1.2.3.2 *Assessment*

It is evident that the pathways for the introduction of marine INNS from vessels are limited both spatially and temporally, while the area of introduced hard substrates where subsequent colonisation may occur is also limited. Although, hard substrate can act as a stepping stone for marine INNS, the distance from the SAC indicates that this is unlikely to occur in relation to the development. Consequently, when considering this impact, pathways to the site are negligible.

5.1.2.3.3 *Conclusion of AEoI*

The impacts of the introduction of marine INNS on the QIs of the Malahide Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.2.4 *Changes to Physical Processes (Operation)*

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for changes to physical processes.

The presence of foundations and scour protection introduce changes to the local hydrodynamic and wave regime, potentially 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. However, changes in flow dynamics and associated scour effects will remain within the array area with small-scale changes around individual foundations having no perceived far-field effects.

5.1.2.4.1 *Assessment*

Consequently, due to any changes being limited spatially to within the vicinity of foundations and the distance of the site from the array area (20.3km), it is determined that no impact will occur on the SAC as a result of changes to physical processes and no mitigation measures are required.

5.1.2.4.2 *Conclusion of AEoI*

The impacts of changes to physical processes on the QIs of the Malahide Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.2.5 *Dust Deposition (Construction and Decommissioning)*

The onshore works for both project options are the same. Dust deposition arising during construction of the onshore development area has the potential to cause degradation of QI habitats of Malahide Estuary SAC, at adjacent works along the Estuary Road. Typically, dust impacts are localised, and dust deposition does not extend further than 100m from the source, however under dry and windy weather conditions dust can travel a significant distance and deposit on habitats a distance greater than 100m from the source. With reference to maps for the SAC[3] it is evident that QI habitats are located adjacent to the proposed development along the Estuary Road.

---

[1] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx

[2] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

[3] https://www.npws.ie/sites/default/files/protected-sites/statutory_instrument_maps/MAP000205.pdf

5.1.2.5.1 *Mitigation*

Standard best practice construction methods will be adopted including preparation and management of site and works areas to minimise soil and dust exposure; maintenance of construction plant and equipment; coverage and revegetation of exposed earthworks; measures specific to Track-out. At Malahide Estuary (Estuary Road) a 2m minimum site hoarding will be erected around the working areas adjacent to ensure dust impacts on Malahide Estuary SAC are reduced as far as practicable.

5.1.2.5.2 *Assessment*

Dust emissions could potentially occur throughout the construction and decommissioning phases these are expected to be low volume and intermittent, and the deposition will most likely be localised to areas in proximity to the construction works i.e. within 100m. Consequently, with the implementation of relevant mitigation measures inputs of dust into the SAC are considered to be negligible.

5.1.2.5.3 *Conclusion of AEoI*

As such, the conclusion can be reached that the construction, and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the intertidal habitats designated in the Malahide Estuary SAC in relation to dust deposition arising from the onshore elements of the proposed development.

5.1.3 Rogerstown Estuary SAC

5.1.3.1 Qualifying Interests of Rogerstown Estuary SAC

Rogerstown Estuary SAC lies 15.7km inshore of the array area and 12.5km from the ECC. The nearest works of the onshore development area to Rogerstown Estuary SAC are located along the R132 at Blakes Cross South which is immediately adjacent to the SAC for c. 50m. The works at this location will include road breaking out, cable trenching and backfilling, road resurfacing, and two watercourse crossings at Deanestown Stream and Ballyboghil Stream. The proposed method of crossing Deanestown Stream and Ballyboghil Stream are combined inline HDD, combined offline HDD and offline open cut trench. The HDD options would avoid in-stream works at these locations, and the offline open cut option would involve in-stream works.

The following coastal and marine habitat qualifying interests have been screened in for further assessment:

- Estuaries*
- Mudflats and sandflats not covered by seawater at low tide*
- Salicornia and other annuals colonising mud and sand*
- Atlantic salt meadows* (*Glauco-Puccinellietalia maritimae*)
- Mediterranean salt meadows* (*Juncetalia maritimi*)

5.1.3.1.1 *Conservation Objectives and Description of Qualifying Interests: Estuaries*

The COs for the Annex I habitat is to maintain the favourable conservation condition of Estuaries in Rogerstown Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent: Maintain the extent of the *Zostera*-dominated community and the *Mytilus edulis*-dominated community, subject to natural processes.
- Community structure: *Zostera* density: Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community structure: Mytilus edulis density: Conserve the high quality of the *Mytilus edulis* dominated community, subject to natural processes; and
- Community distribution: Conserve the following community types in a natural condition: Sand to coarse sediment with *Nephtys cirrosa* and *Scolelepis squamata* community complex; Estuarine sandy mud to mixed sediment with *Tubificoides benedii*, *Hediste diversicolor* and *Peringia ulvae* community complex.

5.1.3.1.2 Conservation Objective and Description of Qualifying Interest: Mudflats and Sandflats Not Covered by Seawater at Low Tide

The COs for Annex I habitat is to maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Rogerstown Estuary SAC, as defined by the following list of attributes and targets:

- Habitat area: The permanent habitat area is stable or increasing, subject to natural processes.
- Community extent: Maintain the extent of the *Zostera*-dominated community and the *Mytilus edulis*-dominated community, subject to natural processes.
- Community structure: Zostera density: Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.
- Community structure: *Mytilus edulis* density: Conserve the high quality of the *Mytilus edulis* dominated community, subject to natural processes; and
- Community distribution: Conserve the following community types in a natural condition: Sand to coarse sediment with *Nephtys cirrosa* and *Scolelepis squamata* community complex; Estuarine sandy mud to mixed sediment with *Tubificoides benedii, Hediste diversicolor* and *Peringia ulvae* community complex.

5.1.3.1.3 Conservation Objective and Description of Qualifying Interest: Salicornia and Other Annuals Colonising Mud and Sand

The COs for Annex I habitat is to maintain the favourable conservation condition of Salicornia and other annuals colonising mud and sand in Rogerstown Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Rogerstown Estuary 0.90ha.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans: Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime: Maintain natural tidal regime.
- Vegetation structure: zonation: Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height: Maintain structural variation within sward.
- Vegetation structure: vegetation cover: Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities: Maintain the presence of species-poor communities listed in SMP; and
- Vegetation structure: negative indicator species - *Spartina anglica*: No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur.

5.1.3.1.4 Conservation Objectives and Description of Qualifying Interest: Atlantic Salt Meadows (Glauco-Puccinellietalia maritimae)

The COs for Annex I habitat is to restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) in Rogerstown Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Rogerstown Estuary 37.2ha.

- Habitat distribution: No decline or change in habitat distribution, subject to natural processes.
- Physical structure: sediment supply: Maintain natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans: Allow creek and pan structure to develop, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime: Maintain natural tidal regime.
- Vegetation structure: zonation: Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height: Maintain structural variation within sward.
- Vegetation structure: vegetation cover: Percentage cover at a representative sample of monitoring stops.
- Vegetation composition: typical species and sub-communities: Maintain range of sub-communities with typical species listed in SMP; and
- Vegetation structure: negative indicator species – *Spartina anglica*: No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur.

5.1.3.1.5 Conservation Objectives and Description of Qualifying Interest: Mediterranean Salt Meadows (Juncetalia maritimi)

The COs for the Annex I habitat is to maintain the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) in Rogerstown Estuary SAC, which is defined by the following list of attributes and targets: Habitat area: Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Rogerstown Estuary 2.18ha.

- Habitat distribution: No decline, subject to natural processes.
- Physical structure: sediment supply: Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure: creeks and pans: Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure: flooding regime: Maintain natural tidal regime.
- Vegetation structure: zonation: Maintain range of saltmarsh habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure: vegetation height: Maintain structural variation in the sward.
- Vegetation structure: vegetation cover: Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition: typical species and sub-communities: Maintain range of sub-communities with characteristic species listed in SMP; and
- Vegetation structure: negative indicator species – *Spartina anglica*: No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is already known to occur.

5.1.3.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning. In addition, suspended material from onshore construction works may enter the marine environment through freshwater run-off.

As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.1.3.2.1 Mitigation

There is potential for material produced by onshore construction activities to enter the marine environment within surface runoff. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. In addition to further protect the SAC from surface water run-off, where an open-cut watercourse crossing method is proposed at Ballyboghill Stream, which flows directly into the Rogerstown Estuary SAC, no in-stream works will occur within 150m of the SAC boundary. Full watercourse protection measures for in-stream works, as outlined in the CEMP will be adhered to. Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and reduce the magnitude of associated impacts on coastal and marine receptors to negligible.

5.1.3.2.2 Assessment

Rogerstown Estuary SAC lies 15.7km from the offshore ECC at the landfall and lies 12.5km from the array area, while the onshore cable corridor is directly adjacent to the site. Sediment plumes caused by works within the array area and ECC are anticipated to be restricted to one tidal excursion as indicated in Figures 5.2 to 5.11 which show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels with subsequent deposition being undetectable above background levels. No sediment plume or deposition extends into the Rogerstown Estuary SAC. Similarly, with the implementation of mitigation measures the amount of sediment from onshore activities entering the estuary and marine environment from freshwater run-off will be imperceptible.

5.1.3.2.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Rogerstown Estuary SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of sedimentation entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI I relation to offshore and offshore activities would apply to Project Option 2.

5.1.3.3 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from construction, operation and decommissioning of offshore activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations.

In addition, due to the adjacent location of the onshore cable route to the estuary, there is potential for an accidental spill to reach the estuary via surface waters. In this case, there is no potential for hydrogeological connectivity and groundwater discharge to the SAC due to the difference in levels between the road corridor and the SAC and absence of groundwater interactions.

5.1.3.3.1 Mitigation

The adoption of pollution management controls as outlined in the CEMP (Appendix 8) and Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals will be restricted and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

In addition to further protect the SAC from surface water run-off, where an open-cut watercourse crossing method is proposed at Ballyboghill Stream, which flows directly into the Rogerstown Estuary SAC, no in-stream works will occur within 150m of the SAC boundary. Full watercourse protection measures for in-stream works, as outlined in the CEMP will be adhered to.

5.1.3.3.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Rogerstown Estuary SAC beyond trace levels. This, allied to the low levels of site-specific sediment bound contaminants throughout the array area and ECC and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Rogerstown Estuary SAC. Similarly, with the implementation of mitigation measures no detectable levels of contaminants from onshore activities will enter the Rogerstown Estuary SAC through freshwater run-off or through accidental spillages.

5.1.3.3.3 Conclusion of AEoI

The impacts from offshore activities of accidental pollution on the QIs of Rogerstown Estuary SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of accidental pollution entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI in relation to offshore and onshore activities would apply to Project Option 2.

5.1.3.4 Introduction of Marine Invasive Non-Native Species (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for introduction of Marine INNS.

There is the potential for the introduction of marine INNS to result from the construction, operation and decommissioning phase of the proposed development from either the introduction of hard substrates onto the seafloor or from vessels. The introduction of hard substrates in the form of WTGs, scour and cable protection will change the type of available habitats for benthic communities. Hard substrate habitats are comparatively rare across the proposed development which is dominated by sedimentary habitats, and the colonisation of these substrates can lead to increases in biodiversity, and locally alter the biotopes that characterise the area. Such changes to the site’s biodiversity will be long term, lasting the duration of the development.

5.1.3.4.1 Mitigation

All vessels will implement the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[4], which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments and guidance provided in “2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species”[5].

5.1.3.4.2 Assessment

It is evident that the pathways for the introduction of Marine INNS from vessels are limited both spatially and temporally, while the area of introduced hard substrates where subsequent colonisation may occur is also limited. Although, hard substrate can act as a stepping stone for marine INNS the distance from the SAC indicates that this is unlikely to occur in relation to the development. Consequently, when considering this impact pathways to the site are negligible.

5.1.3.4.3 Conclusion of AEoI

The impacts of the introduction of marine INNS on the QIs of the Rogerstown Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

---

[4] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx

[5] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

5.1.3.5 Changes to Physical Processes (Operation)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for changes to physical processes.

The presence of foundations and scour protection introduce changes to the local hydrodynamic and wave regime, potentially 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. However, changes in flow dynamics and associated scour effects will remain within the array area with small-scale changes around individual foundations having no perceived far-field effects .

5.1.3.5.1 Assessment

Consequently, due to any changes being limited spatially to within the vicinity of foundations and the distance of the site from the array area (15.7km), it is determined that no impact will occur on the SAC as a result of changes to physical processes and no mitigation measures are required.

5.1.3.5.2 Conclusion of AEoI

The impacts of changes to physical processes on the QIs of the Rogerstown Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.3.6 Dust Deposition (Construction and Decommissioning)

Dust generation and deposition during construction of the onshore infrastructure of the proposed development has the potential to impact Rogerstown Estuary SAC at the adjacent works along the R132 at Blakes Cross South. Typically dust impacts are localised and dust deposition does not extend further than 100m from the source, however under dry and windy weather conditions dust can travel a significant distance and deposit on habitats a distance greater than 100m from the source. According to the SAC COs, QI habitats, estuaries and Atlantic salt meadows, are located c. 635m and c. 600m respectively from the nearest point of the proposed development. At these distances dust impacts are expected to be imperceptible and will not result in any impact that would significantly affect the COs of the Rogerstown Estuary SAC. As such, the conclusion can be reached that the construction, and decommissioning of the onshore infrastructure of the proposed development (alone) will not have AEoI of the intertidal habitats designated in the Rogerstown Estuary SAC in relation to dust deposition arising from the onshore infrastructure of the proposed development.

5.1.3.6.1 Conclusion of AEoI

Considering the above information, the conclusion can be reached that the construction, and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the intertidal habitats designated in the Rogerstown Estuary SAC in relation to dust deposition arising from the onshore elements of the proposed development.

5.1.4 Baldoyle Bay SAC

5.1.4.1 Qualifying Interests and Conservation Objectives

Baldoyle Bay SAC lies 0.9km east of the onshore cable route, 26.1km inshore of the array area and 22.5km from the ECC. The nearest works of the onshore infrastructure of the proposed development to Baldoyle Bay SAC are located along the R124 east of Kinsealy. The works at this location will include road breaking out, cable trenching and backfilling, road resurfacing, and further south of the nearest location the watercourse crossings of Cuckoo Stream and Mayne Stream. The proposed method of crossing of Cuckoo Stream is in-road open cut trench (potential shallow depth of cover) or inline HDD which will be combined with that of Mayne Stream. The crossing option of Mayne Stream is inline HDD which will avoid in-stream works.

The following coastal and marine habitat qualifying interests have been screened in for further assessment:

- Tidal mudflats and sandflats*

- Salicornia mud and other colonising mud and sand*
- Atlantic salt meadows*
- Mediterranean salt meadows*

5.1.4.1.1 Conservation Objectives and Description of Qualifying Interest: Tidal Mudflats and Sandflats

The COs to maintain the favourable conservation condition of mudflats and sandflats not covered by seawater at low tide as defined by the following list of attributes and targets:

- Habitat Area: The permanent habitat area is stable or increasing, subject to natural processes.
- Community distribution: Conserve the following community types in a natural condition:
  - Fine sand dominated by *Angulus tenuis* community complex; and
  - Estuarine sandy mud with *Pygospio elegans* and *Tubificoides benedii* community complex.

5.1.4.1.2 Conservation Objectives and Description of Qualifying Interest: Salicornia and Other Annuals Colonising Mud and Sand

The COs to maintain the favourable conservation condition of Salicornia and other annuals colonising mud and sand as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure (flooding regime): Maintain natural tidal regime.
- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the presence of species-poor communities with typical species listed in the Saltmarsh Monitoring Project; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

5.1.4.1.3 Conservation Objectives and Description of Qualifying Interest: Atlantic Salt Meadows

The COs to maintain the favourable conservation condition of Atlantic salt meadows as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure (flooding regime): Maintain natural tidal regime.

- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the range of communities with typical species; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

5.1.4.1.4 Conservation Objectives of and Description of Qualifying Interest: Mediterranean Salt Meadows

The COs to maintain the favourable conservation condition of Mediterranean salt meadows as defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing, subject to natural processes, including erosion and succession.
- Habitat distribution: No decline, or change in habitat distribution, subject to natural processes.
- Physical structure (sediment supply): Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction.
- Physical structure (creeks and pans): Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure (flooding regime): Maintain natural tidal regime.
- Vegetation structure (zonation): Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure (vegetation height): Maintain structural variation within sward.
- Vegetation structure (vegetation cover): Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition (typical species and subcommunities): Maintain the range of sub-communities with typical species; and
- Vegetation structure (negative indicator species – *Spartina anglica*): No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

5.1.4.2 Suspended Sediment/Deposition (Construction and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning. In addition, suspended material from onshore construction works may enter the marine environment through freshwater run-off. As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.1.4.2.1 Mitigation

There is potential for material produced by onshore construction activities to enter the marine environment within surface runoff.

However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from Offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

5.1.4.2.2 Assessment

Baldoyle Bay Estuary SAC lies 22.5km from the offshore ECC at the landfall and lies 26.1km from the array area. Sediment plumes caused by works within the array area and ECC are anticipated to be restricted to one tidal excursion as indicted by Figures 5.2 to 5.11 which show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels with subsequent deposition being undetectable above background levels. No sediment plume or deposition extends into the Rogerstown Estuary SAC. While the SAC is 0.9km from the onshore cable corridor at the nearest point it is expected that with the implementation of mitigation measures the amount of sediment entering the marine environment from freshwater run-off will be negligible.

5.1.4.2.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Baldoyle Bay SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of sedimentation entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI I relation to offshore and offshore activities would apply to Project Option 2.

5.1.4.3 Accidental Pollution (Construction and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from offshore activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations. For works in high risk areas such as refuelling or the use of chemicals, a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

In addition, due to the proximity of the onshore cable route to the estuary, there is potential for an accidental spill to reach the estuary via surface waters and, albeit limited, potential for hydrogeological connectivity via groundwater discharge to the SAC. As groundwater flow is slow, the infiltration capacity of the soil will limit how much of an accidental spill can enter the ground. Groundwater contamination plumes develop over years of sustained release (e.g. from unlined landfills or brownfield sites).

5.1.4.3.1 Mitigation

The adoption of pollution management controls as outlined in the CEMP (Appendix 8) and Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals, restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

5.1.4.3.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Baldoyle Bay SAC beyond trace levels. This, allied to the low levels of site-specific sediment bound contaminants throughout the development site and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Baldoyle Bay Estuary SAC.

Similarly, with the implementation of mitigation measures no detectable levels of contaminants from onshore activities will enter the Baldoyle Bay SAC through freshwater run-off or through accidental spillages.

5.1.4.3.3 Conclusion of AEoI

The impacts from offshore activities of accidental pollution on the QIs of Baldoyle Bay SAC are therefore considered to have no AEoI for Project Option 1. Similarly, the impacts of accidental pollution entering watercourses and downstream into the SAC are considered to have no AEoI for the onshore activities.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI in relation to offshore and onshore activities would apply to Project Option 2.

5.1.5 Rockabill to Dalkey Island SAC

5.1.5.1 Qualifying Interests of Rockabill to Dalkey Island SAC

Rockabill to Dalkey Island SAC lies 2.4km inshore of the array area and 2.9km from the ECC. The following coastal and marine habitat qualifying interests have been screened in for further assessment:

- Reefs*.

5.1.5.1.1 Conservation Objectives and Description of Qualifying Interest: Reefs

The COs for the Annex I habitat is to maintain the favourable conservation condition of reefs in Rockabill to Dalkey Island SAC, as defined by the following three site-specific COs attributes and targets:

- Habitat Area: The permanent area is stable or increasing, subject to natural processes;
- Habitat Distribution: The distribution of reefs is stable or increasing, subject to natural processes; and
- Community Structure: Conserve the following community types in a natural condition:
  - Intertidal reef community complex; and
  - Subtidal reef community complex.

Community type: Intertidal Reef Community

This reef community complex is recorded on the islands within this site and on the south coast of Howth. The exposure regime of the complex ranges from exposed to moderately exposed reef. Exposed reef is recorded on the east side of Dalkey Island, on the east and southern shores of Ireland's Eye and on all shores of Rockabill and the Muglins. Moderately exposed reef occurs on the western shores of Dalkey and at Howth and Ireland's Eye.

The substrate here is that of flat and sloping bedrock; around Rockabill cobbles and boulders occur on bedrock. Vertical cliff faces are found on the north and northeast shores of Ireland's Eye; steep shorelines are a feature of Rockabill, Muglins and the eastern shore of Dalkey Island.

The species associated with this community complex include the fucoids; *Fucus serratus*, *F. vesiculosus*, *F. spiralis*, *Ascophyllum nodosum* and *Pelvetia canaliculata*, the barnacle *Semibalanus balanoides* and the bivalve *Mytilus edulis*. In the more exposed areas *Semibalanus balanoides* and *Mytilus edulis* dominate while in the more moderately exposed areas it is the fucoid species that are more abundant. The gastropods *Patella vulgata* and *Littorina sp*. are also recorded here. In all areas the kelp species *Laminaria digitata* is recorded at the low water mark.

Species associated with the Intertidal reef community complex include: *Fucus serratus*, *Fucus spiralis*, *Fucus vesiculosus*, *Semibalanus balanoides*, *Ascophyllum nodosum*, *Mytilus edulis*, *Pelvetia canaliculata*, *Patella vulgate*, *Laminaria digitata* and *Littorina sp*.

Community type: Subtidal Reef Community Complex

This community complex is recorded off the islands within the site and also off the coast between Lambay Island and Rush Village. The exposure regime here ranges from moderately exposed reef at the Muglins to exposed reef over the remainder of the site.

The substrate ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland's Eye and to the east of Lambay Island where they give way to sloping bedrock at c.20m. In the northern reaches of the site, at Rockabill and Ireland's Eye, areas of both sediment scouring and a thin veneer of silt were observed on the reefs; the veneer of silt was also recorded at Lambay Island. In the south of the site, strong currents were experienced in the channel between Dalkey Island and the Muglins.

In the shallow reaches of this community complex (<10m) a sparse covering of the kelp species *Laminaria hyperborea* occurs with an undercover of red algal species including *Hypoglossum hypoglossoides*, *Brongniartella byssoides*, *Membranoptera alata*, *Phycodrys rubens* and *Delesseria sanguinea*. In deeper water (>10m) the anemone *Alcyonium digitatum* occurs in moderate abundances and *Metridium senile* also being recorded here.

Faunal crusts of bryozoans such as *Flustra foliacea* and *Chartella papyracea* and hydroids including *Nemertesia antennina* are recorded in deeper water (>20m) along with the ascidian *Aplidium punctum*. The asteroid *Asterias rubens* is recorded throughout the site while the barnacle *Balanus crenatus*, the echinoderms *Echinus esculentus* and *Antedon bifida* also occur here.

In general, it was noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals occurred.

5.1.5.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning. As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

Due to distance from potential hydrological pathways no inputs of SSC are expected into the SAC in relation to onshore activities and this onshore related potential impact has been screened out for this site.

5.1.5.2.1 Mitigation

Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from Offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

5.1.5.2.2 Assessment

The Rockabill to Dalkey Island SAC lays 2.4km from the array area and 2.9km from the ECC. Figure 5.2 through Figure 5.11 show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels. Figure 5.8 shows that trace levels (<1mg/l) of suspended sediment may travel into the northern portion of the Rockabill to Dalkey SAC however, the sediment will likely disperse in the next tidal cycle.

Maps of the extent of the known geogenic reefs within the Rockabill to Dalkey Island SAC (NPWS, 2013a) indicate that no reef QIs of conservation importance (reef habitat within the site occur at Dalkey Island, Maiden Rock and Muglins in the southern portion, off Howth Head, Ireland's Eye and Lambay Island in the central portion, and Rockabill in North Dublin).

As defined above, the site supports subtidal and intertidal reef community complexes. The following biotopes supported by geogenic reef were identified across the site within the Coastal and Marine Habitats Chapter:

- High energy circalittoral rock (EUNIS code: A4.1) (CR.HCR)
- High energy infralittoral rock (EUNIS code: A3.1) (IR.HIR)

- Low energy infralittoral rock (EUNIS code: A1.3) (IR.LIR)
- High energy littoral rock (EUNIS code: A1.1) (LR.HLR)
- Atlantic and Mediterranean high energy infralittoral rock (EUNIS code: A4.1) (IR.HIR) (identified as having medium resemblance to stony reef (Fugro, 2021)).
- Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata (EUNIS code: MA5211) (LR.FLR.Eph.EphX)
- Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock (EUNIS code:MA12441) (LR.MLR.BF.Fser.R)
- Porphyra purpurea and Enteromorpha spp. on sand-scoured mid or lower eulittoral rock (EUNIS code: MA123H) (LR.FLR.Eph.EntPor); and
- Robust fucoid and/or red seaweed communities (EUNIS code: MA123) (LR.HLR.FR).

The communities associated with geogenic reef habitat which is a protected QI of the Rockabill to Dalkey Island SAC, are expected to have some tolerance to increases in SSC particularly as these habitats are naturally subject to strong tidal currents with an abundant supply of suspended matter (as detailed in Section 4.2 As assessed within the MarLIN,MarESA , '*Semibalanus balanoides* and *Littorina spp*. on exposed to moderately exposed eulittoral boulders and cobbles' represent the biotope of highest sensitivity (Medium sensitivity) to sediment deposition (note the biotope has low sensitivity to increased SSC) (Tillin, 2015), due to the sensitivity of limpet and Littorinid populations. However, the level of exposure to the impact may be reduced by wave action or water flows so that site-specific vulnerability may be lower where sediments do not accumulate. In addition, the assessment took a precautionary approach, assuming repeated deposition events, and wide-ranging impact extents (Tillin, 2015).

The conservation targets for 'habitat area' and 'habitat distribution' of reef habitat are met when the permanent area (or distribution as the case may be) is stable or increasing, subject to natural processes. The Rockabill to Dalkey Island SAC COs Supporting Document for Marine Habitats and Species (NPWS, 2013a) notes that:

- the 'permanent area' target refers to activities or operations that propose to permanently remove reef habitat, thus reducing the permanent amount of reef habitat; and
- the 'distribution' target refers to activities or operations that propose to permanently remove reef habitat, thus reducing the range over which this habitat occurs.

These targets do not refer to long or short-term disturbance of the biology of reef habitats. Therefore, the 'habitat area' and 'habitat distribution' conservation targets will not be undermined by the impact of increased SSC and deposition from the construction, operation and decommissioning of the proposed development given the temporary nature of the effect. However, there is a possibility that the 'Community Structure' target to conserve the intertidal and subtidal reef community complexes in a natural condition may be affected by sediment plumes and deposition impacts if the activities resulted in elevated concentrations of suspended sediments in or at the reef community complexes for prolonged periods. As stated in NPWS (2013a), the 'Community Structure' target relates to the structure and function of the reef and therefore it is of relevance to those activities that may cause disturbance to the ecology of the habitat, such as increased suspended sediments and deposition.

Taking into consideration the significant capacity of Dublin Bay to dilute elevated concentrations of suspended sediments, the naturally occurring variability of SSCs across the site, the temporary nature of the impact, and the low sensitivity of the geogenic reef biotopes identified across the site along with the adoption of mitigation measures it is evident that the risk of suspended sediments escaping into the wider marine environment beyond the offshore development area will not imperil the conservation target to conserve the intertidal and subtidal reef community complexes in Rockabill to Dalkey Island SAC in a natural condition.

5.1.5.2.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Rockabill to Dalkey Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI I relation to offshore activities would apply to Project Option 2.

5.1.5.3 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from offshore activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations.

Due to distance from potential hydrological pathways no inputs of contaminants are expected into the SAC in relation to onshore activities and this onshore related potential impact was screened out for this site.

5.1.5.3.1 Mitigation

The adoption of pollution management controls as outlined in the Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high-risk areas such as refuelling or the use of chemicals a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

5.1.5.3.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Rockabill to Dalkey Island SAC beyond trace levels. This, allied to the low levels of site-specific sediment bound contaminants at throughout the development site and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Rockabill to Dalkey Island SAC.

5.1.5.3.3 Conclusion of AEoI

The impacts of accidental pollution arising from onshore and offshore activities on the QIs of the Rockabill to Dalkey Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.5.4 Introduction of Marine Invasive Non-Native Species (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for introduction of Marine INNS.

There is the potential for the introduction of marine INNS to result from the construction, operation and decommissioning phase of the proposed development from either the introduction of hard substrates onto the seafloor or from vessels. The introduction of hard substrates in the form of WTGs, scour and cable protection will change the type of available habitats for benthic communities. Hard substrate habitats are comparatively rare across the proposed development which is dominated by sedimentary habitats, and the colonisation of these substrates can lead to increases in biodiversity, and locally alter the biotopes that characterise the area. Such changes to the site’s biodiversity will be long term, lasting the duration of the development.

5.1.5.4.1 *Mitigation*

All vessels will implement the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[6], which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments and guidance provided in "2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species"[7].

species through ships' ballast water and sediments and guidance provided in "2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species"[8].

5.1.5.4.2 *Assessment*

It is evident that the pathways for the introduction of Marine INNS from vessels are limited both spatially and temporally, while the area of introduced hard substrates where subsequent colonisation may occur is also limited. Although, hard substrate can act as a stepping stone for marine INNS the distance from the SAC indicates that this is unlikely to occur in relation to the development. Consequently, when considering this impact pathways to the site are negligible.

5.1.5.4.3 *Conclusion of AEoI*

The impacts of the introduction of marine INNS on the QIs of the Rockabill to Dalkey Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1 it is considered that the same conclusion of no AEoI would also apply to Project Option 2.

5.1.5.5 *Changes to Physical Processes (Operation)*

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for changes to physical processes.

The presence of foundations and scour protection introduce changes to the local hydrodynamic and wave regime, potentially 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. However, changes in flow dynamics and associated scour effects will remain within the array area with small-scale changes around individual foundations having no perceived far-field effects.

5.1.5.5.1 *Assessment*

Consequently, due to any changes being limited spatially to within the vicinity of foundations and the distance of the site from the array area (2.4km), it is determined that no impact will occur on the SAC as a result of changes to physical processes and no mitigation measures are required.

5.1.5.5.2 *Conclusion of AEoI*

The impacts of changes to physical processes on the QIs of the Rockabill to Dalkey Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.6 Boyne Coast and Estuary SAC

5.1.6.1 *Qualifying Interests and Conservation Objectives*

Boyne Coast and Estuary SAC lies 16.4km inshore of the array area and 7.9km north of the ECC. The following qualifying interests have been screened in for further assessment:

---

[6] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx

[7] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

[8] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

- Estuaries*
- Mudflats and sandflats not covered by seawater at low tide*
- Salicornia and other annuals colonising mud and sand*; and
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)*

5.1.6.1.1 Conservation Objectives and Description of Qualifying Interest: Estuaries

The COs for the Annex I habitat is to maintain the favourable conservation condition of Estuaries in Boyne Coast and Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: The permanent habitat area is stable or increasing, subject to natural processes; and
- Community distribution: Conserve the following community types in a natural condition: Intertidal estuarine mud and fine sand with *Hediste diversicolor* and *Corophium volutator* community; and subtidal fine sand dominated by polychaetes community.

5.1.6.1.2 Conservation Objectives and Description of Qualifying Interest: Tidal Mudflats and Sandflats

The COs to maintain the favourable conservation conditions on tidal mudflats and sandflats in Boyne Coast and Estuary SAC are defined by the following list of attributes and targets:

- Habitat Area: The permanent habitat area is stable or increasing, subject to natural processes.
- Community Distribution: Conserve the following community types in a natural condition: Intertidal estuarine mud and fine sand with *Hediste diversicolor* and *Corophium volutator* community; and Fine sand dominated by bivalves' community complex.

Community type: Intertidal Estuarine Mud and Fine Sand with Hediste diversicolor and Corophium volutator community

This community occurs on the mudflats of the Boyne River from the Boyle Bridge in Drogheda town eastwards to the mouth of the river. The mudflats are most extensive on the southern shore of the estuary from Mornington to Burrow Point.

The sediment of this community is largely fine material with fine sand ranging from 11% to 51%, very fine sand from 7% to 24% and silt-clay from 36% to 68%. The coarser fractions are generally less than 6%.

This community is distinguished by the presence of the polychaete *Hediste diversicolor* and the crustacean *Corophium volutator* which occur in high abundances; the gastropod *Peringia ulvae* and the crustacean *Crangon crangon* are recorded in moderate abundances.

Community type: Fine Sand Dominated by Bivalves Community Complex

This community complex occurs in the coastal portion of the site from its northern boundary at Termonfeckin to Bettystown at its southern margin. It is recorded intertidally and subtidally to a depth of approximately 1m.

The sediment is largely fine sand (ranging from 28% to 82%) with variable proportions of remaining sand fractions (coarse sand ranges from 0% to 15%, medium sand from 0% to 12%, very fine sand from 10% to 26%). The amounts of silt-clay and very coarse material are negligible (< 9% and <4% respectively).

The fauna is dominated by the bivalves *Donax vittatus* and *Tellina tenuis* with the polychaete *Nephtys cirrosa* and the bivalve *Nucula nitidosa* also recorded here in moderate abundances. The polychaete Arenicola marina occasionally occurs here.

Community type: Fine Sand Dominated by Polychaetes Community

This community occurs in the channel of the Boyne River from Tom Roe's Point to the mouth of the river. It occurs in depths of between 1m and 5m.

The sediment is largely fine sand (ranging from 7% to 70%) with a gradient of increasing fine material towards the inner reaches of the estuary (very fine sand ranging from 7% to 60% and silt-clay from 2% to 78%); coarser material is negligible (< 6%).

The faunal community is dominated by polychaetes *Nephtys kersivalensis, Streblospio shrubsolii, Nephtys cirrosa*, *Spio filicornis* and *Glycera tridactyla*. Stands of the polychaete *Lanice conchilega* are recorded in the northern part of the river channel from Quinnsborough to the Haven. The bivalve *Mytilus edulis* occurs in the eastern confines of the Boyne River channel near Burrow Point.

5.1.6.1.3 Conservation Objectives and Description of Qualifying Interest: Salicornia and Other Annual Colonising Mud and Sand

The COs to restore the favourable conservation condition of Salicornia and other annuals colonising mud and sand in Boyne Coast and Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: Area stable or increasing, subject to natural processes, including erosion and succession. For sub - sites mapped: Baltray - 2.91ha, Mornington - 1.14ha.
- Habitat distribution: No decline or change in habitat distribution, subject to natural processes.
- Physical structure - sediment supply: Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure - creeks and pans: Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure - flooding regime: Maintain natural tidal regime.
- Vegetation structure - zonation: Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure - vegetation height: Maintain structural variation within sward.
- Vegetation structure - vegetation cove: Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition - typical species and sub - communities.
- Vegetation structure - negative indicator species - *Spartina anglica*.

5.1.6.1.4 Conservation Objectives and Description of Qualifying Interest: Atlantic Salt Meadows

The COs to maintain the favourable conservation condition of Atlantic salt meadows (*Glauco - Puccinellietalia maritimae*) in Boyne Coast and Estuary SAC, which is defined by the following list of attributes and targets:

- Habitat area: Area stable or increasing, subject to natural processes, including erosion and succession. For sub - sites mapped: Baltray - 17.67ha, Mornington - 8.76ha.
- Habitat distribution: No decline or change in habitat distribution, subject to natural processes.
- Physical structure - sediment supply: Maintain natural circulation of sediments and organic matter, without any physical obstructions.
- Physical structure - creeks and pans: Maintain creek and pan structure, subject to natural processes, including erosion and succession.
- Physical structure - flooding regime: Maintain natural tidal regime.
- Vegetation structure - zonation: Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.
- Vegetation structure - vegetation height: Maintain structural variation within sward.
- Vegetation structure - vegetation cover: Maintain more than 90% of area outside creeks vegetated.
- Vegetation composition - typical species and sub - communities: Maintain range of sub - communities with typical species listed in Saltmarsh Monitoring Project (McCorry and Ryle 2009).

- Vegetation structure - negative indicator species - *Spartina anglica*: No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.

5.1.6.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning. As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

Due to distance from potential hydrological pathways no inputs of SSC are expected into the SAC in relation to onshore activities and this onshore related potential impact was screened out for this site.

5.1.6.2.1 Mitigation

Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

5.1.6.2.2 Assessment

Boyne Coast and Estuary SAC lies 7.9km from the offshore ECC at the landfall and lies 16.4km from the array area. Sediment plumes caused by works within the array area and ECC are anticipated to be restricted to one tidal excursion as indicated by Figures 5.2 through 5.11 which show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels with subsequent deposition being undetectable above background levels. No sediment plume or deposition extends into the Boyne Coast and Estuary SAC.

5.1.6.2.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Boyne Coast and Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI I relation to offshore and offshore activities would apply to Project Option 2.

5.1.6.3 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons, and organic pollutants as a result of sediment mobilisation from construction, operation and decommissioning activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations.

Due to distance from potential hydrological pathways no inputs of contaminants are expected into the SAC in relation to onshore activities and this onshore related potential impact was screened out for this site.

5.1.6.3.1 Mitigation

The adoption of pollution management controls as outlined in the Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals, a RAMS will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

5.1.6.3.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Boyne Coast and Estuary SAC beyond trace levels. This, allied to the low levels of site-specific sediment bound contaminants at throughout the development site and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Boyne Coast and Estuary SAC.

5.1.6.3.3 Conclusion of AEoI

The impacts of accidental pollution on the QIs of the Boyne Coast and Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.6.4 Introduction of Marine Invasive Non-Native Species (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for introduction of Marine INNS.

There is the potential for the introduction of Marine INNS to result from the construction, operation and decommissioning phase of the proposed development from either the introduction of hard substrates onto the seafloor or from vessels. The introduction of hard substrates in the form of WTGs, scour and cable protection will change the type of available habitats for benthic communities. Hard substrate habitats are comparatively rare across the proposed development which is dominated by sedimentary habitats, and the colonisation of these substrates can lead to increases in biodiversity, and locally alter the biotopes that characterise the area. Such changes to the site's biodiversity will be long term, lasting the duration of the development.

5.1.6.4.1 Mitigation

All vessels will implement the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[9], which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments and guidance provided in "2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species"[10].

5.1.6.4.2 Assessment

It is evident that the pathways for the introduction of Marine INNS from vessels are limited both spatially and temporally, while the area of introduced hard substrates where subsequent colonisation may occur is also limited. Although, hard substrate can act as a stepping stone for marine INNS the distance from the SAC indicates that this is unlikely to occur in relation to the development. Consequently, when considering this impact pathways to the site are negligible.

5.1.6.4.3 Conclusion of AEoI

The impacts of the introduction of marine INNS on the QIs of the Boyne Coast and Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.6.5 Changes to Physical Processes (Operation)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for changes to physical processes.

The presence of foundations and scour protection introduce changes to the local hydrodynamic and wave regime, potentially 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.

---

[9] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx

[10] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

However, changes in flow dynamics and associated scour effects will remain within the array area with small-scale changes around individual foundations having no perceived far-field effects.

5.1.6.5.1 Assessment

Consequently, due to any changes being limited spatially to within the vicinity of foundations and the distance of the site from the array area (16.3km), it is determined that no impact will occur on the SAC as a result of changes to physical processes.

5.1.6.5.2 Conclusion of AEoI

The impacts of changes to physical processes on the QIs of the Boyne Coast and Estuary SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.7 Assessment of Lambay Island SAC

5.1.7.1 Qualifying Interests of Lambay Island

Lambay Island SAC is 15.7km to southwest of the offshore ECC and, 14.8km from the array area. The following qualifying interests have been screened in for further assessment:

- Reefs*

5.1.7.1.1 Conservation Objectives and Description of Qualifying Interest: Reefs

The Cos to maintain the favourable conservation condition on reefs in Lambay Island SAC as defined by the following list of attributes and targets:

- Habitat Area: The permanent habitat area is stable or increasing, subject to natural processes.
- Distribution: The distribution of reefs is stable or increasing, subject to natural processes.
- Community Structure: Conserve the following community types in a natural condition: Intertidal reef community complex; Laminaria-dominated community complex.

Community type: Reef Complex Community

This community complex is recorded extensively on all shores of the island with the exception of the sandy beach around the quay on the western shore. The substrate here is that of boulders and cobbles with some bedrock outcrops in the northwest and southwest. The species associated with this community are the gastropods *Littorina littorea* and *Patella 106ulgate*, the brown alga *Ascophyllum nodosum*, the red algae *Lomentaria articulata*, *Vertebrata lanosa*, *Mastocarpus stellatus* and species of the family *Corallinaceae*. The brown alga *Fucus serratus* and *Laminaria digitata*, the red alga *Chondrus crispus*, the hydroid *Dynamena pumila* and the barnacle *Semibalanus balanoides* are also recorded from this community complex.

Community type: Laminaria-Dominated Community Complex

This community complex occurs on the broad expanse of hard substrate in the north, east and southern shores of the island and in a narrow band on its western shore. It is recorded in water depths of between 0m and 20m. The exposure regime is that of exposed to moderately exposed reef. The substrate of this community is primarily that of bedrock. In the northeast of the site large boulders, cobble and pebbles overly the bedrock. Vertical or near vertical faces are recorded throughout the community but are more prominent in shallower water (0m to 10m). In deeper water (ca. 20m) boulders and bedrock have a veneer of silt. The species associated with this community are the kelp *Laminaria hyperborea*, the red algae *Phycodrys rubens* and *Delesseria sanguinea*, the barnacle *Balanus crenatus*, the echinoderm *Asterias rubens*, the crustacean *Necora puber* and the cnidarian *Alcyonium digitatum*. The density of *Laminaria hyperborea* exhibits a gradation with depth becoming less dense with increasing depth. The red algae *Hypoglossum hypoglossoides* and *Membranoptera alata*, *Palmaria palmata* and *Corallinaceae*, the bryozoan *Membranipora membranacea* and bryozoan crusts are also recorded from this community complex.

5.1.7.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has the greater potential for adverse effects on coastal and marine habitats compared to Project Option 2 for increased suspended sediment and deposition.

Offshore during construction, temporary localised increases in SSC and associated sediment deposition are expected from seabed preparation works (including sandwave clearance) in addition to foundation and cable installation and HDD. Similarly, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and any removal of infrastructure during decommissioning. As detailed in paragraph 4.2, increased turbidity can lead to impacts on sessile filter feeders resulting from smothering, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

Due to distance from potential hydrological pathways no inputs of SSC are expected into the SAC in relation to onshore activities and this onshore related potential impact was screened out for this site.

5.1.7.2.1 Mitigation

Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from Offshore activities into the water column. Use of HDD to entirely avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

5.1.7.2.2 Assessment

Lambay Island SAC lies 15.7km from the offshore ECC at the landfall and lies 14.8km from the array area. Sediment plumes caused by works within the array area and ECC are anticipated to be restricted to one tidal excursion as indicated by Figures 5.2 to Figure 5.11 which show the extent of the modelled sediment plumes and depositions as a result of seabed levelling, foundation drilling and cabling. The sediment plume and deposition modelling does not extend into any SACs beyond trace levels with subsequent deposition being undetectable above background levels. No sediment plume or deposition extends into the Lambay Island SAC.

5.1.7.2.3 Conclusion of AEoI

The impacts from offshore activities of increased SSC and deposition on the QIs of Lambay Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI I relation to offshore and offshore activities would apply to Project Option 2.

5.1.7.3 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from construction, operation and decommissioning activities to be released into the water column, leading to an effect on coastal and marine habitat receptors.

As detailed in Section 4.3, site-specific contaminants sampling undertaken and provided confirmation that the levels of sediment bound contaminants are generally low within the array and ECC (for both project options) when compared to background concentrations.

Due to distance from potential hydrological pathways no inputs of contaminants are expected into the SAC in relation to onshore activities and this potential impact was screened out for this site.

5.1.7.3.1 Mitigation

The adoption of pollution management controls as outlined in the Offshore EMP (Appendix 7) will minimise and manage accidental spills. For works in high-risk areas such as refuelling or the use of chemicals, a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

5.1.7.3.2 Assessment

Modelling indicates no sediment plume or deposition will extend into the Lambay Island SAC beyond trace levels.

This, allied to the low levels of site-specific sediment bound contaminants at throughout the development site and the adoption of mitigation measures, indicates that no detectable levels of contaminants will enter the Lambay Island SAC.

5.1.7.3.3 Conclusion of AEoI

The impacts of accidental pollution arising from onshore and offshore activities on the QIs of the Lambay Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.7.4 Introduction of Marine Invasive Non-Native Species (Construction, Operation and Decommissioning)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for introduction of marine INNS.

There is the potential for the introduction of marine INNS to result from the construction, operation and decommissioning phase of the proposed development from either the introduction of hard substrates onto the seafloor or from vessels. The introduction of hard substrates in the form of WTGs, scour and cable protection will change the type of available habitats for benthic communities. Hard substrate habitats are comparatively rare across the proposed development which is dominated by sedimentary habitats, and the colonisation of these substrates can lead to increases in biodiversity, and locally alter the biotopes that characterise the area. Such changes to the site's biodiversity will be long term, lasting the duration of the development.

5.1.7.4.1 Mitigation

All vessels will implement the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[11], which aims to minimize the transfer of invasive aquatic species through ships' ballast water and sediments and guidance provided in "2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species"[12].

5.1.7.4.2 Assessment

It is evident that the pathways for the introduction of marine INNS from vessels are limited both spatially and temporally, while the area of introduced hard substrates where subsequent colonisation may occur is also limited. Although, hard substrate can act as a stepping stone for marine INNS the distance from the SAC indicates that this is unlikely to occur in relation to the development. Consequently, when considering this impact pathways to the site are negligible.

5.1.7.4.3 Conclusion of AEoI

The impacts of the introduction of marine INNS on the QIs of the Lambay Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.1.7.5 Changes to Physical Processes (Operation)

As determined in Table 5.2, Project Option 1 has a greater potential for adverse effects on coastal and marine habitats than Project Option 2 for changes to physical processes.

The presence of foundations and scour protection introduce changes to the local hydrodynamic and wave regime, potentially 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] https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx

[12] https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

However, changes in flow dynamics and associated scour effects will remain within the array area with small-scale changes around individual foundations having no perceived far-field effects.

5.1.7.5.1 Assessment

Consequently, due to any changes being limited spatially to within the vicinity of foundations and the distance of the site from the array area (14.8km), it is determined that no impact will occur on the SAC as a result of changes to physical processes and no mitigation measures are required.

5.1.7.5.2 Conclusion of AEoI

The impacts of changes to physical processes on the QIs of the Lambay Island SAC are therefore considered to have no AEoI for Project Option 1.

Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.2 Migratory Fish Species

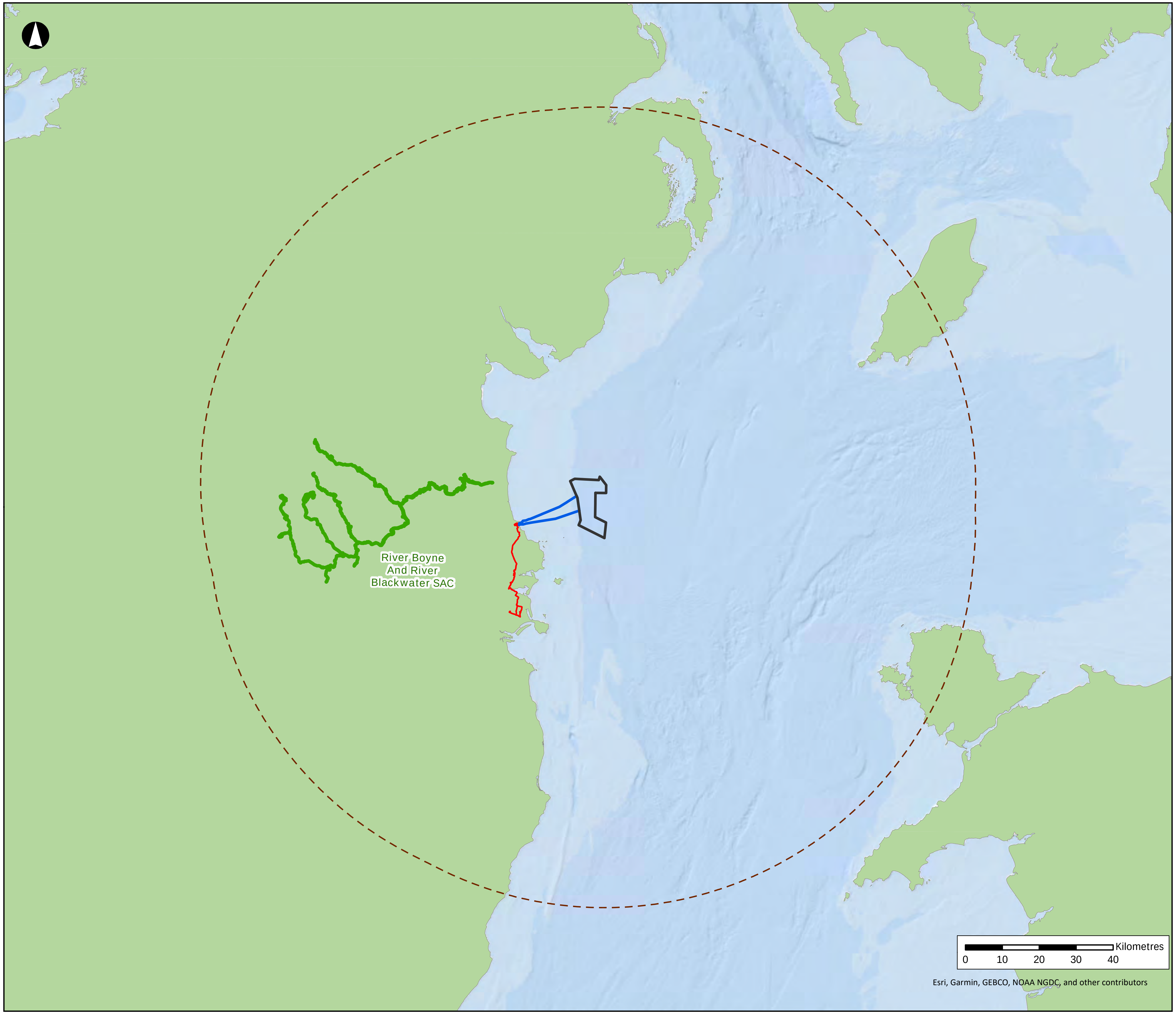
5.2.1 Approach

The assessment process for migratory fish species is in line with the relevant guidance as outlined in Section 1.7 and the process outlined in Section 1.5. The assessment is informed by site-specific underwater noise modelling; further details of the modelling and the results are presented within the Underwater Noise Modelling Report (Appendix 6). In addition, the assessment is informed by site-specific plume modelling with the results being presented in Section 5.1.

The European Sites designated for migratory fish species screened in for assessment are listed in Table 5.3 below. All European sites with qualifying migratory fish interests are located outside the areas that will be affected by onshore activities. Therefore, impacts of onshore activities on the qualifying interests while residing within the SAC and their supporting habitats have been screened out of the assessments presented below.

Table 5.3: European Sites Screened in for Migratory Fish Species.

European site name	Qualifying Interest	Impacts screened in for construction and decommissioning	Impacts screened in for the operational phase
River Boyne and River Blackwater SAC	Annex II species: River lamprey; and Atlantic salmon.	Underwater noise from piling, UXO clearance and other noise sources; Offshore suspended sediment /deposition; and Offshore accidental pollution.	Offshore suspended sediment/deposition; Offshore accidental pollution; Electro-magnetic fields (EMF).



Array Area
Offshore Export Cable Corridor
Onshore Cable Route
Zone of Influence
Special Areas of Conservation

NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Sites Screened in for Migratory Fish Receptors

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:1,000,000 @A3	5.12
Status: Issue	

5.2.1.1 Project Option 1 and Project Option 2 Determination of Greatest Effects

For migratory fish receptors an assessment has been completed to determine which of the two project options (Project Option 1 or Project Option 2) presents the greatest potential for AEoI on designated sites. Table 5.4 shows the outcome of this assessment.

The piling of foundations it anticipated to take place over a period of up to 9 months between spring and autumn 2028. Piling is expected to be split into individual piling events, with each event lasting a couple of days, which is followed by several piling free days. The duration of the impact would therefore be temporary (less than one year), and it would occur intermittently during the proposed piling activities.

Table 5.4: Potential impacts and the Project Option which has the greatest potential for AEoI on Migratory Fish. The Projects Option that has the greatest potential for AEoI is Identified in Blue

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of migratory fish
Construction			
Introduction of underwater noise during offshore construction activities	**Installation of WTG foundations** Indicative total duration = up to 9 months 49 monopile WTG foundations (12.5m pile diameter, 5,500kJ hammer energy) One monopile foundation installed in a 24- hour period, **Installation of one OSP** One OSP on monopile foundation with two monopiles per foundation (12.5m diameter, 5,500kJ hammer energy). One monopile foundation installed in a 24-hour period. OR One OSP on jacket foundations with 4 pin piles per foundation (6m pile diameter, 3,000 kJ hammer energy). Two pin piles installed in a 24-hour period. **UXO clearance** Pre-construction surveys have not yet been completed; therefore, it is not possible at this time to determine how many items of UXO will require clearance. **Other construction noise** Noise emitted from construction vessels and arising during construction activities (e.g., placement of scour and cable protection, drilling of foundations).	**Installation of WTG foundations** Indicative total duration = Up to 9 months 35 monopile WTG foundations (12.5m pile diameter, 5,500kJ hammer energy) One monopile foundation installed in a 24- hour period. OR 35 jacket WTG foundations (6m pile diameter, 3,000kJ hammer energy) Two pin piles installed in a 24-hour period. **Installation of one OSP** One OSP on monopile foundation with two monopiles per foundations (12.5m diameter, 5,500kJ hammer energy). One monopile foundation installed in a 24-hour period. OR One OSP on jacket foundations with 4 pin piles per foundation (6m pile diameter, 3,000 kJ hammer energy). Two pin piles installed in a 24-hour period. **UXO clearance** Pre-construction surveys have not yet been completed; therefore, it is not possible at this time to determine how many items of UXO will require clearance. **Other construction noise** Noise emitted from construction vessels and arising	**Project Option 1 and Project Option 2 both represent the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential for AEoI is defined by spatial and temporal extents of noise propagation resulting from the installation of turbine and OSP foundations during the construction phase. Project Option 1 has the greatest spatial extent due to the larger hammer energy whereas Project Option 2 (jacket foundations only) has the greatest temporal extent as there are more active piling hours in a 24-hour period and more total active days piling. For the array area, the spatial scenario with the greatest potential magnitude of impact results from the pile driving of a single monopile foundation in a 24-hour period. The temporal scenario with the greatest potential for AEoI results from the sequential piling of up to two pin piles in a 24-hour period. As a precautionary approach, it has been assumed that all foundations would be installed by impact pile driving. No simultaneous piling is expected. Note the programme is indicative at this stage as it is dependent on the contractor selected at construction stage.

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of migratory fish
		during construction activities (e.g., placement of scour and cable protection, drilling of foundations).	
Temporary increase in SSC and sediment deposition from offshore construction activities	**Total volume of suspended sediment and sediment deposition 805,292m³.** **WTG foundation drill cuttings:** 49 turbines foundations with 75% requiring drilling = 338,243m³. **OSP foundations (array):** One OSP foundation requiring seabed preparation and drilling = 22,089m³. **Cable trenching:** Installation of 111km of array cables = 333,000m³. Installation of two export cables = 108,000m³ (excluding the part of the export cable within the array area). **Subtidal HDD:** Exit pits total volume = 3,960m³. Release of drilling muds (i.e. bentonite) during exit pit punch-out = 30 tonnes.	**Total volume of suspended sediment and sediment deposition 897,061m³.** **WTG foundation preparatory dredging:** Dredging at the seabed in preparation for foundation placement (jacket foundations only) at 50% of locations = 133,755m³. **WTG foundation drill cuttings:** 35 turbines foundations with 100% requiring drilling = 356,257m³. **OSP Foundations (array):** One OSP foundation requiring seabed preparation and drilling = 22,089m³ of sediment. **Cable trenching:** Installation of 91km of array cables = 273,000m³ Installation of two export cables = 108,000m³ (excluding the part of the export cable within the array). **Subtidal HDD:** Exit pits total volume = 3,960m³. Release of drilling muds (i.e. bentonite) during exit pit punch-out = 30 tonnes.	**Project Option 2 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential for AEoI is defined by the largest volume of sediments released during construction activities including seabed preparation activities, cable installation and the drilling of foundations. For foundation installation, the largest volume of suspended sediments are released during jacket foundation seabed preparation and installation. For cable installation, the largest volume of suspended sediments results from installation using energetic means (CFE). This also assumes the largest number of cables and the greatest burial depth. One OSP will be constructed within the offshore development area. Project Option 2 has a higher total volume of suspended sediments than Project Option 1 (91,769m³ more volume of materials) and therefore has the greater potential for AEoI of migratory fish.
Accidental pollution from offshore construction activities	**Total volume of suspended sediment and sediment deposition 805,292 m³.** The impact considers the largest volume of sediments released during construction activities.	**Total volume of suspended sediment and sediment deposition 897,061m³.** The impact considers the largest volume of sediments released during construction activities.	**Project Option 2 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the largest volume of sediments that may be released into the water column during construction activities. Project Option 2 represents the option with the largest volumes of sediments released during construction and therefore the largest amount of contaminated sediment that may be released into the water column.

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of migratory fish
			The risk of accidental pollution as a result of spillages or collisions will be managed through the implementation of an Offshore EMP, and therefore no design scenarios are presented for accidental contamination.
Operational and Maintenance Phase			
Temporary increase in SSC and sediment deposition from offshore maintenance activities	The volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction phase. **Repair and maintenance of scour protection for WTG and OSP foundations** Once every 5 years **Inter-array cable replacement, repair and reburial** Once every 5 years **Export cable repair and reburial** Once every 5 years	The volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction phase. **Repair and maintenance of scour protection for WTG and OSP foundations** Once every 5 years **Inter-array cable replacement, repair and reburial** Once every 5 years **Export cable repair and reburial** Once every 5 years	**Project Option 1 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the largest volume of sediments released into the water column during maintenance activities. The volume of sediment that could be suspended during maintenance activities has not been calculated but will be of much smaller quantity compared with that generated by construction and decommissioning activities. There is more infrastructure to maintain for Project Option 1, and therefore, the increase of SSC from operational activities will be greater from Project Option 1.
Accidental pollution from offshore maintenance activities	The impact considers the largest volume of sediments released during the operational and maintenance phase. Temporary increases in SSC will result from periodic jack-up vessel deployment, and cable repair, replacement and reburial activities (as listed above for 'Temporary increase in SSC and sediment deposition').	The impact considers the largest volume of sediments released during the operational and maintenance phase. Temporary increases in SSC will result from periodic jack-up vessel deployment, and cable repair, replacement and reburial activities (as listed above for 'Temporary increase in SSC and sediment deposition').	**Project Option 1 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the largest volume of contaminated sediments released into the water column during maintenance activities. There is more infrastructure to maintain for Project Option 1, and therefore, the increase of SSC from operational activities will be greater from Project Option 1. The risk of accidental contamination as a result of spillages or collisions will be managed through the implementation of an offshore EMP, and therefore no design scenarios are presented for accidental contamination.
Potential barriers to movement through the presence EMF from inter-array and export cables	**Inter-array cables** Total length = 111km Nominal operating voltage 66kV or 132kV **Export cables** Two export cables, each with a length of 18km	**Inter-array cables** Total length = 91km Nominal operating voltage 66kV or 132kV **Export cables** Two export cables, each with a length of 18km	**Project Option 1 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the total length of cables

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of migratory fish
	Nominal voltage of 220kV with High Voltage Alternating Current (HVAC) Target burial depth of all cables = 1m-3m	Nominal voltage of 220kV with High Voltage Alternating Current (HVAC) Target burial depth of all cables = 1m-3m	and the type and strength of currents to be applied.
Decommissioning			
Introduction of underwater noise during offshore decommissioning activities	It is anticipated that the activities resulting in the impact will be similar to the construction phase apart from piling for foundations and excluding the removal of UXO. Therefore, it is expected that the potential for AEoI will be less than that during construction.	It is anticipated that the activities resulting in the impact will be similar to the construction phase apart from piling for foundations and excluding the removal of UXO. Therefore, it is expected that the potential for AEoI will be less than that during construction.	**Project Option 1 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by spatial and temporal extents of noise propagation resulting from the decommissioning of infrastructure. Project Option 1 has more turbines and inter array cables; therefore; the temporal extent will be greater. The spatial extents are not expected to vary between options as the decommissioning activities will be similar.
Temporary increase in SSC and sediment deposition from offshore decommissioning activities	It is anticipated that the activities resulting in the impact will be similar to the construction phase apart from seabed preparation works and excluding the removal of structures that may remain. Therefore, it is expected that the volume of sediments released during decommissioning activities and associated bed level changes would be comparable or less to the amounts released during the construction phase.	It is anticipated that the activities resulting in the impact will be similar to the construction phase apart from seabed preparation works and excluding the removal of structures that may remain. Therefore, it is expected that the volume of sediments released during decommissioning activities and associated bed level changes would be comparable or less to the amounts released during the construction phase.	**Project Option 2 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the largest volume of sediments released into the water column during the removal of offshore infrastructure including foundations, cables, and scour and cable protection. The project option with the greatest potential for AEoI is assumed to be as per the construction phase, with all infrastructure removed in reverse-construction order. The removal of cables is considered, however the necessity to remove cables will be reviewed at the time of decommissioning.
Accidental pollution from offshore decommissioning activities	The impact considers the largest volume of sediments released during offshore decommissioning activities. The impacts are expected to be equivalent to those outlined for construction above.	The impact considers the largest volume of sediments released during offshore decommissioning activities. The impacts are expected to be equivalent to those outlined for construction above.	**Project Option 2 represents the greatest potential for AEoI of migratory fish in relation to this impact.** The Project Option with the greatest potential of AEoI is defined by the largest volume of contaminated sediments that may be released into the water column during the decommissioning phase.

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of migratory fish
			The risk of accidental contamination as a result of spillages or collisions will be managed through the implementation of an offshore EMP, and therefore no design scenarios are presented for accidental contamination.

5.2.2 Underwater Noise and Migratory Fish

Effects from underwater noise on migratory fish are most likely to occur during the construction phase with any effects during decommissioning activities expected to be less. As detailed in the SISAA, there are several activities that have the potential to introduce an effect receptor pathway for underwater noise, primarily from piling of foundations, UXO clearance, seabed preparation works, drilling of foundations, cable installation activities, and vessel operations. The largest impact ranges would result from pile driving of foundations (i.e., impact piling of monopiles or pin piles in the array area). These activities would generate impulse sounds, which are characterised by high acoustic energy levels with rapid rise time followed by rapid decay (Popper and Hawkins, 2019). Impulse sounds would also be created during the controlled explosion of UXO, though any detonation would represent a short-term (i.e., seconds) increase in underwater noise. General construction noise arising, for example, from vessel movements, dredging, drilling and cable installation works would intermittently generate lower levels of non-impulse sounds, which typically do not have a high peak pressure with rapid rise time.

Fish species can perceive underwater sounds by detecting either the acoustic pressure or the particle motion element of a sound field. Acoustic pressure is the stress (or energy) level imposed on an individual through the sound and is measured in terms of force per unit area, typically either in N/m^2 or Pascal (Pa). In contrast, particle motion describes the back-and forth movement of water, substrate or other media as a sound wave passes; it contains information on the directionality of the sound wave and can be measured as the displacement (m), velocity (m/s), or acceleration (m/s^2) of particles in the sound field (Popper et al., 2014).

All fish species can sense particle motion, while only some groups can also detect sound pressure. Particle motion is primarily detected by fish via sensory organs within the inner ear called the otolith organs. These contain numerous mechanosensory hair cells that are in close contact with a dense calcium-carbonate structure, the otolith. Mechanical energy such as particle motion leads to differential motion between the otolith and the sensory hairs cells, resulting in the deformation of the hair cells and the subsequent release of neurotransmitters, which initiates the transmission of the sound signal to the brain (Popper and Hawkins, 2019; Putland et al., 2019). A secondary means by which fish can detect particle motion is the lateral line (Popper and Hawkins, 2019). Lateral lines run along the body and are comprised of sensory epithelial cells that can detect vibration and pressure changes over shore ranges. Lateral lines are known to be used to detect prey and for predator avoidance in the near field. The lateral line is considered to be most effective in the detection of particle motion over short ranges (Higgs and Radford, 2016).

Based on their sound detection mechanism and hearing capabilities, fish receptors are grouped by Popper et al. (2014) into the following functional hearing groups:

- Group 1: Fishes with no swim bladder or other gas filled chambers, which include all lamprey species. Group 1 species are sensitive only to particle motion within a narrow band of frequencies. Some barotrauma may occur from the exposure to sound pressure (Popper et al., 2014);
- Group 2: Fishes with swim bladders or other gas filled body cavities that do not appear to play a role in hearing. This group includes salmonids, such as Atlantic salmon. Hearing in the species only involves particle motion, not sound pressure, but some barotrauma may occur from the exposure to sound pressure (Popper et al., 2014);
- Group 3: Fishes with swim bladders that are close but not intimately connected to the ear. These species can detect both particle motion and sound pressure across a wider frequency range than Group 1 and Group 2 species. These species are susceptible to barotrauma (Popper and Hawkins, 2019); and

- Group 4: Fishes in which hearing involves a swim bladder or other gas filled chambers and that have special structures mechanically linking the swim bladder to the ear. This groups includes clupeids such as shad species including twaite shad. These species are primarily sensitive to sound pressure, although they also detect particle motion. Group 4 species are susceptible to barotrauma and can sense sounds over a wider frequency range than the remaining groups (Popper and Hawkins, 2019).

The qualifying migratory fish interests screened into the assessment belong to hearing Group 1 (river lamprey) and hearing Group 2 (Atlantic salmon).

The range of potential effects from intense impulse sound sources, such as pile driving and underwater explosions, includes immediate death, permanent or temporary tissue damage, temporary shifts in hearing, and 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. The extent to which underwater sound might cause an adverse impact in a particular fish species is dependent upon the level of sound pressure or particle motion, its frequency, duration and/or repetition (Hastings and Popper, 2005). In general, physical injuries as a result of underwater noise are either related to a sudden, large pressure change (barotrauma) or to the total quantity of sound energy received by a receptor over a period of time.

To assess the likely significance of effects from underwater sounds on fish, potential effects are typically divided into the following categories:

- Mortality and potential mortal injury
  - Exposure to sound may result in instantaneous or delayed mortality. The potential for mortality or mortal injury is likely to only occur in extreme proximity to intense sounds, such as those emitted during percussive impact piling. The risk of mortality or mortal injury occurring during piling will be reduced by use of soft start techniques at the start of the piling sequence. This means that fish in close proximity to piling operations are likely to move outside of the impact range before noise levels reach a level likely to cause irreversible injuries (Popper et al., 2014).
- Recoverable injury
  - Recoverable injury is a survivable injury with full recovery occurring after exposure, although decreased fitness during the recovery period may result in increased susceptibility to predation or disease (Popper et al., 2014). The potential for recoverable injury during piling operations is likely to only occur in extreme proximity to the pile, although 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 in close proximity to piling operations are likely to move outside of the impact range before noise levels reach a level likely to cause recoverable injuries.
- Temporary threshold shift (TTS)
  - TTS is a temporary reduction in hearing sensitivity caused by exposure to intense sound or sounds of long duration (e.g., tens of minutes to hours). TTS has been demonstrated in some fishes, resulting from the loss or damage of sensory hair cells of the inner ear and/or damage to auditory nerves. However, sensory hair cells are constantly added to fishes and are replaced when damaged, and therefore the extent of TTS is of variable duration and magnitude. Normal hearing ability returns following cessation of the noise causing TTS, though this period is variable between species, lasting between a few hours to several days. When experiencing TTS, fish may have decreased fitness due to a reduced ability to communicate, detect predators or prey, and/or assess their environment (Popper et al., 2014; Popper and Hawkins, 2019).
- Behavioural effects
  - Behavioural effects as a result of 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 intensity, timing and duration of exposure there is the potential for some of these responses to lead to significant effects at an individual level (e.g., reduced fitness, increased susceptibility to predation) or at a population level (e.g., interference with foraging, avoidance or

delayed migration to key spawning grounds) (e.g., Popper and Hawkins, 2019). Some behavioural responses may only be short-term with no wider effects for the individual or population, particularly once acclimatisation to the sound has taken place (Popper and Hawkins, 2019). There is also evidence that behavioural responses can vary depending on the activity in which the receptors are engaged during sound emission (Skaret et al., 2005). For example, Wardle et al. (2001) have shown that the interaction between hearing and vision can alter the response to a noise source, with fish responses to a seismic airgun being greater when the airgun was visible. Even when disturbed by a noise source, fish rapidly returned to the swimming track they were on prior to the noise source within seconds or minutes following exposure (Wardle et al., 2001). As such, the context in which a fish is exposed to underwater noise might be as important if not more so than the received sound level.

Project-specific underwater noise modelling has been undertaken to identify potential ranges for the onset of mortality and potential mortal injury, recoverable injury and TTS for a range of activities, based on the impact thresholds recommended by Popper et al. (2014). Table 5.5 lists the respective thresholds for sounds emitted during impact piling; the corresponding thresholds for continuous noise sources (e.g. vessel noise) and sounds from explosions are listed in the Underwater Noise Modelling Report. These thresholds represent current best practice sound exposure criteria for fish and have consequently been applied in the impact assessment.

Popper et al. (2014) present impact thresholds for pile driving as both single strike, unweighted peak Sound Pressure Levels (SPL_{peak}) and cumulative unweighted Sound Exposure Levels (SEL_{cum}). SPL_{peak} represents the maximum sound energy level of individual impulse sounds measured as differential pressure from positive to zero. By contrast, SEL_{cum} is a measure of the accumulated sound energy an animal is exposed to over an exposure period. It takes account of repeated impulse sounds such as those generated during pile driving (Popper et al., 2014). These dual criteria (SPL_{peak} and SEL_{cum}) are commonly used to assess the risk of mortality and injury of marine fish to multiple impulsive sounds. For single impulse sound events, such as triggered explosions during the clearance of UXO, Popper et al. (2014) recommend the use of SPLpeak thresholds, while impact thresholds for continuous sounds (e.g., from shipping) are presented as root-mean-square sound pressure levels (SPL_{rms}) measured over a specific time interval.

It is important to note that all impact thresholds in the Popper et al. (2014) guidelines are based on received sound pressure levels. However, as discussed previously, many species of fish only detect particle motion rather than acoustic pressure (e.g., Popper and Hawkins, 2019). Research into the effects of particle motion on fish is scarce, with no criteria for assessment currently available. Research on particle motion is continuing, with recent publications calling for updated criteria and guidelines on how to assess the risk of effects from changes in particle motion. In the absence of this, the Popper et al. (2014) guidance is still recommended as the most suitable reference source for assessing impacts of underwater noise including particle motion on fish (Popper and Hawkins, 2019). In this respect, it should also be noted that particle motion dominates the acoustic information within the area close to the sound source, while at larger distances from the sound source the majority of the acoustic information is dominated by the propagating pressure wave (Radford et al., 2012). This indicates that particle motion effects are contained within the sound pressure impact ranges, and therefore the lack of quantitative thresholds for particle motion is not expected to alter the conclusions of the assessment.

There are also no quantitative thresholds advised to be used to assess behavioural impacts; however, Popper et al. (2014) provide qualitative behavioural criteria for fish from a range of sources. These categorise the risks of effects in relative terms as ‘high’, ‘moderate’ or ‘low’ at three distances from the sound source: near (10s of metres), intermediate (100s of metres), and far (1000s of metres), respectively. The assessment of migratory fish follows this approach and draws upon relevant guidance identified throughout. The largest concern for migratory fish relating to underwater noise aside from injury and death is underwater noise acting as a barrier to fish migration.

Table 5.5: Impact Thresholds for Pile Driving (Popper et al., 2014)

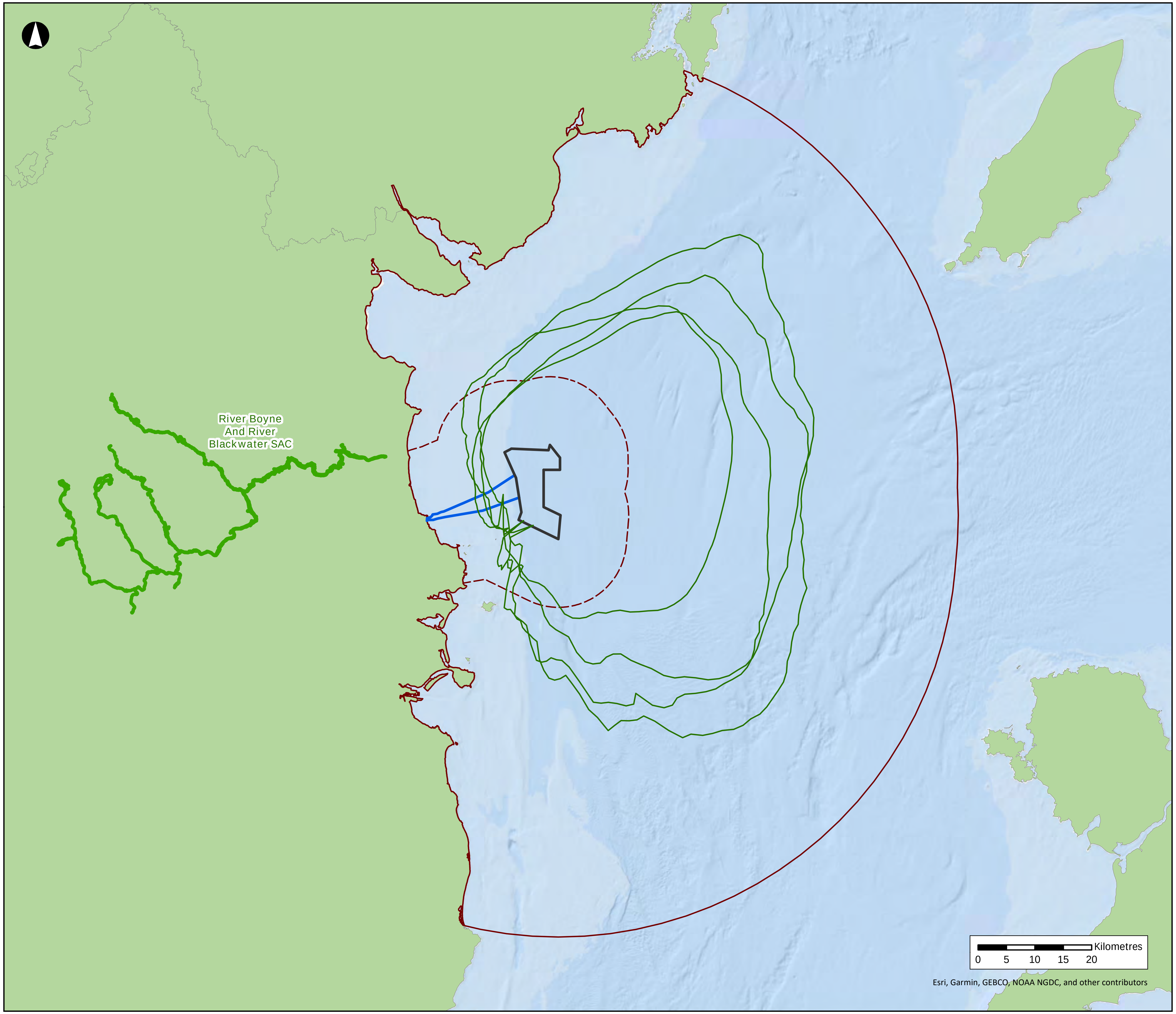
Hearing group	Mortality and potential mortal injury	Recoverable injury	TTS	Behavioural changes
Group 1	> 219dB SEL_{cum} or > 213dB SPL_{peak}	> 216dB SEL_{cum} or > 213dB SPL_{peak}	>> 186dB SEL_{cum}	Near - High

Hearing group	Mortality and potential mortal injury	Recoverable injury	TTS	Behavioural changes
				Intermediate - Moderate Far - Low
Group 2	210dB SEL_{cum} or > 207dB SPL_{peak}	203dB SEL_{cum} or > 207dB SPL_{peak}	> 186dB SEL_{cum}	Near - High Intermediate - Moderate Far - Low
Groups 3 and 4	207dB SEL_{cum} or > 207dB SPL_{peak}	203dB SEL_{cum} or > 207dB SPL_{peak}	186dB SEL_{cum}	Near - High Intermediate - High Far - Moderate

To determine the potential spatial extent of underwater noise for the different effect categories listed in Table 5.5 above, noise modelling has been undertaken for four representative locations (NW, NE, SW and SE) in the array area. To calculate received sound levels, soft-start and ramp-up procedures along with the total duration of piling and hammer strike rates were considered (full details of the modelling approach are given in the Underwater Noise Modelling Report). For migratory fish species, impact ranges were modelled assuming a fleeing receptor scenario whereby the receptors are assumed to flee from the noise source at a consistent rate of 1.5m/s.

The results of the noise modelling are presented in the Underwater Noise Modelling Report (Appendix 6) and referred to as appropriate in the following assessments. The modelled noise contours for the respective impact onset thresholds for piling activities and migratory fish species (i.e., SEL_{cum} for 186dB, 203dB, 207dB, 210dB, 213dB, 216dB and 219dB) are shown in Figure 5.13 and Figure 5.14. Note that modelled impact ranges less than 100m from the piling source are not shown in the figures.

The two screened in migratory species that are QIs of the assessed SAC, river lamprey and Atlantic salmon, are both true anadromous species and therefore have the potential to be present within the area affected by underwater noise from the proposed development whilst undertaking migrations or living at sea. The sensitivity of these species to impacts scoped in for the construction, operational and maintenance, and decommissioning phases are detailed in the following sections.



Array Area
Offshore Export Cable Corridor
Underwater Noise ZoI - 70km
Secondary ZoI - 12km
Special Areas of Conservation
Monopile SELcum Fleeing
(5500 kJ Hammer Energy)
186dB

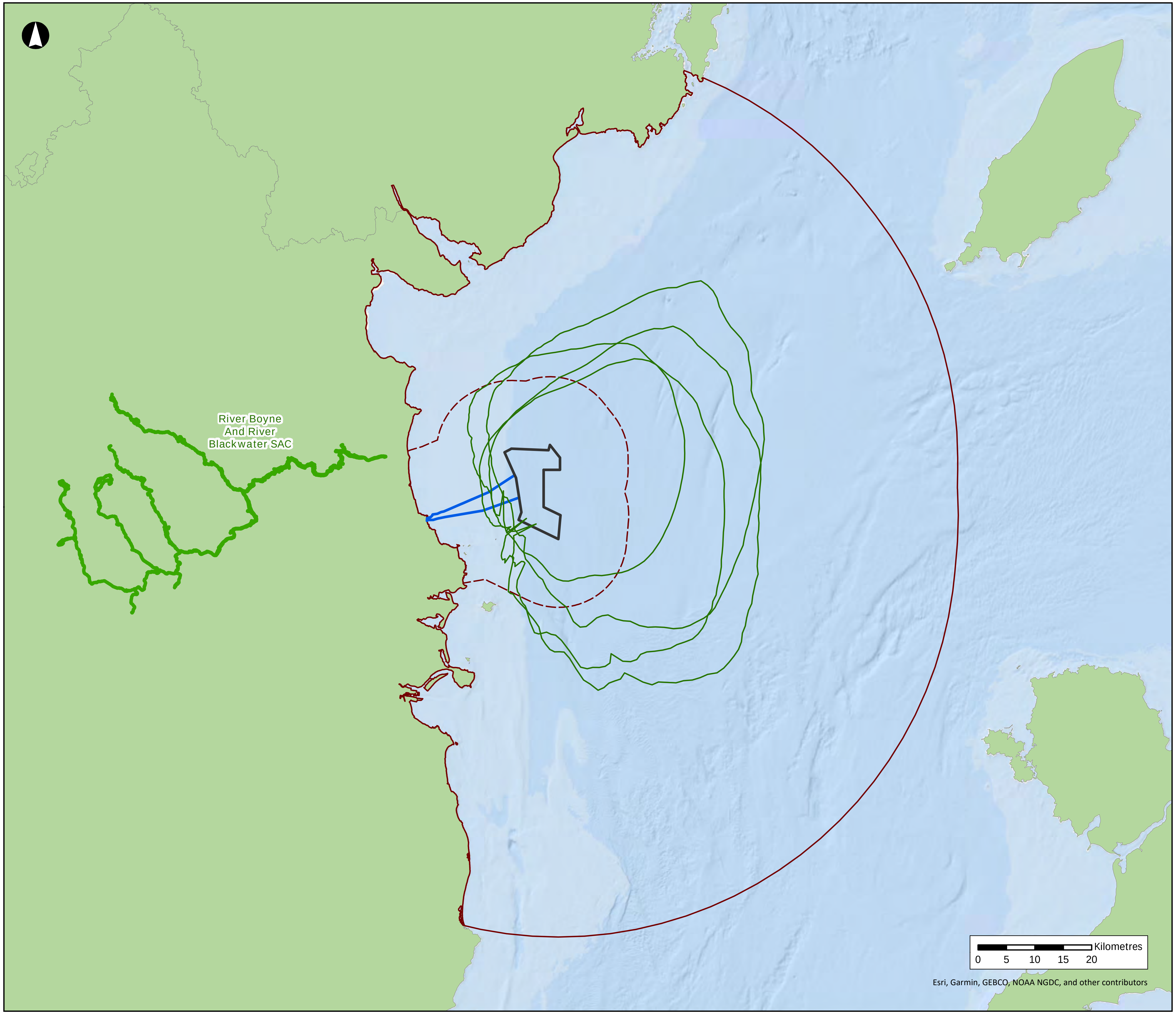
NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Predicted Maximum Impact Ranges for Migratory Fish from Piling of Monopile Foundations within the Array Area (5,500kJ)

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:650,000 @A3	5.13
Status: Issue	



Array Area
Offshore Export Cable Corridor
Underwater Noise ZoI - 70km
Secondary ZoI - 12km
Special Areas of Conservation
Pin Pile SELcum Fleeing
(3000 kJ Hammer Energy)
186dB

NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Predicted Maximum Impact Ranges for Migratory Fish from Sequential Piling of Jacket Foundations within the Array Area (3,000kJ)

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:650,000 @A3	5.14
Status: Issue	

5.2.2.1 Underwater Noise from Piling

5.2.2.1.1 *River lamprey*

Lamprey species are considered to belong to hearing Group 1, as defined above, as they lack a swim bladder or other gas-filled chambers. This makes them less prone to pressure-mediated injuries to body tissues and the inner ear (Popper et al., 2014). In addition, the sound detection capabilities of lamprey are relatively poor, with auditory tests suggesting that hearing is limited to low frequency sounds up to about 300Hz (Mickle et al., 2019). Data on the potential for TTS and behavioural responses to anthropogenic noise stimuli are scarce, though laboratory studies on sea lamprey have shown disruption to resting behaviour and a subsequent increase in swimming behaviour following the exposure to low frequency tones (Mickle et al., 2019). Pile driving generates broadband sounds with the highest energy typically occurring at low frequencies between about 20-1000Hz (Hildebrand, 2009). There is therefore potential for lamprey species to exhibit behavioural responses during pile driving. Any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Effects of TTS would also be temporary, with existing studies suggesting that fish affected by TTS recovered to normal hearing levels within a few hours to several days after noise exposure (Popper et al., 2014; Popper and Hawkins, 2019).

5.2.2.1.2 *Atlantic salmon*

Atlantic salmon are considered to be a Group 2 species of fish when it comes to the effects of underwater noise, meaning that they possess a swim bladder that is not involved in the hearing process (Hawkins and Johnstone, 1978; Popper et al., 2014). Instead, Atlantic salmon are considered to primarily sense underwater noise through particle motion (Hawkins and Johnstone, 1978; Popper and Fay, 2011). Hearing sensitivity tests have shown that hearing in salmon is restricted to a narrow frequency range below about 800Hz, with greatest sensitivities occurring at frequency of less than 300Hz (Harding et al., 2016; Hawkins and Johnstone, 1978).

The presence of a swim bladder increases the likelihood of injury to body tissues as pressure-induced volume changes to the swim bladder may damage nearby organs (Popper et al., 2014). However, given their mobile nature, Atlantic salmon would be able to adapt their behaviour during soft-start procedures and avoid harmful piling sounds. There is also the potential for TTS and behavioural changes to occur during piling activities. The ecological consequences of TTS in salmon (and fish in general) are unknown, although it has been suggested that a change in hearing sensitivities could potentially affect a receptor's fitness by impairing its ability to communicate, detect predators or prey and/or assess its environment (Popper et al., 2014). Few studies have investigated behavioural reactions of Atlantic salmon to piling noise, providing unconclusive results with some studies showing a lack of behavioural responses and others reporting changes in the abundance and distribution of salmon due to avoidance reactions (reviewed by Gillson et al., 2022).

Any behavioural responses would likely be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Effects of TTS would also be temporary, with existing studies suggesting that fish affected by TTS recovered to normal hearing levels within a few hours to several days after noise exposure (Popper et al., 2014; Popper and Hawkins, 2019). However, the implications of Atlantic salmon experiencing temporary avoidance or stress responses are not fully understood, and it cannot be excluded that such responses delay migration in the short-term.

5.2.2.2 Underwater Noise from UXO Clearance

There is a possibility that UXO of varying sizes may exist within the offshore development area, which would need to be cleared before construction can begin. Depending on their nature, the presence of UXO can be managed in a number of ways: avoidance (through micro-siting), non-destructive clearance through moving or removal of the UXO, or destructive clearance (i.e., in-situ detonation).

The preference will be to avoid UXO targets where practicable through micro-siting of infrastructure. Where avoidance is not possible, relocating the UXO to a safe place or removal of the UXO from the site will be considered. Where clearance of UXO is required (i.e. avoidance, relocation or removal is not practicable), low order clearance (i.e., burn out of UXO without detonation) would be the preferred method and attempted before high order clearance was attempted.

High order clearance requires an external 'donor charge' initiator to detonate the explosive material in the UXO, producing a blast wave equivalent to the full detonation of the device. High order clearance of UXO would represents the greatest impact and has consequently been used for underwater noise modelling and the impact assessment for migratory fish species.

High order detonation of UXO is one of the loudest anthropogenic noise sources that occur underwater, typically. Detonation of UXO would result in a short-term (i.e., seconds) increase in underwater noise (i.e., increase in SPL and particle motion) to levels that could cause mortality and potential mortal injury, recoverable injury, TTS or behavioural changes in fish species, with the severity of effects depending on the proximity of the individuals to the UXO location and the size of the UXO.

Small scale mortality and physical injury in fish as a result of underwater explosions have been reported by several authors, with physical injuries including rupture of the swim bladder and hemorrhage caused by the rupture of blood vessels (Dahl et al., 2020; Popper et al., 2014). No published data are available on the effects of explosions on hearing (e.g., TTS) or fish behaviour; however, it is suggested that there may be temporary or partial loss of hearing at high sound levels, especially in species where the swim bladder enhances sound pressure detection (Popper et al., 2014). Behavioural effects are likely to include startle reactions, but it is suggested that such responses are of short duration and do not necessarily cause longer-term changes in behaviour (Popper et al., 2014). Compared to impact piling, UXO detonations are considered to have a lower likelihood of triggering population level effects due to the significantly reduced temporal footprint of the noise that would result from them (Popper et al., 2014).

5.2.2.3 Underwater Noise from Other Noise Sources

Besides piling and the detonation of UXO, there will be several other construction activities that will produce underwater noise, namely dredging, drilling, cable laying, rock placement, geophysical and geotechnical surveys, and vessel noise. These activities produce non-impulse (continuous) sounds and may occur either alongside piling or separately.

Sound levels associated with construction activities have received considerably less attention and very little monitoring data is available. Among the construction activities, suction dredging is predicted to generate the largest sound levels of 186dB re 1µPa at 1m SEL_{RMS} (Underwater Noise Modelling Report). Rock placement is generally considered to be the nosiest external protection method, since the rocks fall down a fall pipe from the rock placement vessel, which may result in underwater noise. Other external protection measures such as mattresses and grout bags are typically placed onto the seabed using an ROV or crane, and as such these are unlikely to result in any significant underwater noise. Nedwell and Edwards (2004) found that the noise of rock placement was not detectable over the vessel noise, since there was no determinable difference between measurements taken when rock placement was ongoing, and when the vessel was holding station without placing rock. The estimated source levels of underwater noise from rock placement at the proposed development is 172dB re 1 µPa at 1m, and the noise emitted from large vessels is estimated at 168dB re 1µPa at 1 m (Underwater Noise Modelling Report). Vessel noise would occur from jack-up vessels during the piling of foundations and WTG installations and from other large and medium sized vessels that carry out other construction tasks and anchor handling. Additional small vessels will be required for crew transport and maintenance on site.

Additional surveys will be required prior to construction, as part of the seabed preparation phase, which are included as part of this planning application. These surveys will be required to further characterise the seabed conditions and morphology and identify any potential obstructions or hazards to the construction works. The additional pre-construction surveys include geophysical surveys that are non-intrusive and will utilize towed equipment such as side scan sonar, sub bottom profiler, multibeam echosounder and magnetometer to gather detailed information on the bathymetry, seabed sediments, geology, and anthropogenic features (e.g., existing seabed infrastructure, unexploded ordnance (UXO) that exist across the offshore development area.

There is currently no evidence that non-impulse sounds, such as those emitted during cable installation, the drilling of foundations and vessel operations, cause mortality or potential mortal injury in fish, and therefore the relative risk of lethal effects occurring is considered to be negligible (Popper et al., 2014). The limited data on other effects on fish hearing indicate the potential for auditory tissue injuries and associated TTS in species with enhanced sensitivities to sound pressure (e.g., Group 3 and Group 3 species). TTS following non-impulse sounds, which has been observed in a few noise-sensitive species, were temporary, with full recovery taking up to fourteen days following noise exposure (reviewed in Popper et al., 2014).

Observations of behavioural responses in fish to continuous noise sources are also sparse but so far have included avoidance reactions, alteration of schooling behaviour and changes in swimming speed and direction (Popper et al., 2014).

5.2.3 River Boyne and River Blackwater SAC

5.2.3.1 Qualifying Interests and Conservation Objectives

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC and is designated for the following migratory fish species:

- River lamprey (*Lampetra fluviatilis*)
- Atlantic salmon (*Salmo salar*)

5.2.3.1.1 Conservation Objectives of Qualifying Interests: River lamprey

To restore the favourable conservation condition of river lamprey in the River Boyne and River Blackwater SAC, defined by the following list of attributes and targes:

- Distribution: Restore access to all water courses down to first order streams.
- Distribution of larvae: Not less than 50% of sample sites with suitable habitat positive for larval brook/river lamprey.
- Population structure of larvae: At least three age/size classes of larval brook/river lamprey present.
- Larval lamprey density in fine sediment: Mean density of brook/river larval lamprey at sites with suitable habitat more than $5/m^2$; and
- Extent and distribution of spawning nursery habitat: No decline in extent and distribution of spawning and nursery beds.

5.2.3.1.2 Conservation Objective of Qualifying Interest: Atlantic salmon

To restore the favourable conservation condition of Atlantic salmon in the River Boyne and River Blackwater SAC, defined by the following list of attributes and targets:

- Distribution (extent of anadromy): 100% of river channels down to second order accessible from estuary.
- Adult spawning fish: Conservation limit (CL) for each system consistently exceeded.
- Salmon fry abundance: Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling.
- Out-migrating smolt abundance: No significant decline.
- Number and distribution of redds: No decline in number and distribution of spawning redds due to anthropogenic causes; and
- Water quality: At least Q4 at all sites sampled by EPA.

5.2.3.2 River lamprey

5.2.3.2.1 Underwater Noise from Piling (Construction)

As determined in Table 5.4, Project Option 1 is likely to have a greater spatial impact owing to a greater extent over which TTS and behavioural effects might occur, while Project Option 2 may have a greater temporal impact due to the larger number of active piling days associated with the installation of jacket foundations.

Mitigation

The installation of each foundation will commence with a soft start of a maximum of 20% of the maximum hammer energy for a duration of 30 minutes. The hammer energy will then ramp-up in steps until the levels required to install the pile are reached.

Implementation of soft-start and ramp-up procedures will allow mobile fish to move away from the piling location prior to the use of the highest hammer energies (and consequently greatest received sound), which will reduce the risk of any mortal or recoverable injuries. In addition, these measures are considered to reduce the number of individuals at risk of TTS or behavioural reactions, through the partial displacement of individuals from the impact zones.

Assessment

River lamprey belong to hearing Group 1, based on their restricted hearing abilities and low susceptibility to pressure-related injuries (see Section 5.2.2).

Potential impact ranges for the onset of mortality, recoverable injury and TTS have been determined by underwater noise modelling for fleeing and stationary fish, as presented in the Underwater Noise Modelling Report. Due to their mobile nature, river lamprey are assessed within this NIS as a fleeing receptor only.

Based on the noise modelling and the criteria set out in Popper et al. (2014), mortality and potential mortal injury, and recoverable injury to Group 1 fleeing receptors during the course of piling (SEL_{cum}) is predicted to occur <100m from the noise source for both the piling of monopile (5,500kJ hammer energy) and jacket (3,000kJ hammer energy) foundations. Instantaneous mortality and recoverable injury during piling (SPL_{peak}) may occur up to 140m from monopile installation and up to 120m from the installation of jacket foundations. TTS of fleeing Group 1 receptors during piling is anticipated to occur up to 51km from the noise source during the installation of monopile foundations, and up to 40km from the noise source during the piling of jacket foundations. The relative risk of behavioural changes is likely to be high at near (10s of metres) distances from the piling location, moderate at intermediate (100s of metres) distances, and low at far (1,000s meters) distances from piling operations (Popper et al., 2014).

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC. Based on the modelling results and the risk evaluation in Popper et al. (2014), no mortality or potential mortal injury, recoverable injury or TTS are predicted for river lamprey within the SAC (Figures 5.13 and 5.14), with the risk of behavioural responses considered to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

River lamprey are reported to typically remain in estuarine areas during their marine stage (Maitland, 2003). This suggests that the predicted impact ranges for the onset of mortality, recoverable injury, TTS and behavioural responses are located outside the areas of primary importance for river lamprey. Therefore, and given their low susceptibility to pressure-related injuries, the risk of lethal or sublethal physical injuries to river lamprey during piling is assessed as low. Moreover, as a mobile species, river lamprey are considered able to move away from piling operations during soft-start and ramp-up procedures before sound energies reach levels that may cause irreversible injuries. Any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Effects of TTS would also be temporary, with existing studies suggesting that fish affected by TTS recovered to normal hearing levels within a few hours to several days after noise exposure (Popper et al., 2014; Popper and Hawkins, 2019).

Conclusion of AEoI

Factoring in the mitigation measures and considering the temporary (up to nine months) and intermittent (several active piling days followed by several piling-free days) nature of piling together with the low risk of lethal or sublethal injuries and the temporary nature of potential TTS or behavioural changes, it is concluded that underwater noise emitted during pile driving will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 1 or Project Option 2.

5.2.3.2.2 Underwater Noise from UXO Clearance (Construction)

As determined in Table 5.4, both Project Options have an equal potential for adverse effects on migratory fish when considering underwater noise impacts from UXO clearance.

Any UXO clearance would be completed within the array area and ECC as part of the pre-construction site preparatory works. However, due to the early stage for the proposed development and the consequent lack of detailed site-specific data, the need for UXO clearance activities to be undertaken remains unknown. Studies to date indicate the array area to be of low risk for the presence of UXO, while one area within the ECC near the coast is considered medium risk of encountering UXOs.

Mitigation
Given the high intensity nature of sounds generated during UXO detonation and their potential for adverse effects on marine species, mitigation is included by implementation of specific measures should UXO clearance be required. The clearance of UXO will follow a mitigation hierarchy with high order detonation of UXO only taken place where avoidance, relocation, removal or low order deflagration is not possible. To minimise the area affected by underwater noise and the sound levels received by marine species at any one time, any UXO detonations will not occur within the same 24-hour window as piling operations, and where there may be clusters of UXO requiring detonation, these UXO will not be detonated at the same time. In addition, where auditory injury impact ranges for marine mammals from the use of high order detonations are greater than what can be mitigated using MMP/PAM watch and ADD (e.g., 120kg UXO charge weight plus donor weight), noise abatement will be used to attenuate the sound emitted by a detonation. While the primary driver for the use of noise abatement systems is to mitigate effects on marine mammals, their use will also reduce the likelihood of potential lethal or recoverably physical injuries in fish, including river lamprey. In addition, use of NAS will also likely reduce the number of individuals at risk of TTS or behavioural reactions, through a reduction in the potential impact zones.

Assessment
The impact assessment presented below assumes a precautionary approach, that UXO would be removed through high-order detonation. An estimation of the potential impact ranges for mortality and potential mortal injury of fish from UXO clearance activities has been made, based purely on the charge weight of the UXO. This estimation does not take into account the design, composition, age, position, orientation, and sediment coverage of the UXO, which leads to a high degree of uncertainty. Due to these uncertainties, a precautionary estimation has been used for the calculations, assuming the UXO is not buried, degraded or subject to any other significant attenuation.

Mortality and potential mortal injury during the detonation of UXO is predicted to occur up to 810m from the detonation site, based on the maximum scenario of using an UXO charge sizes of 525kg and an additional donor weight of 0.5kg to initiate detonation (Underwater Noise Modelling Report). The relative risk of recoverable injury in Group 1 fish species is considered to be high at the near field (10s of meters) and low at intermediate (100s of meters) and far (1000s of meters) distances from the sound source. The relative risk of TTS and behavioural changes is likely to be high within the near field, moderate at intermediate distances, and low within the far field (Popper et al., 2014).

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC. Based on the modelling results and the risk evaluation in Popper et al. (2014), no mortality or potential mortal injury and recoverable injuries are predicted for river lamprey within the SAC, with the risk of TTS and behavioural reactions within the SAC assessed to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

As discussed previously, river lamprey are reported to typically remain in estuarine areas during their marine stage (Maitland, 2003), which suggests that the predicted impact ranges for the onset of mortality, recoverable injury, TTS and behavioural responses during high order UXO clearance are mainly located outside the areas of primary importance for river lamprey, except for potential clearance operations within the ECC close to shore. Given their low susceptibility to pressure-related injuries (see Section 5.2.2), the risk of lethal or recoverable physical injuries to river lamprey during UXO clearing is assessed as low. Any TTS or behavioural responses would be temporary, with individuals expected to be able to re-colonise areas shortly after the clearance event. Moreover, each UXO detonation is a discrete and brief (lasting less than one day) event, which is not anticipated to cause widespread and prolonged displacement of river lamprey from their estuarine habitats or migration routes into their spawning streams.

Conclusion of AEoI
Based on the above, it is concluded that high-order UXO clearance events will not alter the survival or reproductive rates of river lamprey to the extent that could alter the species' population trajectory within the SAC. In addition, high order detonations are not predicted to result in barrier effects to any upstream or downstream migration that would prevent river lamprey from accessing or leaving the SAC. Therefore, it is concluded that underwater noise emitted during UXO clearance will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 1 or Project Option 2.

5.2.3.2.3 Underwater Noise from Other Noise Sources (Construction and Decommissioning)

Assessment

As discussed in Section 5.2.2.3, there is currently no evidence that non-impulse (i.e., continuous) sounds, such as those emitted during vessel operations and construction and decommissioning activities, cause mortality or potential mortal injury in fish (Popper et al., 2014). The risk of recoverable injuries in Group 1 fish from continuous construction noise is also considered to be low, while the risk of TTS is likely to be moderate near (10s of meters) the noise source and low at intermediate (100s of meters) and far (1,000s meters) distances. The likelihood of behavioural responses is considered to be moderate at near and intermediate distances and low at far field distances from the noise source (Popper et al., 2014).

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC. Based on current evidence (Popper et al., 2014) and factoring in the lower noise levels compared to piling, no mortality or potential mortal injury, recoverable injury and TSS are predicted for river lamprey within the SAC from non-impulse sounds, with the risk of behavioural reactions considered to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

As discussed previously, river lamprey have restricted hearing abilities (see Section 5.2.2) and given their preference for estuarine areas during their marine stage (Maitland, 2003), they will mostly avoid the areas over which TTS or behavioural responses are likely to occur, with the exception of coastal areas near the landfall site. Any non-impulse sounds during construction and decommissioning activities including pre-construction surveys would be intermittent and temporary, with any potential effects on the behaviour or distribution of river lamprey anticipated to also be temporary and reversible. Moreover, as a mobile species, river lamprey are considered able to move away from construction and decommissioning activities and might therefore not remain exposed to the impact for extended periods of time.

Conclusion of AEoI

Based on the above, it is concluded that non-impulse sounds will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 1 or Project Option 2.

5.2.3.2.4 Increase in SSC and Sediment Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.4, Project Option 2 has a greater potential for increases in SSC and associated sediment deposition compared to Project Option 1 during construction and decommissioning activities. During the operational phase, Project Option 1 has a greater potential for increases in SSC and sediment deposition; however, the volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction and decommissioning phase. Therefore, it is considered that Project Option 2 has a greater potential for adverse effects on migratory fish during the lifetime of the proposed development compared to Project Option 1 when considering increases in SSC and sediment deposition.

Temporary increases in SSCs and associated sediment deposition are expected from offshore construction activities that disturb the seabed (e.g. seabed preparation works, foundation and cable installation) and from the release of dredged material and drill cuttings. In addition, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and during the removal of infrastructure during decommissioning. Increased turbidity and sediment deposition may lead to smothering of sensitive fish receptors, or barrier effects, which may impede migration.

Mitigation

Implementation of mitigation measures detailed in the Offshore EMP and the CBRA will minimise release of sediments from offshore activities into the water column. Use of HDD to avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

Assessment

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC.

As detailed in Section 5.1.6 and shown in Figure 5.2 through Figure 5.11, the project-specific plume modelling predicts that sediment plumes caused by works within the array area and ECC will not extend into the River Boyne estuary beyond trace levels with subsequent sediment deposition being undetectable above background levels. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

River lamprey are reported to typically remain in estuarine areas during their marine stage (Maitland, 2003). Therefore, the capacity of river lamprey to accommodate increases in SSC and sediment deposition is assessed as high given the nature of resuspension and deposition within their natural more turbid environments. Moreover, river lamprey are mobile and would be able to relocate to nearby unimpacted areas.

Sediment plumes are expected to quickly dissipate after cessation of the construction activities due to settling and wider dispersion, with SSCs reducing to background levels within a couple of tidal cycles The highest SSCs would be confined to the points of discharge, such as around WTG locations and cable trench lines. In addition, construction activities are largely expected to be carried out on a sequential basis with minimal opportunity for successive periods of sediment disturbance to develop overlapping sediment plumes (i.e., plumes are expected to fully disperse with material settling out of suspension prior to the occurrence of a subsequent sediment disturbance event).

Conclusion of AEoI

Given the temporary, intermittent and localised increases in SSCs and considering the river lamprey's adaptation to naturally turbid estuarine conditions, any local changes in the species' distributions resulting from avoidance behaviour while at sea are expected to be temporary and not discernible from baseline conditions. It is therefore concluded that increases in SSC and associated sediment deposition will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 2.

Based on the increased risk of effects of Project Option 2, it is considered that the same conclusion of no AEoI would apply to Project Option 1.

5.2.3.2.5 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.4, Project Option 2 has the greater potential for adverse effects on migratory fish species compared to Project Option 1 with regards to accidental pollution during construction and decommissioning activities. During the operational phase, Project Option 1 has a greater potential for the release of contaminated sediments; however, the volume of sediment released during the operational and maintenance phase would be less to those experienced during the construction and decommissioning phase. Therefore, it is considered that Project Option 2 has a greater potential for adverse effects on migratory fish during the lifetime of the proposed development compared to Project Option 1 with regards to accidental pollution.

There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants to be released into the water column as a result of sediment mobilisation from construction, operation and decommissioning activities, which may lead to effects on sensitive fish receptors. There is also a risk of accidental spillages or collision incidents, which could result in the release of pollutants, such as hydrocarbon fuels, oils and lubricants.

Mitigation

The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. Pollution prevention and control measures will include navigational safety measures to reduce the likelihood of collision events, procedures to safely use, store and transport harmful substances including vessel fuels, and emergency response methods that would be implemented in the case of accidental spills or collision events. The adoption of these pollution management controls will minimise and manage accidental spills, thereby reducing the likelihood of pollution impacts on potentially sensitive migratory fish species.

Assessment

Site-specific contaminants sampling provided confirmation that the levels of sediment-bound contaminants are low within the array area and ECC when compared to background concentrations. Sediment-bound contaminants are likely to be rapidly diluted by tidal currents, and increased bio-availability that could potentially result in adverse eco-toxicological effects in fish is therefore not expected. In addition, very small concentrations of contaminants enter the dissolved phase, with the majority adhering to sediment particles when temporarily entering suspension in the water column. Partition coefficients may be applied to estimate the concentration of the contaminants entering the dissolved phase, which will result in a reduction of several orders of magnitude than the concentrations associated with suspended sediments. As such, it is considered highly unlikely that the Maximum Allowable Concentration Environmental Quality Standards threshold, as prescribed by the Irish Action Levels (Marine Institute, 2006, 2009), will be exceeded for any of the substances as a result of disturbing sediments during construction, maintenance and decommissioning activities. In addition, modelling indicates no sediment plume or deposition will extend into the River Boyne and River Blackwater SAC beyond trace levels.

Conclusion of AEoI

Given the fates of the sediment plumes, the low concentrations of sediment-bound contaminants in the offshore development area, and the low likelihood of increased bio-availability of contaminants in the water column, it is concluded that the release of sediment-bound contaminants during construction, maintenance and decommissioning activities will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 2.

Based on the increased risk of effects of Project Option 2, it is considered that the same conclusion of no AEoI would apply to Project Option 1.

5.2.3.2.6 EMF (Operation)

As determined in Table 5.4, Project Option 1 has a greater potential for adverse effects on migratory fish than Project Option 2 when considering EMF generated during the operational phase.

The transmission of power through the inter-array and export cables during the operational phase of the proposed development would produce EMF in the surrounding sediment and water column. These fields have the potential to affect fish receptors that use electric or magnetic senses for foraging, navigation or communication.

Mitigation

Export and inter-array cables will be buried where practicable to ensure they are not exposed by sediment movements. Where cables cannot be buried due to ground conditions, additional cable protection measures such as rock placement or mattressing will be applied to achieve adequate cable protection. Up to 20% of cable length is expected to need protection either during initial installation, or throughout the operational phase of the proposed development. While cable burial or cable protection do not decrease the strength of EMF at source, it does increase the distance between the cables and electro- and magneto-sensitive receptors, thereby reducing the EMF (from attenuation of the EMF) received by those receptors.

Assessment

Lamprey species possess specialised ampullary receptors that are responsive to weak, low frequency electric fields (Bodznick and Northcutt, 1981; Bodznick and Preston, 1983), but information regarding what use they make of the electric sense is limited. Behavioural studies by Chung-Davidson et al. (2008) suggest that weak E-fields may play a role in the reproduction of sea lamprey, with electric stimuli thought to be important in detecting potential mates, retaining lampreys in their nests or in regulating sexual behaviour. Others have suggested that adult lamprey may use their electric senses to locate prey over short distances or to navigate by using the electric fields induced in the water column by the Earth's magnetic fields (Bodznick and Preston, 1983). Laboratory tests conducted on adult sea lamprey (i.e., individuals at their marine stage) showed strong reductions in swimming behaviour at electric fields strengths of 30μV/cm and above (Chung-Davidson et al., 2004). Overall, current evidence suggests that the threshold for behavioural response in sea lamprey lies within the range of electric fields induced (iE-fields) by subsea power cables (CMACS, 2003; Normandeau Associates et al., 2011).

While the impact would occur constantly throughout the 35-year operational phase of the proposed development, EMF generated by the power cables will be detectable above background levels only in close proximity to the cables (i.e., within about 10 metres of the cable lines), as the EMF created will rapidly attenuate away from the centre line of the cables (e.g., Hermans, 2022; Normandeau Associates et al., 2011). Cable burial below the sea floor will further decrease the vertical and horizontal distances at which EMF attenuate into the marine environment (Normandeau Associates et al., 2011). Any potential behavioural responses of river lamprey would therefore be localised and restricted to the immediate vicinity of the cables. Moreover, as discussed previously, river lamprey are mainly found across estuaries during their marine stage (Maitland, 2003), reducing the likelihood of individuals to be affected by EMF emitted by the power cables of the proposed development. Similarly, given the distance between the River Boyne estuary and the array area (16.4km) and ECC (7.9km), EMF from the inter-array and export cables will not result in a barrier effect, which would prevent the receptor from accessing or leaving the SAC.

Conclusion of AEoI

Based on the above, it is concluded that EMF emitted during the operational phase will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for Project Option 1. Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.2.3.3 Atlantic Salmon

5.2.3.3.1 Underwater Noise from Piling (Construction)

As determined in Table 5.4, Project Option 1 is likely to have a greater spatial impact owing to a greater extent over which TTS and behavioural effects might occur, while Project Option 2 may have a greater temporal impact due to the larger number of active piling days associated with the installation of jacket foundations.

Mitigation

The installation of each foundation will commence with a soft-start of a maximum of 20% of the maximum hammer energy for a duration of 30 minutes. The hammer energy will then ramp-up in steps until the levels required to install the pile are reached. Implementation of soft-start and ramp-up procedures will allow mobile fish to move away from the piling location prior to the use of the highest hammer energies (and consequently greatest received sound), which will reduce the number of individuals at risk of lethal or recoverable injuries. In addition, these measures are considered to reduce the number of individuals at risk of TTS or behavioural reactions, through the partial displacement of individuals from the impact zones.

Assessment

Atlantic salmon belong to hearing Group 2, based on the presence of a swim bladder that is not involved in hearing (see Section 5.2.2).

Potential impact ranges for the onset of mortality, recoverable injury and TTS have been determined by the underwater noise modelling for both fleeing and stationary fish, as presented in the Underwater Noise modelling report (Appendix 6). Due to their mobile nature, Atlantic salmon are assessed within this NIS as a fleeing receptor only.

Based on the noise modelling and the criteria set out in Popper et al. (2014), mortality and potential mortal injury and recoverable injury to Group 2 fleeing receptors during the course of piling (SEL_{cum}) is predicted to occur <100m from the noise source for both the piling of monopile (5,500kJ hammer energy) and jacket (3,000kJ hammer energy) foundations. Instantaneous mortality and recoverable injury during piling (SPL_{peak}) may occur up to 360m from monopile installation and up to 310m from the installation of jacket foundations. TTS of fleeing Group 2 receptors during piling is anticipated to occur up to 51km from the noise source during the installation of monopile foundations, and up to 40km from the noise source during the piling of jacket foundations. The relative risk of behavioural changes is likely to be high at near (10s of metres) distances from the piling location, moderate at intermediate (100s of metres) distances, and low at far (1,000s meters) distances from piling operations (Popper et al., 2014).

The River Boyne and River Blackwater SAC is located approximately 21km from the array area and 13.0km from the ECC. Based on the modelling results and the risk evaluation in Popper et al. (2014), no mortality or potential mortal injury, recoverable injury or TTS are predicted for Atlantic salmon within the SAC, (Figures 5.13 and 5.14), with the risk of behavioural reactions considered to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

The migratory movement patterns of Atlantic salmon away from coastal waters to the open ocean are poorly understood. Acoustic telemetry data suggest that young salmon (smolts) from the River Boyne and other rivers along the east coast of Ireland move north upon leaving their home rivers (Barry et al., 2020). The tracking data further suggest that on leaving their natal rivers, smolts move rapidly away from the coast towards the deep waters of the Irish Sea, possibly to take advantage of the northwards flowing surface currents, which can assist their journey to the oceanic feeding grounds in the North-East Atlantic (Barry et al., 2020). There is therefore high potential that migratory smolts from the River Boyne and its tributaries pass through areas where noise levels may induce TTS or behavioural reactions (Figures 5.13 and 5.14). No information is available on the movement patterns of returning salmon; however, a similar pathway to that of outward moving smolts may be assumed.

The marine phase of Atlantic salmon begins between spring and early summer when large numbers of smolts leave Irish rivers to migrate to their oceanic feeding grounds (e.g., Gilbey et al., 2021; Holm et al., 2000). The return migration of salmon into their natal rivers peaks during spring and summer, and spawning occurs during the following autumn and winter (Finstad et al., 2005). As such, piling activities, which are expected to take place over a period of up to 9 months between spring and autumn/early winter would coincide with the peak migration periods of Atlantic salmon. There is therefore the potential for salmon to experience TTS or exhibit temporary avoidance reactions that might present barriers to migration. This is of particular concern for adult individuals returning to their natal rivers, with the potential of behavioural response delaying migration, which subsequently may affect the reproductive success of some individuals.

Given their migratory nature, Atlantic salmon are anticipated to be transient across marine areas, and therefore any exposure to piling noise is anticipated to be temporary. Moreover, Atlantic salmon would be able to move away from the piling location during soft-start and ramp-up procedures, thereby reducing the likelihood of mortal or recoverable injuries. Any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours and continue their migration shortly after piling has ceased. Effects of TTS would also be temporary, with existing studies suggesting that fish affected by TTS recovered to normal hearing levels within a few hours to several days after noise exposure (Popper et al., 2014; Popper and Hawkins, 2019). In addition, piling would be temporary (i.e. less than one year) and intermittent, with individuals expected to be able to continue their migration during piling free days. Therefore, impact piling is not considered to present a long-term barrier to Atlantic salmon accessing or leaving the SAC.

Conclusion of AEoI

Based on the above and factoring in the mitigation measures, potential changes in the behaviour and/or distribution of salmon and any potential short-term delays in migration are not considered to alter reproductive rates to the extent that could alter the trajectory of the River Boyne and River Blackwater salmon population. Therefore, it is considered that underwater noise emitted during pile driving will not adversely affect the COs for this QI, and as such it is concluded that there will be no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC for either Project Option 1 or Project Option 2.

5.2.3.3.2 Underwater Noise from UXO Clearance (Construction)

As determined in Table 5.4, both Project Options have an equal potential for adverse effects on migratory fish when considering underwater noise impacts from UXO clearance.

Mitigation

As discussed previously, any UXO clearance would be completed within the array area and ECC as part of the pre-construction site preparatory works. Given the high intensity nature of sounds generated during UXO detonation and their potential for adverse effects on marine species, mitigation is included by implementation of specific measures should UXO clearance be required.

The clearance of UXO will follow a mitigation hierarchy with high order detonation of UXO only taken place where avoidance, relocation, removal or low order deflagration is not possible. To minimise the area affected by underwater noise and the sound levels received by marine species at any one time, any UXO detonations will not occur within the same 24-hour window as piling operations, and where there may be clusters of UXO requiring detonation, these UXO will not be detonated at the same time. In addition, where auditory injury impact ranges for marine mammals from the use of high order detonations are greater than what can be mitigated using MMP/PAM watch and ADD (e.g., 120kg UXO charge weight plus donor weight), noise abatement will be used to attenuate the sound emitted by the detonation. While the primary driver for the use of NAS is to mitigate effects on marine mammals, its use will also reduce the likelihood of potential lethal or recoverably physical injuries in fish, including Atlantic salmon. In addition, the use of noise abatement will also likely reduce the number of individuals at risk of TTS or behavioural reactions, through a reduction in the potential impact zones.

Assessment

Mortality and potential mortal injury during the high order detonation of UXO is predicted to occur up to 810m from the detonation site, based on the maximum scenario of using an UXO charge sizes of 525kg and an additional donor weight of 0.5kg to initiate detonation (Underwater Noise Modelling Report). The relative risk of recoverable injury and behavioural responses in Group 2 fish species is considered to be high at near (10s of meters) and intermediate (100s of meters) distances from the sound source and low at far (1000s of meters) distances. The relative risk of TTS is likely to be high within the near field, moderate at intermediate distances, and low within the far field (Popper et al., 2014).

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC. Based on the modelling results and the risk evaluation in Popper et al. (2014), no mortality or potential mortal injury and recoverable injury are predicted for Atlantic salmon within the SAC, with the risk of TTS and behavioural reactions within the SAC assessed to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

It is possible that UXO operations will be planned to take place year-round during the UXO clearance campaign pre-construction, and therefore they have the potential to interact with the key migration periods of Atlantic salmon. However, as outlined previously, studies to date indicate a low likelihood of UXO to be present within the offshore development area. In addition, should UXO be encountered, high order clearance will only be undertaken when other clearance options, such as micro-siting, removal or low order deflagration are not possible. Moreover, each UXO detonation is a discrete and brief (lasting less than one day) event and while this may result in mortality to some individuals, it is not anticipated to cause widespread and long-term displacement of salmon from specific migration routes. Instead, any TTS or behavioural responses would be temporary, with individuals expected to be able to continue their migration following the clearance event.

Long-term monitoring data suggest that since the 1980's the number of wild salmon returning to Irish rivers has decreased from 15-20% to only 5%, indicating a decrease in salmon survival in the marine environment (Millane et al., 2023). This decline closely mirrors global trends of declining salmon stocks. Moreover, data from fish counters indicate that the salmon stock of the River Boyne is currently below river-specific conservation limits (Millane et al., 2023).

Conclusion of AEoI

Factoring in the low likelihood of high order UXO clearance combined with the mitigation measures mentioned above and acknowledging the infrequent and brief nature of the impact, the highly localised nature of potential mortal effects, and the temporary nature of potential TTS or behavioural changes, it is concluded that UXO clearance will not alter the survival, fitness or reproductive rates of Atlantic salmon to the extent that could alter the trajectory of the River Boyne and River Blackwater salmon population. In addition, high order detonations are not predicted to result in barrier effects to any upstream or downstream migration that would prevent Atlantic salmon from accessing or leaving the SAC. Therefore, it is concluded that underwater noise emitted during UXO clearance will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC for Project Option 1 or Project Option 2.

5.2.3.3.3 Underwater Noise from Other Noise Sources (Construction and Decommissioning)

As discussed in Section 5.2.2, there is currently no evidence that non-impulse sounds cause mortality or potential mortal injury in fish (Popper et al., 2014). The risk of recoverable injuries in Group 2 fish from non-impulse sounds is also considered to be low at all distances from the noise source, while the risk of TTS is likely to be moderate near (10s of meters) the noise source and low at intermediate (100s of meters) and far (1,000s meters) distances. The likelihood of behavioural responses is considered to be moderate at near and intermediate distances and low at far field distances from the noise source (Popper et al., 2014).

Given the distance between the SAC and the offshore development area (20.9km from the array area and 13.0km from the ECC) and factoring in the lower noise levels compared to piling, no mortality or potential mortal injury, recoverable injury and TSS are predicted for Atlantic salmon within the SAC from non-impulse sounds, with the risk of behavioural reactions considered to be at most low. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

Given their migratory nature, Atlantic salmon are anticipated to be transient within the marine area, and therefore any exposure to non-impulse sounds is anticipated to be temporary. Moreover, any construction and decommissioning noise would be intermittent and temporary, with any potential effects on the behaviour or distribution of Atlantic salmon anticipated to also be temporary and reversible.

Conclusion of AEoI

Based on the above, it is concluded that non-impulse sounds will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC for Project Option 1 or Project Option 2.

5.2.3.3.4 Increase in SSC and Sediment Deposition (Construction, Operation and Decommissioning)

As determined in Table 5.4, Project Option 2 has a greater potential for increases in SSC and associated sediment deposition compared to Project Option 1 during construction and decommissioning activities. During the operational phase, Project Option 1 has a greater potential for increases in SSC and sediment deposition; however, the volume of sediment released during the operational and maintenance phase and associated bed level changes would be less to those experienced during the construction and decommissioning phase. Therefore, it is considered that Project Option 2 has a greater potential for adverse effects on migratory fish during the lifetime of the proposed development compared to Project Option 1 when considering increases in SSC and sediment deposition.

As detailed in Section 4.2, temporary increases in SSCs and associated sediment deposition are expected from construction activities that disturb the seabed and from the release of dredged material and drill cuttings. In addition, increases in SSC are likely to occur during maintenance activities associated with seabed structures and cabling and during the removal of infrastructure during decommissioning.

Mitigation

Implementation of mitigation measures detailed in the EMP and the CBRA will minimise release of sediments from offshore activities into the water column. Use of HDD to avoid any direct impact from cable corridor preparation and laying within the intertidal zone will decrease the release of material into the water column and the magnitude of associated impacts on coastal and marine receptors to negligible.

Assessment

The River Boyne and River Blackwater SAC is located 20.9km from the array area and 13.0km from the ECC. As detailed in Section 5.1.6 and shown in Figure 5.2 through Figure 5.11, the project-specific plume modelling predicts that sediment plumes caused by works within the array area and ECC will not extend into the River Boyne estuary SACs beyond trace levels with subsequent sediment deposition being undetectable above background levels. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the site itself.

As discussed previously, sediment plumes are expected to quickly dissipate after cessation of the construction activities due to settling and wider dispersion, with SSCs reducing to background levels within a couple of tidal cycles. The highest SSCs would be confined to the points of discharge, such as around WTG locations and cable trench lines.

In addition, construction activities are largely expected to be carried out on a sequential basis with minimal opportunity for successive periods of sediment disturbance to develop overlapping sediment plumes (i.e., plumes are expected to fully disperse with material settling out of suspension prior to the occurrence of a subsequent sediment disturbance event).

Atlantic salmon are highly mobile and would be expected to avoid unfavourable sediment plumes during migration at sea. In addition, modelling indicates that dispersed sediments reaching the River Boyne estuary are undetectable from background levels. Based on this together with the temporary, intermittent and localised nature of the predicted changes in SSC and sediment deposition, it is concluded that any displacement will not result in a barrier effect to any upstream or outgoing migration preventing Atlantic salmon from accessing or leaving their freshwater habitat within the SAC.

Conclusion of AEoI

Based on above, any avoidance reactions at sea are expected to be localised and temporary, and changes in SSC are not predicted to result in a barrier effect to any upstream or outgoing migration that would prevent Atlantic salmon from accessing or leaving the SAC. Therefore, it is concluded that increases in SSC and associated sediment deposition will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC for Project Option 2.

Based on the increased risk of effects of Project Option 2, it is considered that the same conclusion of no AEoI would apply to Project Option 1.

5.2.3.3.5 Accidental Pollution (Construction, Operation and Decommissioning)

As determined in Table 5.4, Project Option 2 has the greater potential for adverse effects on migratory fish species compared to Project Option 1 with regards to accidental pollution during construction and decommissioning activities. During the operational phase, Project Option 1 has a greater potential for the release of contaminated sediments; however, the volume of sediment released during the operational and maintenance phase would be less to those experienced during the construction and decommissioning phase. Therefore, it is considered that Project Option 2 has a greater potential for adverse effects on migratory fish during the lifetime of the proposed development compared to Project Option 1 with regards to accidental pollution.

Mitigation

The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. Pollution prevention and control measures will include navigational safety measures to reduce the likelihood of collision events, procedures to safely use, store and transport harmful substances including vessel fuels, and emergency response methods that would be implemented in the case of accidental spills or collision events. The adoption of these pollution management controls will minimise and manage accidental spills, thereby reducing the likelihood of pollution impacts on potentially sensitive migratory fish species.

Assessment

Consideration is given to the assessment for river lamprey above, which based on the fates of the sediment plumes, the low concentrations of sediment-bound contaminants in the offshore development area, and the low likelihood of increased bio-availability of contaminants in the water column concluded that the release of sediment-bound contaminants during construction, maintenance and decommissioning activities will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC for both Project Option 1 and Project Option 2.

Conclusion of AEoI

As the same impact-receptor pathway exists for Atlantic salmon, it is concluded that there also will be no AEoI of Atlantic salmon from the potential release of sediment-bound contaminants for both Project Option 1 and Project Option 2.

5.2.3.3.6 EMF (Operation)

As determined Table 5.4, Project Option 1 has a greater potential for adverse effects on migratory fish than Project Option 2 when considering EMFs generated during the operational phase.

The transmission of power through the inter-array and export cables during the operational phase of the proposed development would produce EMF in the surrounding sediment and water column. These fields have the potential to affect fish receptors that use electric or magnetic senses for foraging, navigation or communication.

Mitigation

Export and inter-array cables will be buried where practicable to ensure they are not exposed by sediment movements. Where cables cannot be buried due to ground conditions, additional cable protection measures such as rock placement or mattressing will be applied to achieve adequate cable protection. Up to 20% of cable length is expected to need protection either during initial installation, or throughout the operational phase of the proposed development. While cable burial or cable protection do not decrease the strength of EMF at source, it does increase the distance between the cables and electro- and magneto-sensitive receptors, thereby reducing the EMF (from attenuation of the EMF) received by those receptors.

Assessment

Atlantic salmon are magneto-sensitive and have been shown to use the Earth’s magnetic field for orientation (Gill and Bartlett, 2010; Hutchison et al., 2020). There have therefore been suggestions (Gill et al., 2005) that the presence of magnetic fields (B-fields) generated by submarine cables may interrupt navigation and consequently migration in salmon. Field studies investigating the responses of Atlantic salmon to artificial EMF emissions are limited. Using acoustic transmitters, Wyman et al. (2018) studied the movement patterns of Chinook salmon smolts before and after the installation of a high-voltage direct current cable within San Francisco Bay. Their data showed mixed effects with salmon smolts swimming parallel to the cable observed to swim faster, and some possible attraction to the active cable leading to misdirection and increased seaward transit times. However, the survival and outward migration success of smolts was not affected (Wyman et al., 2018). Minor route deviations and short-term delays in migration have also been observed in the European eel in response to AC and DC B-fields; however, the effects were of short duration and not considered to impact the overall migration (reviewed in Öhman et al., 2007). Overall, the current evidence suggests that magneto-receptive diadromous fishes including Atlantic salmon may exhibit short-term, localised behavioural changes to B-fields emitted by subsea power cables, which, however, are unlikely to affect their migratory patterns and behaviour in the long-term. Impacts from induced electric fields (Ie-fields) would not be expected.

While the impact would occur constantly throughout the 35-year operational phase of the proposed development, EMF generated by the power cables will be detectable above background levels only in close proximity to the cables (i.e., within about 10 metres of the cable line), as the EMF created will rapidly attenuate away from the centre line of the cables (e.g., COWRIE, 2005; Hermans, 2022; Normandeau Associates et al., 2011). Cable burial below the sea floor will further decrease the vertical and horizontal distances as which EMF attenuate into the marine environment (Normandeau Associates et al., 2011). Any potential behavioural responses of Atlantic salmon would therefore be localised and restricted to the immediate vicinity of the cables. Moreover, the proximity of the cables to natal rivers is also considered likely to have a bearing on the potential exposure of Atlantic salmon to EMFs (Gill and Bartlett, 2010). The ECC of the proposed development lies approximately 7.9km southward of the River Boyne estuary, and given the evidence that salmon native to the site leave the Irish Sea in a northward direction (Barry et al., 2020), their migration routes may not overlap with the ECC. Similarly, given the distance between the River Boyne estuary and the array area (16.4km), EMFs from the inter-array cables are not considered to result in a barrier effect that would prevent Atlantic salmon from accessing or leaving the SAC. Moreover, tagging studies suggest that returning salmon mainly swim close to the surface when approaching their natal rivers, with only occasional downward movements in the water column (Davidsen et al., 2013). Similar results were found for outward migrating smolts in estuarine and coastal areas, with post-smolts mainly recorded in surface waters (Plantalech Manel-La et al., 2009).

Conclusion of AEoI

Based on the above, it is concluded that EMF emitted during the operational phase will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC for Project Option 1. Based on the increased risk of effects of Project Option 1, it is considered that the same conclusion of no AEoI would apply to Project Option 2.

5.3 Marine Mammals

5.3.1 Approach

European Sites designated for marine mammals have been screened in given their potential connectivity with the proposed development boundary. Given the mobile nature of the species considered the extent of any pathway has been classified taking into account the scale of movement and population structure. For each species (harbour porpoise, bottlenose dolphin, grey seal and harbour seal) the area considered is defined by the appropriate management unit for cetaceans and the typical foraging ranges for seals, as defined in the SISAA Report.

The assessment process for marine mammal species is in line with relevant guidance Section 1.7 and the process outlined in Section 1.5. The assessment is informed by site-specific underwater noise modelling and dynamic energy budget (DEB) modelling, further details are presented within Appendix 6 and Appendix 9 respectively.

It should be noted that no onshore activities or impacts have been identified for marine mammals as all SACs with this receptor group as QIs are outside of the ZoI for onshore impacts and there is no connectivity between the sites and the onshore development area.

The European Sites designated for marine mammal species screened in for assessment are listed in Table 5.6 below.

Table 5.6: European Sites Screened in for Marine Mammal Receptors

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
Rockabill to Dalkey Island SAC	Annex II species: Harbour porpoise.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Lambay Island SAC	Annex II species: Harbour porpoise; Harbour seal; Grey seal.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Hook Head SAC	Annex II species: Harbour porpoise; Bottlenose dolphin.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Codling Fault Zone SAC	Annex II species: Harbour porpoise	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Underwater noise Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution
North Anglesey Marine/ Gogledd Môn Forol SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
		Changes to prey; and Accidental pollution.	Accidental pollution.	Changes to prey; and Accidental pollution.
Murlough SAC	Annex II species: Harbour seal.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
North Channel SAC	Annex II species Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Glannau Ynys Gybi/ Holy Island Coast SAC	Annex II species: Grey seal	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
West Wales Marine/ Gorllewin Cymru Forol SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC	Annex II species: Bottlenose dolphin.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Blackwater Bank SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Carnsore Point SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Cardigan Bay/ Bae Ceredigion SAC	Annex II species: Bottlenose dolphin.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise;	Offshore development area only Vessel disturbance;	Offshore development area only Underwater noise;

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
		Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Roaringwater Bay and Islands SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Blasket Islands SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Kenmare River SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Bunduff Lough and Machair/Trawalua/Mullaghmore SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;

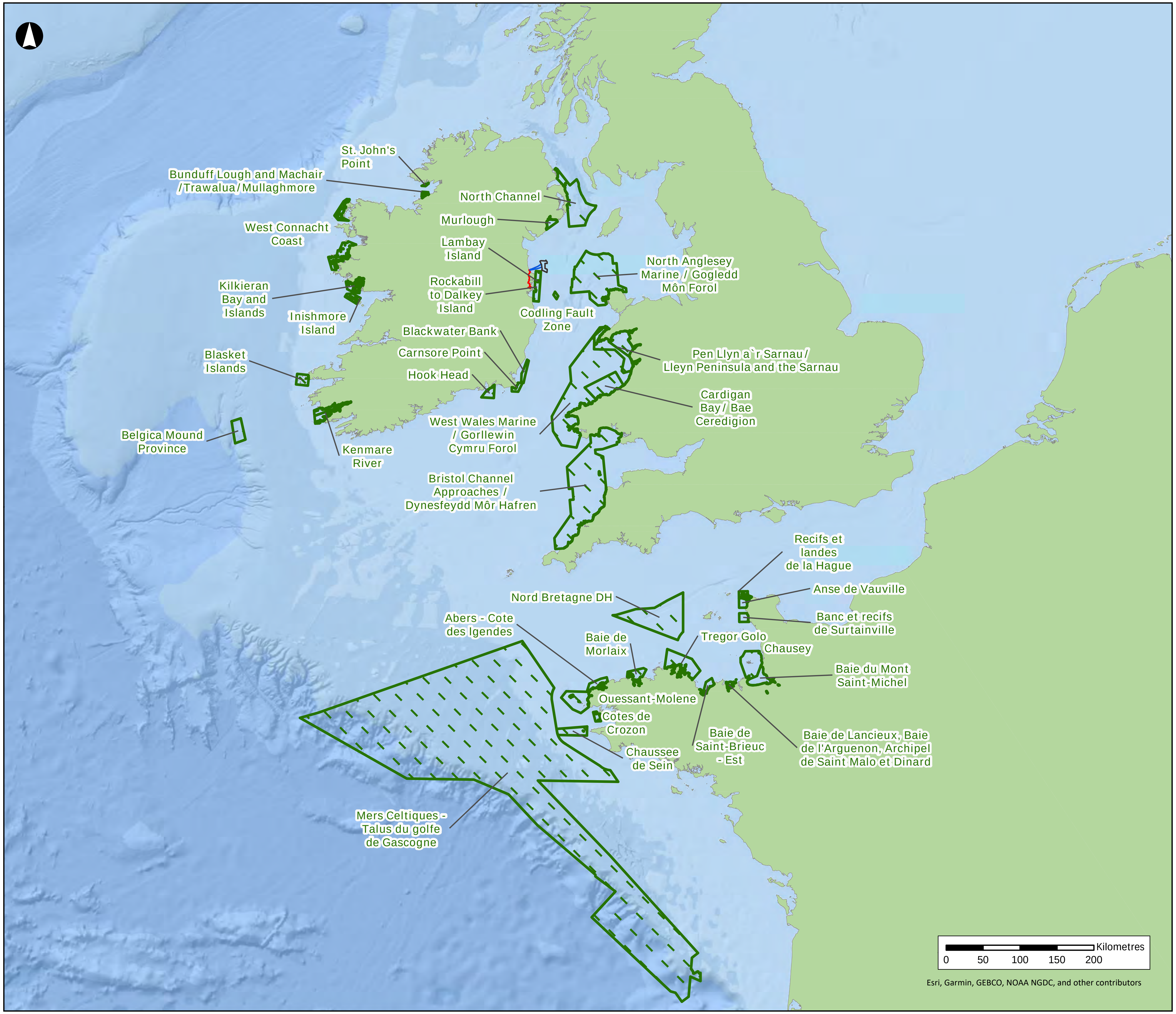
European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
		Changes to prey; and Accidental pollution.	Accidental pollution.	Changes to prey; and Accidental pollution.
Nord Bretagne DH SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
West Connacht Coast SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Mers Celtiques – Talus du golfe de Gascogne SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Récifs et landes de la Hague SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
Anse de Vauville SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Banc et récifs de Surtainville SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Tregor Goëlo SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Belgica Mound SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Baie de Morlaix SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise;	Offshore development area only Vessel disturbance;	Offshore development area only Underwater noise;

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
		Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Abers-Côtes des légendes SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Ouessant-Molène SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Chausey SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Baie de Saint-Brieuc – Est SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
		Changes to prey; and Accidental pollution.	Accidental pollution.	Changes to prey; and Accidental pollution.
Côtes de Crozon SAC,	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Baie du Mont Saint-Michel SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Kilkieran Bay and Islands SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.

European site name	Qualifying Interest	Impacts screened in for construction	Impacts screened in for operation	Impacts screened in for decommissioning
Chaussée de Sein SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.
Inishmore Island SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.



Array Area
Offshore Export Cable Corridor
Onshore Cable Route
Special Areas of Conservation

NISA
North Irish Sea Array

ARUP GoBe

Project
North Irish Sea Array Offshore Wind Farm

Figure Title
Sites Screened for Marine Mammal Receptors

Job No: 281240	Datum: WGS84 Projection: UTM30N
Date: May 2024	Figure No:
Scale: 1:5,000,000 @A3	5.15
Status: Issue	

The greatest effects on marine mammals are most likely to occur during the construction phase with any effects during decommissioning expected to be less. As detailed in the Section 5.1.6 of the SISAA, there are several activities that have the potential to introduce an effect receptor pathway for underwater noise, primarily from piling for monopile and/or multileg foundations, UXO clearance, vessel operations, seabed preparation works, cable installation and other activities. These impacts have varying degrees of severity, ranging from changes in behaviour and masking (i.e. affecting communication and listening space, and/or locating prey) (Pirotta et al. 2012, Dunlop 2016, Erbe et al. 2016, Heiler et al. 2016, Wisniewska et al. 2018, Pine et al. 2019, Basran et al. 2020), displacement and disturbance (Brandt et al. 2011, Pirotta et al. 2014, Culloch et al. 2016, Stone et al. 2017, Graham et al. 2019), to injury and even mortality (Schaffeld et al. 2019).

With respect to noise assessments, using the criteria outlined in Southall et al. (2019), there are two types of impacts considered: a temporary threshold shift (TTS) in hearing, and a Permanent Threshold Shift (PTS) in hearing, the latter of which is typically regarded as injury. To assess this, sound sources are typically divided into two categories, ‘impulsive’ and ‘non-impulsive’, based on attributes of the sound source:

- Impulsive sound sources, such as impact pile driving and UXO detonation, are transient and brief (less than a second), broadband and typically consist of high peak pressure with rapid rise time and decay; and
- Non-impulsive sound sources, such as dredging, trenching and shipping, can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak pressure with rapid rise time.

Noise exposure criteria outlined in Southall et al. (2019) grouped all marine mammals into functional hearing groups (FHGs) based on their hearing ability, as listed in Table 5.7.

Table 5.7: Generalised Hearing Ranges and Noise Exposure Criteria from Southall et al. (2019) for Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) in Hearing for the Functional Hearing Groups Phocid in Water (PW), High Frequency Cetaceans (HF), Very High Frequency Cetaceans (VHF), (NMFS 2018, Southall et al. 2019). The Unit for SEL_{cum} Criteria is dB 1µPa^{2}S, and Unit for SPL_{peak} Criteria is dB re 1µPA.

Functional hearing group	Relevant species	Generalised hearing range	Estimated peak region of sensitivity	Noise exposure criteria					
				Impulsive				Non-impulsive	
				TTS		PTS		TTS	PTS
				SEL_{cum} dB re 1 µPa2s weighted	SPL_{peak} dB re 1 µPa unweighted	SEL_{cum} dB re 1 µPa2s weighted	SPL_{peak} dB re 1 µPa unweighted	SEL_{cum} dB re 1 µPa2s weighted	SEL_{cum} dB re 1 µPa2s weighted
Phocids in water	Grey seal and harbour seal	50 Hz – 86 kHz	1.9 – 30 kHz	170	212	185	218	181	201
High Frequency Cetaceans	Bottlenose dolphin	150 Hz – 160 kHz	8.8 – 110 kHz	170	224	185	230	178	198
Very High Frequency Cetaceans	Harbour porpoise	275 Hz – 160 kHz	12 – 140 kHz	140	196	155	202	153	173

The noise level thresholds outlined in Table 5.7 are peak Sound Pressure Level (SPL), which is the maximum absolute value used to assess the potential risk of instantaneous TTS or PTS. These are based on the animal being close to the sound source (within 1m), which is unlikely and, therefore, extremely precautionary. The cumulative Sound Exposure Level (SEL_{cum}) is used to assess the potential risk of TTS or PTS through exposure to noise accumulated over time (typically 24 hours).

Harbour porpoises are dependent on sound to detect their prey and are sensitive to underwater noise. Harbour porpoises are defined as very high frequency (VHF) cetaceans, with a generalised hearing range of 275Hz to 160 kHz (NMFS, 2018; Southall et al., 2019; Table 5.7), their vocal repertoire includes VHF, short-range and Narrow-Band High Frequency (NBHF) echolocation clicks. The hearing sensitivity of harbour porpoise is greatest in the higher part of this range. The instantaneous (SPL_{peak}) PTS and TTS onset criteria are 202dB re 1µPa and 196dB re 1µPa, respectively (Table 5.7). The cumulative (SEL_{cum}) PTS and TTS onset criteria are 155dB re 1µPa^{2}s and 140dB re 1µPa2s, respectively (Table 5.7). Their high sensitivity to sound, coupled with them being the most abundant marine mammal species in UK and Irish waters, means they are often a species of concern when assessing risks of impacts from impulsive sound sources, such as piling works.

Bottlenose dolphins are also dependent on sound to detect their prey and are sensitive to underwater noise. Bottlenose dolphins are classified as high frequency (HF) cetaceans, with a generalised hearing range of 150 Hz to 160 kHz (NMFS 2018, Southall et al. 2019; Table 5.7). The instantaneous (SPL_{peak}) PTS and TTS onset criteria are 230dB re 1µPa and 224dB re 1µPa, respectively (Table 5.7). The cumulative (SEL_{cum}) PTS and TTS onset criteria are 185dB re 1µPa^{2}s and 170dB re 1µPa2s, respectively (Table 5.7).

Grey seals and harbour seals are less reliant on sound for foraging but are nonetheless sensitive to underwater noise. There are in air and in water thresholds for seals, only the latter, defined as phocids in water (PW), are relevant to the assessment of underwater noise. Seals have a generalised hearing range of 50Hz to 86kHz (Southall et al. 2019; Table 5.7). The instantaneous (SPL_{peak}) PTS and TTS onset criteria are 218dB re 1µPa and 212dB re 1µPa, respectively (Table 5.7). The cumulative (SEL_{cum}) PTS and TTS onset criteria are 185dB re 1µPa2s and 170dB re 1µPa2s, respectively (Table 5.7).

In view of the limited data available for assessing behavioural disturbance on marine mammals, the National Oceanic and Atmospheric Administration (NOAA) (2005) Level B harassment threshold for impulsive noise on marine mammals has been considered for quantifying such disturbance effect within SACs. The threshold predicts Level B harassment, which refers to acts with the potential to disturb (but not injure) a marine mammal or marine mammal stock by disrupting behavioural patterns, will occur when an individual is exposed to piling noise with received levels above 160dB re 1µPa (rms). This threshold is based on avoidance responses observed in a grey whale mother and calf pair under air gun playback signals at levels above the threshold levels (Malme et al., 1984).

5.3.1.1 Project Option 1 and Project Option 2 Determination of Greatest Effects

For marine mammal ecology an evaluation has been completed to determine which of the two project options (Project Option 1 or Project Option 2) presents the greatest potential for AEoI on designated sites. Table 5.8 shows the outcome of this assessment.

Table 5.8: Potential impacts and the Project Option which has the greatest potential for AEoI on Marine Mammals. The Project Option that has the greatest potential for AEoI is Identified in Blue.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
Construction			
Underwater noise from piling	WTGs: 49 monopile WTG foundations; 12.5m diameter piles; Maximum hammer energy: 5,500kJ; Maximum 6.08 hours per pile; and One monopile foundation installed in a 24- hour period = 49 piling days. OSP:	WTGs: 35 jacket WTGs, 4 pin-piles per jacket = total 140 pin piles; 6m diameter pin-piles; Maximum hammer energy: 3,000kJ; Maximum 3.33 hours per pile; and 2 pin-piles installed per 24-hour period = 70 piling days. Project Option 2 also includes the possibility of 35 WTGs	Project Option 1 represents the greatest potential for an AEoI in relation to PTS from piling. The greatest potential for an AEoI is defined by the extent of noise propagation resulting from the installation of WTG and OSP foundations during the construction phase.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
	1 OSP installed on 2 monopiles; 12.5m diameter piles; Maximum hammer energy: 5,500kJ; One monopile foundation installed in a 24-hour period; Maximum 6.08 hours per pile; and 1 monopile installed per day = 2 piling days.	on monopile foundations, however as this is less than Project Option 1 it is not considered in this impact assessment. OSP: 1 OSP installed on 2 monopiles; Maximum hammer energy: 5,500kJ; Maximum 6.08 hours per pile; and 1 monopile installed per day = 2 piling days.	
Underwater noise from UXO clearance	A detailed UXO survey will be completed prior to construction. The type, size (net explosive quantities (NEQ) and number of possible detonations and duration of UXO clearance operations is not known at this stage. Therefore, an illustrative assessment is presented here, using a range of UXO charge sizes from 25 kg to 525 kg.	A detailed UXO survey will be completed prior to construction. The type, size (net explosive quantities (NEQ) and number of possible detonations and duration of UXO clearance operations is not known at this stage. Therefore, an illustrative assessment is presented here, using a range of UXO charge sizes from 25 kg to 525 kg.	The greatest potential for an AEoI is considered to be the same for both Project Option 1 and Project Option 2.
Underwater noise from other noise sources	Inter-array cables: Installation of 111km of array cables; Installation method: jetting, ploughing, trenching; Protection: burial, mattressing and/or loose rock; and Duration: 240 days. Export cables: Installation of 18km of export cables; Installation: jetting, ploughing, trenching; Protection: mattressing and/or loose rock; and Duration: 180 days. Landfall: HDD. A series of pre-construction surveys will be undertaken in the array area and along the ECC. Geophysical surveys will utilize towed equipment such as side scan sonar, sub bottom profiler, multibeam	Inter-array cables: Installation of 91km of array cables; Installation method: jetting, ploughing, trenching; Protection: burial, mattressing and/or loose rock; and Duration: 240 days. Export cables: Installation of 18km of export cables; Installation: jetting, ploughing, trenching; Protection: mattressing and/or loose rock; and Duration: 180 days. Landfall: HDD. A series of pre-construction surveys will be undertaken in the array area and along the ECC. Geophysical surveys will utilize towed equipment such as side scan sonar, sub bottom profiler, multibeam	Project Option 1 represents the greatest potential for an AEoI in relation to PTS from other construction noise. The greatest potential for an AEoI is defined by the extent of construction activity which will generate noise. The greatest potential for an AEoI from pre construction surveys is considered to be the same for both Project Option 1 and Project Option 2.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
	echosounder and magnetometer	echosounder and magnetometer	
Vessel disturbance	Total construction vessel numbers: 67 Total number of return trips: 3,008; and Maximum vessels simultaneously onsite: 49. ECC installation vessels: 1 cable laying vessel; 1 burial vessel; 1 support vessel; 12 work boats/Rigid Inflatable Boat (RIBs); 1 work boat for landfall HDD installation; 1 small JUV for landfall HDD installation; and 1 guard vessel for HDD and cable installation. Array cable installation vessels: 1 main laying vessel; 1 burial vessel; 1 transport vessel; and 1 main SOV/CTV vessel. WTG Installation vessels: 2 installation vessels; 6 support vessels; 2 transport vessels; and 1 support helicopter.	Total construction vessel numbers: 69 Total number of return trips: 2,530; and Maximum vessels simultaneously onsite: 47. ECC installation vessels: 1 cable laying vessel; 1 burial vessel; 1 support vessel; 12 work boats/Rigid Inflatable Boat (RIBs); 1 work boat for landfall HDD installation; 1 small JUV for landfall HDD installation; and 1 guard vessel for HDD and cable installation. Array cable installation vessels: 1 main laying vessel; 1 burial vessel; 1 transport vessel; and 1 main SOV/CTV vessel. WTG Installation vessels: 2 installation vessels; 6 support vessels; 2 transport vessels; and 1 support helicopter.	Project Option 1 represents the greatest potential for an AEoI in relation to disturbance from vessels. The greatest potential for an AEoI is defined by the number of vessels associated with construction activities.
Collision risk	Total construction vessel numbers: 67 Total number of return trips during construction: 3,008 ECC installation vessels: 1 cable laying vessel; 1 burial vessel; 1 support vessel; 12 work boats/Rigid Inflatable Boat (RIBs); 1 work boat for landfall HDD installation; 1 small JUV for landfall HDD installation; and 1 guard vessel for HDD and cable installation.	Total construction vessel numbers: 69 Total number of return trips during construction: 2,530 ECC installation vessels: 1 cable laying vessel; 1 burial vessel; 1 support vessel; 12 work boats/Rigid Inflatable Boat (RIBs); 1 work boat for landfall HDD installation; 1 small JUV for landfall HDD installation; and 1 guard vessel for HDD and cable installation.	Project Option 1 represents the greatest potential for an AEoI in relation to collision with vessels. The greatest potential for an AEoI is defined by the number of vessels associated with construction activities.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
	Array cable installation vessels: 1 main laying vessel; 1 burial vessel; 1 main support vessel; and 1 main SOV/CTV vessel. WTG Installation vessels: 2 installation vessels; 6 support vessels; 2 transport vessels; and 1 support helicopter.	Array cable installation vessels: 1 main laying vessel; 1 burial vessel; 1 main support vessel; and 1 main SOV/CTV vessel. WTG Installation vessels: 2 installation vessels; 6 support vessels; 2 transport vessels; and 1 support helicopter.	
Changes to prey	Please refer to Table 5.4 Potential impacts and the project options which has the greatest potential for AEoI on migratory fish.		
Operation and Maintenance			
Collision risk	Total operation vessel numbers: Total vessels: 12 Total number of return trips:1,261; and Maximum number of vessels simultaneously onsite: 12. Vessel activity 2 JUV vessels; 2 SOV vessels; 6 CTV vessels; 2 lift vessels; 2 cable vessels; and 7 aux vessels.	Total operation vessel numbers: Total vessels: 12 Total number of return trips: 1,055; and Maximum number of vessels simultaneously onsite: 12. Vessel activity: 2 JUV vessels; 2 SOV vessels; 6 CTV vessels; 2 lift vessels; 2 cable vessels; and 7 aux vessels.	Project Option 1 represents the greatest potential for an AEoI in relation to collision with vessels. The greatest potential for an AEoI is defined by the number of vessels associated with operation activities.
Vessel disturbance	Total operation vessel numbers: Total vessels: 12 Total number of return trips: 1,261; and Maximum number of vessels simultaneously onsite: 12. Vessel activity 1 JUV vessels; 1 SOV vessels; 1 CTV vessels; 1 lift vessels; 1 cable vessels; and 7 aux vessels.	Total operation vessel numbers: Total vessels: 12 Total number of return trips: 1,055; and Maximum number of vessels simultaneously onsite: 12. Vessel activity: 1 JUV vessels; 1 SOV vessels; 1 CTV vessels; 1 lift vessels; 1 cable vessels; and 7 aux vessels.	Project Option 1 represents the greatest potential for an AEoI in relation to disturbance from vessels. The greatest potential for an AEoI is defined by the number of vessels associated with operation activities.
Changes to prey	Please refer to Table 5.4 Potential impacts and the project options which has the greatest potential for AEoI on migratory fish.		

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
Decommissioning			
Underwater noise from decommissioning	The final method chosen shall be dependent on the technologies available at the time of decommissioning. The numbers of vessels and/or plant required for each activity is therefore not available at this stage. The indicative methodology, however, would be: Deployment of ROV's or divers to inspect each pile footing and reinstate lifting attachments if necessary. Mobilise a jack-up barge/heavy lifting vessel. Remove any scour protection or sediment obstructing the cutting process. It may be necessary to dig a small trench around the foundation. Deploy crane hooks from the decommissioning vessel and attach to the lift points. Cut piles at 2m below seabed level. Inspect seabed for debris and remove debris where necessary. Considering the current technology, the decommissioned components are likely to be transported back to shore by lifting onto a jack-up or heavy lift vessels, freighter, barge, or by buoyant tow. Transport all components to an onshore site where they will be processed for reuse/recycling/disposal. Inspect seabed and remove debris.	The final method chosen shall be dependent on the technologies available at the time of decommissioning. The numbers of vessels and/or plant required for each activity is therefore not available at this stage. The indicative methodology, however, would be: Deployment of ROV's or divers to inspect each pile footing and reinstate lifting attachments if necessary. Mobilise a jack-up barge/heavy lifting vessel. Remove any scour protection or sediment obstructing the cutting process. It may be necessary to dig a small trench around the foundation. Deploy crane hooks from the decommissioning vessel and attach to the lift points. Cut piles at 2m below seabed level. Inspect seabed for debris and remove debris where necessary. Considering the current technology, the decommissioned components are likely to be transported back to shore by lifting onto a jack-up or heavy lift vessels, freighter, barge, or by buoyant tow. Transport all components to an onshore site where they will be processed for reuse/recycling/disposal. Inspect seabed and remove debris.	More infrastructure will require decommissioning for Project Option 1, with a similar indicative methodology for both project options. As such, Project Option 1 has the greatest potential for an AEoI for PTS from decommissioning.
Vessel disturbance	The greatest potential for a likely significant effect is identical to (or less than) that of the construction phase	The greatest potential for a likely significant effect is identical to (or less than) that of the construction phase	Project Option 1 represents the greatest potential for an AEoI in relation to disturbance from vessels. The number of vessels required during decommissioning is dependent upon the technologies available at the time of decommissioning, and the methodology likely to be used.

Potential effect	Project 1 (49 WTG)	Project 2 (35 WTG)	Rationale for the project option with the greatest potential for AEoI of marine mammals
			More infrastructure will require decommissioning for Project Option 1. As such, Project Option 1 has the greatest potential for an AEoI for disturbance from vessels.
Collision risk	The greatest potential for a likely significant effect is identical to (or less than) that of the construction phase	The greatest potential for a likely significant effect is identical to (or less than) that of the construction phase	Project Option 1 represents the greatest potential for an AEoI in relation to collisions with vessels. The number of vessels required during decommissioning is dependent upon the technologies available at the time of decommissioning, and the methodology likely to be used. More infrastructure will require decommissioning for Project Option 1. As such, Project Option 1 has the greatest potential for an AEoI for collisions with vessels.
Changes to prey	Please refer to Table 5.4 Potential impacts and the project options which has the greatest potential for AEoI on migratory fish lease refer to Table 5.4 for fish		

5.3.2 Rockabill to Dalkey Island SAC

5.3.2.1 Qualifying Interests and Conservation Objectives

The Rockabill to Dalkey Island SAC lies 2.4km from the array area and 2.9km from the ECC and is designated for the following marine mammal species:

- Harbour porpoise (*Phocoena phocoena*)

The Rockabill to Dalkey Island SAC, covering an area of approximately 273km^2, contains key habitat for harbour porpoises, including inshore shallow sand and mudbanks, and rocky reefs scoured by strong current flow (NPWS 2014). Harbour porpoises occur year-round within the site and have been observed with calves. Line-transect surveys conducted in 2021 estimated an abundance of 227 ± 39 porpoises within the SAC (Berrow et al., 2021), compared to 424 ± 45 individuals estimated in 2016 (O'Brien and Berrow 2016) and 391±25 porpoises predicted in 2013 (Berrow and O'Brien 2013).

In the summer of 2021 (Sep-Aug), boat-based line transect surveys were conducted within the SAC to estimate density and abundance. The density estimates for each survey had an overall pooled density of 0.83 ± 0.14 (CV=0.17) porpoises/km^2 (Berrow et al., 2021). This indicated a significant decline in porpoise density when comparing estimated boat-based values in 2013 and 2016, which were found to be 1.44 ± 0.09 (CV=0.09) porpoises/km^2 (Berrow and O'Brien 2013) and 1.55 ± 0.17 (CV=0.10) porpoises/km^2 (O'Brien and Berrow 2016) respectively. The decline was also observed in the Roaringwater Bay and Islands SAC, and Co Cork and Blasket Islands SAC in porpoises off the southern Ireland, which could potentially be due to changes in distribution and habitat use at a local scale instead of actual declines in population sizes (Berrow et al. 2021).

Seven dedicated line-transect surveys were conducted between Howth Head and Lambay Island in an area that partially overlaps with the SAC and was considered to be most favourable for harbour porpoises between April 2015 and January 2017 for the Greater Dublin Drainage Project (Berrow et al., 2021). Harbour porpoise densities within this area of the SAC ranged from 0.61 porpoises/km^2 in February 2016 to 2.29 porpoises/km^2 in August 2021.

The proportion of juveniles and calves to all porpoises was estimated to be approximately 5.5% for this SAC (Berrow et al., 2021), which appears to be lower than in 2016 (15.5%) and 2013 (8.8%).

5.3.2.1.1 Conservation Objectives of Qualifying Interests

The COs to maintain the favourable conservation condition of the harbour porpoise within the Rockabill to Dalkey Island SAC, are defined by the following list of attributes and targets:

- Access to suitable habitats: species range within the site should not be restricted by artificial barriers to site use; and
- Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

NPWS have provided the following technical clarification in relation to the specific COs for Annex II species within this SAC to facilitate the assessment process, with these clarifications being the focus of the assessment herein:

- Target 1: Species range within the site should not be restricted by artificial barriers to site use:
  - This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour porpoise from part of its range within the site or will permanently prevent access for the species to suitable habitat therein.
  - It does not refer to short-term or temporary restriction of access or range.
  - Early consultation or scoping with the Department in advance of formal application is advisable for proposals that are likely to result in permanent exclusion.
- Target 2: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site:
  - Proposed activities or operations should not introduce man-made energy (e.g. aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and/or the community of harbour porpoise within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle.
  - This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc) upon which harbour porpoises depend. In the absence of complete knowledge on the species ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis.
  - Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community at the site.

5.3.2.2 Underwater Noise from Piling (Construction)

5.3.2.2.1 PTS and TTS

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impacts from piling.

For the monopile foundation scenario (WTG and OSP foundations for Project Option 1) involving the installation of 12.5m piles with a maximum blow energy of 5,500kJ, the maximum auditory injury (PTS-onset) impact range for harbour porpoise was 15km for the installation of a monopile at the SE modelling location.

Using the cumulative TTS-onset thresholds the maximum impact range for harbour porpoise during a single monopile piling event was calculated at 83km for the SE monopile location, overlapping with the SAC.

While for the pin-pile foundation scenario (WTG foundations for Project Option 2, with a maximum blow energy of 3,000kJ), sequential installation of two 6m piles within a 24-hour period instead of single pin-pile installation would be considered as per the precautionary approach. For harbour porpoise the maximum auditory injury (PTS-onset) impact range was 9.5km for the installation of two sequential pin piles at the SE modelling location. TTS onset is predicted to occur out to 66 km at the SE modelling location, overlapping with the SAC.

Whether there are ecological consequences of PTS for marine mammals from piling noise is a subject of active study. At an expert elicitation workshop for the interim Population Consequences of Disturbance framework (iPCoD framework), experts in marine mammal hearing discussed the nature, extent and potential consequence of PTS to UK marine mammal species arising from exposure to repeated low-frequency impulsive noise such as pile driving (Booth and Heinis, 2018). This workshop outlined and collated the best and most recent empirical data available on the effects of PTS on marine mammals. Of particular relevance for this NIS, the findings of the elicitation included that PTS did not mean animals were deaf, that the limitations of the ambient noise environment should be considered and that the magnitude and frequency band in which PTS occurs are critical to assessing the effect on vital rates. The potential implications of PTS (and TTS) to individual harbour porpoise and the community of the SAC are discussed below.

For piling noise, most energy is between ~30–500Hz, with a peak usually between 100–300Hz and energy extending above 2kHz (Kastelein et al. 2015a, Kastelein et al. 2016). Studies have shown that exposure to impulsive pile driving noise induces TTS (and consequently PTS) in a relatively narrow frequency band in harbour porpoise and harbour seals (reviewed in Finneran 2015), with statistically significant TTS occurring at 4 and 8kHz (Kastelein et al. 2016) and centred at 4kHz (Kastelein et al. 2012a, Kastelein et al. 2012b, Kastelein et al. 2013b, Kastelein et al. 2017). Therefore, during the expert elicitation workshop, the experts agreed that any threshold shifts (temporary or permanent) as a result of pile driving would manifest themselves in the 2–10kHz range (Kastelein et al. 2017) and that a PTS 'notch' of 6–18dB in a narrow frequency band in the 2–10kHz region is unlikely to significantly affect the fitness of individuals (i.e. it's ability to survive and reproduce). The expert elicitation concluded that:

"… the effects of a 6 dB PTS in the 2-10 kHz band was unlikely to have a large effect on survival or fertility of the species of interest.

… for all species experts indicated that the most likely predicted effect on survival or fertility as a result of 6 dB PTS was likely to be very small (i.e., <5% reduction in survival or fertility).

… the defined PTS was likely to have a slightly larger effect on calves/pups and juveniles than on mature females' survival or fertility."

Further to this for harbour porpoise, there is evidence from previous studies, using static Passive Acoustic Monitoring (PAM) devices that harbour porpoise detections are reduced in the immediate vicinity of the pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Brandt et al. 2018, Rose et al. 2019, Benhemma-Le Gall et al. 2021, Benhemma-Le Gall et al. 2023). For example, harbour porpoise detections were found to gradually decline by up to 33% in the 48 hours before piling during the installation campaigns of both Beatrice and Moray East offshore wind farms (Benhemma-Le Gall et al., 2023). This is likely due to an increase in other construction-related activities and the presence of vessels in advance of pile driving, which deter harbour porpoises away from the works area, therefore reducing the risk of auditory injury (Benhemma-Le Gall et al., 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity of the pile driving site at the start of the activity. As such, the densities of harbour porpoise predicted to be within the potential impact ranges are likely to be reduced from the baseline and the scale of the effect thereby reduced in terms of individuals (proportion of the SAC population) exposed.

The PTS and TTS onset contours from the noise modelling overlap with the SAC, and considering the highly mobile nature of harbour porpoise, are likely to encompass individuals from the SAC when in surrounding areas.

As described above, the PTS (and TTS) from piling noise is expected to result in a “notch” of reduced hearing sensitivity in exposed individuals within a frequency range that is considered to be of limited importance for biologically important purposes (Kastelein et al. 2017). As such, current scientific understanding is that PTS (and TTS) would not result in significant impacts on the fitness of individual harbour porpoises, for either adults or calves/pups, although there is somewhat more uncertainty regarding impacts on the latter. It is also important to note that the density of harbour porpoises is expected to be somewhat reduced within the vicinity of the construction site, which will consequently reduce the number of individuals exposed to PTS/TTS.

Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to harbour porpoise, prior to the start of piling activities, acoustic deterrent devices (ADDs) will be used to displace harbour porpoise outwith the potential PTS-onset range (as predicted by updated noise modelling which will be undertaken closer to the point of construction). Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. The piling scenario used to inform the updated modelling will include any refinements to the maximum hammer energy required and confirm that soft-start will be used to encourage marine mammals to flee prior to the use of the highest hammer energies (and consequently greatest received sound). Marine mammal observers (MMOs) and passive acoustic monitoring (PAM) will be used together, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the piling specific Marine Mammal Mitigation Protocol (MMMP) (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, PTS and TTS, being impacts to the hearing of individuals, are not considered to present a barrier to the use of the site and as such will not affect harbour porpoise access to the site. Regarding Target 2, PTS and TTS will affect individuals within the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the underwater noise associated with the onset of PTS or TTS is not predicted to result in any “significant negative impacts”[13] on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Option 1 or Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from piling will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.2.2 Behavioural Disturbance

As discussed within Southall et al. (2019), internationally recognised noise thresholds for determining behavioural impacts are not currently available. In view of the limited data available for assessing behavioural disturbance from piling noise on marine mammals, consideration has been given to the potential for the harbour porpoise QI of this SAC to be present within the NOAA (2005) Level B harassment threshold for impulsive noise and/or the 145dB SELss contour (after Lucke et al. 2009).

[13] As per the clarifications provided by NPWS

The Level B threshold refers to acts with the potential to disturb (but not injure) a marine mammal or marine mammal stock by disrupting behavioural patterns, will occur when an individual is exposed to piling noise with received levels above 160 dB re1µPa (rms). The 145dB SELss threshold was demonstrated to cause consistent behavioural reactions in a captive harbour porpoise (Lucke et al. 2009). The impact range of both the Level B harassment threshold and the 145dB SELss contour from the Project overlap with the SAC and with wider areas of the Irish Sea which may be used by individuals associated with the SAC.

Previous studies have shown that harbour porpoises are displaced from the vicinity of piling events. For example, studies at wind farms in the German North Sea have recorded large declines in porpoise detections close to the piling (>90% decline at noise levels above 170dB re 1 µPa2s) with decreasing effect with increasing distance from the pile (25% decline at noise levels between 145 and 150dB) (Brandt et al. 2016). The detection rates revealed that porpoise were only displaced from the piling area in the short term (1 to 3 days) (Brandt et al. 2011, Dähne et al. 2013, Brandt et al. 2016, Brandt et al. 2018). Harbour porpoise are small cetaceans which makes them vulnerable to heat loss and requires them to maintain a high metabolic rate with little energy remaining for fat storage (e.g. Rojano-Doñate et al. 2018). This makes them vulnerable to starvation if they are unable to obtain sufficient levels of prey intake. Harbour porpoises are typically considered more susceptible than other, larger, marine mammals to disturbance from piling, considering their smaller body sizes and income breeding strategy of fuelling pregnancy and lactation with concurrent increase in energy intake (Mchuron et al., 2017).

A recent study by Benhemma-Le Gall et al. (2021) provided two key findings in relation to harbour porpoise response to pile driving. Porpoise were not completely displaced from the piling site: detection of clicks (echolocation) and buzzing (associated with prey capture) in the short-range (2km) did not cease in response to pile driving. Furthermore, detections of both clicks (echolocation) and buzzing (associated with prey capture) increased above baseline levels with increasing distance from the pile, which could be a result of increased local density of animals through augmentation by animals displaced closer to piling and/or that displaced porpoises compensate by increasing foraging activities beyond the impact range. Therefore, porpoise that experience displacement are expected to be able to compensate for the lost foraging opportunities and increased energy expenditure of fleeing.

Whilst the Level B harassment threshold overlaps with the SAC, as described above, the behaviour of individuals is important to inform the potential for a negative impact, and whether disturbance or displacement in and of itself may result in an impact on the fitness of an individual or its survival, and consequently how that relates to wider population level effects and then to potential impacts to the community QI of the SAC.

In relation to the COs for the Rockabill to Dalkey SAC, it is important to note that target 2 includes proposed activities or operations should not introduce man-made energy (e.g. aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and/or the community of harbour porpoise within the site. This refers to the aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle (NPWS, 2013a).

To consider the potential for impact on individuals at the site, project specific dynamic energy budget (DEB) models (Chudzińska et al., 2024; Pirotta et al., 2018; Pirotta et al., 2023) have been undertaken (Appendix 9) to study how behavioural disturbance from piling activities might potentially impact this sensitive species in a more species- and spatially specific context. Recognising that disturbance may result in a temporary change in the distribution of individuals using the SAC, and a temporary change in behaviour whereby individual porpoise may cease foraging for a limited period of time, the DEB model can be used to predict the changes in individual body condition and explore how such changes could affect that individual’s vital rates. These kinds of models have been widely used to investigate how natural and anthropogenic disturbance might affect individuals and populations of marine mammals.

The DEB models (Appendix 9) were run to investigate how piling disturbance might alter the vital rates, i.e., calf mortality rate, adult mortality rate and birth rate of female harbour porpoises during different life history stages. The DEB model The DEB model assumes an impacted area with a 30 km radius and considers impacts generally occurring to the population of harbour porpoises present within the general area around the project, rather than being specific to the part of the harbour porpoise population which utilises the SAC. The results from the modelling are discussed below and have been used to inform the potential for an AEoI on the QI of the SAC.

The conclusions of the DEB show the predicted effects of the different combinations of values for disturbance effect and probability of disturbance on porpoise birth rate, calf mortality rate and adult mortality rate. Results are expressed as a percentage change from no disturbance. The full DEB report and parameters are presented within Appendix 9.

The DEB model used different combinations of values for the disturbance effect (how long an individual ceases to feed as a result of disturbance: 1, 2, 4 or 6 hours) and probability of disturbance (informed by the probability that an individual is exposed to noise from piling and the probability that it will respond to that exposure: 0.05, 0.1 and 0.2). Based on the available evidence, the most realistic scenario is that porpoise cease foraging for <3 hours, and there is very little scientific support for probability of disturbance values of above 0.1 (10% of the individuals within the 30 km impact radius respond).

Using the most realistic effect of disturbance (where disturbance resulted in 4 hours of non-foraging time and where 10% of the individuals present in the impacted area were affected) (discussed within Appendix 9), there was no statistically significant effect on birth rate, calf mortality rate or adult mortality rate from piling under either Project Option 1 or Project Option 2.

Under an extreme scenario (where disturbance caused a 6h reduction in foraging and where 20% of the individuals present in the impacted area were affected) (for which little scientific evidence exists), was also included within the modelling to account for the uncertainty in how harbour porpoise use the area around the project. Were this disturbance rate to hold, even under the greatest impact on foraging (6 hour reduction in foraging), the only parameter for which a significant change was identified was calf mortality, under both Option 1 and Option 2. There was no change to birth rate or adult mortality under even the most extreme scenarios. The small change (2.4% increase) in calf mortality applies to the general population surrounding the Project and so is unlikely that, even under this overly conservative scenario, there would be any impact to individuals associated with the SAC. The DEB model shows that most of the change in calf mortality is associated with the timing of the piling events, with the assumed scenario having this coinciding with the calving season of harbour porpoises when porpoise calves are most vulnerable. Any other timings associated with piling would have a lesser effect by avoiding the time of greatest vulnerability.

Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, whilst underwater noise generated from piling may result in temporary exclusion of harbour porpoise from an area, this only lasts for the period of piling, with harbour porpoise returning to areas from which they were displaced within 1 – 2 days (Brandt et al. 2016). Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the underwater arising from piling, however, as described above, this is not predicted to result in any “significant negative impact” to individual fitness or reproductive success (of any life stage) under any realistic scenario and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with underwater noise from piling is not predicted to result in any “significant negative impacts” on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no behavioural disturbance impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that behavioural disturbance arising from piling will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.3 Underwater Noise from UXO Clearance (Construction)

As determined in Table 5.8, the greatest magnitude of impact is considered to be the same for both Project Option 1 and Project Option 2 when considering underwater noise impact from UXO clearance.

5.3.2.3.1 PTS and TTS

Most of the acoustic energy produced by a high-order detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10kHz (von Benda-Beckmann et al. 2015, Salomons et al. 2021). Recent acoustic characterisation of UXO clearance noise has shown that there is more energy at lower frequencies (<100 Hz) then previously assumed (Robinson et al., 2022). Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for harbour porpoises, (Southall et al., 2019).

It is also noted in the JNCC (2020) guidance that one-off explosions, each being of a short-term duration, would not cause widespread and prolonged displacement of porpoises. If PTS or TTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of the porpoise.

As UXO detonation is defined as a single pulse, both the weighted SEL_{ss} criteria and the unweighted SPL_{peak} criteria from Southall et al. (2019) were considered (see Tables 5-10 and 5-11 of Appendix 6: UWN Modelling Report). The maximum PTS impact range of UXO clearance on harbour porpoises is 12 km when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525kg (and an additional donor weight of 0.5kg to initiate detonation) and the adoption of 'high-order' clearance technique.

Whilst the impact ranges overlap with the SAC, the modelling of UXO clearance impact range has assumed no degradation of the UXO, and no smoothing of the impact wave over distances (meaning injurious potential of the impact wave at greater distances would be lower than just a reduction in absolute noise level, Cudahy and Parvin (2001)), which is a very precautionary approach. As such, the true impact ranges are likely to much smaller.

As discussed above for effects of PTS and TTS from piling, hearing loss from UXO clearance, due to the peak energy being contained within lower frequencies, is likely to form a notch in the hearing of a harbour porpoise that is not considered to result in any biologically significant effects (Booth and Heinis, 2019). As such, current scientific understanding is that PTS (and TTS) would not result in significant impacts on the fitness of individual harbour porpoises, for either adults or calves, although there is somewhat more uncertainty regarding impacts on the latter. It is also important to note that the density of harbour porpoises is expected to be somewhat reduced within the vicinity of the construction site, which will consequently reduce the number of individuals exposed to PTS/TTS.

Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to harbour porpoise, prior to any detonations, ADDs will be used to displace harbour porpoise outwith the potential PTS-onset range. NAS (e.g. bubble curtains) may also be used where high-order clearance techniques are required to be used for UXO where the predicted impact ranges may exceed that over which ADDs are considered to be effective. The PTS-onset range for each detonation will be determined by the charge size of each specific UXO, as confirmed by an explosive ordnance (EOD) expert following target investigations. The ADD duration will be set to displace harbour porpoise from within the PTS-onset area for each UXO, rather than applying a fixed value for all UXO irrespective of charge size. MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aids in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the MMMP (Appendix 10). Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, PTS, being an impact to the hearing of individuals, is not considered to present a barrier to the use of the site and as such will not affect harbour porpoise access to the site.

Regarding Target 2, PTS and TTS will affect individuals within or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the underwater noise associated with the onset of PTS or TTS is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from UXO clearance will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.3.2 Behavioural Disturbance

As discussed within Southall et al. (2019), internationally recognised noise thresholds for determining behavioural impacts are not currently available. There is also currently no guidance available from NPWS or IWDG on the methodology to assess behavioural disturbance from UXO clearance. Various methods could be used to determine whether there is a potential overlap from the noise from UXO clearance at the project with the SAC, including use of TTS-onset thresholds as a proxy, or a fixed 26km range (JNCC 2010 and e.g. JNCC, NE, DEARA, 2022), with both options resulting in a spatial overlap with the SAC. However, considering the highly mobile nature of harbour porpoise, and the one-off pulses generated by UXO clearance, a qualitative assessment of the potential risk of behavioural effects to harbour porpoise is considered more appropriate rather than a specific spatial assessment.

It is noted in the JNCC guidance (2020) that UXO detonation is not expected to cause widespread and prolonged displacement of marine mammals. The impact is short-term and intermittent in nature with a temporary behavioural effect, which would be expected to be significant less than that associated with piling. As described above, DEB modelling of any realistic scenario for piling, including a foraging pause of 6 hours, would not result in any significant changes to individual or population level demographic rates. As such, a much shorter, in most case single pulse events, which would be expected to on affect foraging behaviour over a period of at most minutes, is very unlikely to alter survival or reproductive rate to the extent to alter harbour porpoise population trajectory.

Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, whilst underwater noise generated from UXO clearance may result in a startle reaction, this only lasts for the period of activities, with harbour porpoise returning to areas from which they were displaced within 1 – 2 days (Brandt et al. 2016). Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the underwater arising from UXO clearance activities, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) under any realistic scenario and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with underwater noise from UXO clearance is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from UXO will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.4 Underwater Noise from Other Noise Sources (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from other noise sources.

5.3.2.4.1 PTS and TTS

Noise sources resulting from non-piling works during construction, including from cable laying, dredging (backhoe and suction), drilling, rock placement, trenching and pre-construction surveys (UWN Modelling report (Appendix 6)), are considered non-impulsive and continuous noise. The impact ranges for these noise sources, considering the worst-case assessment scenario of constant operation for 24 hours, are detailed in Tables 5-4 and 5-5 of Appendix 6 (UWN modelling report).

The PTS-onset ranges with non-impulsive weighted SEL_{cum} thresholds are shorter than 100m for harbour porpoises for all non-piling construction noise, assuming the harbour porpoise as fleeing animals. The TTS-onset ranges for harbour porpoises are less than 100m for most non-piling construction noise, except for noise from rock placement which is 990m. It is also important to note that the model resolution is such that impact ranges below 100m cannot be reliably determined and as such, the maximum values of <100m will likely to less than this, further reducing the scale of effect.

Continuous noise from cable installation is generally considered to be unlikely to impact marine mammals due to its non-impulsive nature generated, and the fact that it is likely to be dominated by vessels from which installation takes place (Genesis, 2011). In general, support and supply and large-sized vessels tend to emit low frequency noise with the majority of energy below 1kHz (OSPAR, 2009). The energy of continuous and broadband noise from dredging activities is mainly below 1kHz, although its frequency and sound pressure level can vary considerably depending on the equipment used, activity carried out, and the environmental characteristics (Todd et al., 2015). Dredging will potentially be required for seabed preparation works for foundations, and the installations of export cable and inter-array cable for the proposed development. The frequency range of dredging has been described to vary between 45Hz and 7kHz (Evans, 1990; Thompson et al., 2009; Verboom, 2014). For noise from cable trenching activities, its sound levels at the North Hoyle OWF were generally low (10 to 15dB above background levels) with frequencies ranging from 100Hz to 1kHz (Nedwell et al. 2003). Noise generated by rock placement works is largely unknown. The study of rock placement activities in the Yell Sound in Shetland found that relevant noise produced low frequency tonal noise from the machinery, and that the measured noise levels were within background levels (Nedwell and Howell 2004). MMO (2015) provided information on the acoustic properties of anthropogenic continuous noise sources including from dredging, drilling and shipping.

The hearing sensitivity of harbour porpoises below 1kHz is relatively poor, considering its estimated region of peak sensitivity ranges between 12 kHz and 140kHz (Southall et al., 2019). It is thus expected that any auditory injury or TTS arising from such low frequency sounds would result in little impact to porpoise vital rates due to the nature of the notch of PTS or TTS which may be caused by these sound sources (as discussed for piling and UXO). As described above for piling and UXO, harbour porpoise presence is known to be reduced around vessels of the type to be used for these construction activities (e.g. Benhemma-Le Gall et al., 2023).

Pre-construction surveys of the type used for offshore wind projects tend to comprise smaller scale equipment than that typically used for oil and gas surveys, with airguns not used for offshore wind surveys. The specifications of the survey equipment are described in section 4.6 above. These systems produce highly directional sound sources, with the energy directed towards the seabed (to maximum the returns and therefore data collection), which inherently results in very limited horizontal propagation of the sound source. Crocker and Fratantonio (2016) identified that typical spherical or conical spreading models do not accurately capture this highly constrained nature of propagation and have provided realistic impact ranges arising from this type of equipment. CSA (2020) presented modelled impact ranges for a wide range of geophysical survey equipment, based on the National Marine Fisheries Service (NMFS) User Spreadsheet (NMFS, 2018) which has been designed to account for the limited horizontal propagation of sound from these systems, with impacts to “Level A” harassment thresholds (equivalent to PTS-onset values from Southall et al. 2019), all less than 36.5m (Table 4 of CSA 2020). It is expected that the displacement effect of the vessels used for these works will be greater than any potential PTS effect (e.g. Benhemma-Le Gall et al., 2023). Whilst modelling is not available for TTS effects, the extremely small scale of PTS ranges suggests that TTS effects will be constrained to a similarly small area and likely fully within that arising from the vessel itself.

Mitigation
Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to harbour porpoise, prior to any surveys commencing, MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Technical discussion of these specific measures is presented within the MMMP (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible. These measures will also reduce the number of individuals at risk of TTS.

Assessment
As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, PTS and TTS, being an impact to the hearing of individuals, is not considered to present a barrier to the use of the site and as such will not affect harbour porpoise access to the site. Regarding Target 2, PTS and TTS will affect individuals within or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the underwater noise associated with the onset of PTS or TTS is not predicted to result in any “significant negative impacts” on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI
Therefore, it is concluded that PTS and TTS arising from other construction activities and geophysical surveys will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.4.2 Behavioural Disturbance
For dredging activities, short term avoidance of harbour porpoises was observed at distances ranging from 400m to 5km (Diederichs et al., 2010; Verboom, 2014; McQueen et al., 2020), with 5km range being a very conservative estimate. As disturbance from dredging has been observed as short-term, localised and intermittent behavioural effect on a small proportion of harbour porpoises, the magnitude of behavioural disturbance from dredging is considered low (adverse) under Project Option 1.

There is a lack of information on disturbance impact from other non-piling construction activities including cable laying, trenching, drilling and rock placement. Non-piling activities including acoustic surveys, dredging, rock trenching, pipe laying and rock placement for an underwater pipeline in northwest Ireland were observed to result in a decline in harbour porpoise detections (Todd et al. 2020). There was however a considerable increase in detections after these activities, suggesting that any impact arising from these works was localised and temporary. It is expected that any disturbance impact will be primarily dominated by the underwater noise/presence of vessels for non-piling works. The nature of the offshore works are that they are often mobile and intermittent, therefore the impact within any specific area will be very temporally limited.

Considering the potential for disturbance from geophysical surveys, CSA (2020) present Level B harassment ranges for a wide range of geophysical survey equipment, which in the absence of more widely accepted behavioural thresholds (Southall et al. 2019), remain the best available option for considering the range within which behavioural effects could occur. Based on the modelling undertaken to inform the assessment therein, CSA (2020) identifies that Level B harassment ranges could extent up to 141m from the source. As noted above, this is expected to be fully contained within the potential disturbance/displacement effect of the vessels associated with the project (e.g. Benhemma-Le Gall et al., 2023).

While harbour porpoises may be sensitive to disturbance from non-piling activities, construction period monitoring at the Beatrice and Moray East offshore wind farms indicated that porpoises were able to compensate for short-term local displacement arising from non-piling works (e.g. Benhemma-Le Gall et al. 2023), and thus it is not expected that individual vital rates would be impacted (Booth and Heinis, 2019).

Assessment
As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, whilst underwater noise generated from other construction activities may result in temporary exclusion of harbour porpoise from an area, this only lasts for the period of activities, with harbour porpoise quickly returning to areas from which they were displaced (Todd et al. 2020). Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the underwater noise arising from other construction activities, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with underwater noise from UXO clearance is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI
Therefore, it is concluded that disturbance arising from other construction activities and geophysical surveys will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.5 Vessel Disturbance (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during construction phase due to the greater number of vessels and vessel movements associated with that Option.

Vessel disturbance to marine mammals is driven by a combination of underwater vessel noise and the physical presence of the vessel itself (e.g. Pirotta et al. 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Vessel noise from medium to large-sized construction vessels (travelling at a speed of 10knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SEL_{cum} dB re 1µPa@1m (rms), and in the frequency range of 10 to 100Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from support and supply vessels (50 to 100 m in length) are expected to have broadband source levels ranging165 to 180 dB re 1µPa, with the majority of energy below 1kHz (OSPAR, 2009). Large commercial vessels (>100 m in length) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of harbour porpoise is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for harbour porpoises as per Appendix 6 (UWN modelling report).

Several offshore studies focused on harbour porpoise behaviour around offshore wind farm construction sites have observed an increase in vessel presence to correlate with a decrease in harbour porpoise presence (Brandt et al. 2018, Benhemma-Le Gall et al. 2021). Benhemma-Le Gall et al. (2021) identified that there was no significant change of harbour porpoise occurrence detected beyond 4km of construction vessels. Therefore, whilst, as noted above, there will be a localised reduction of harbour porpoise density from the presence of vessels, this is spatially limited and is not considered to significantly constrain the foraging option for this species.

The land-based behavioural study of harbour porpoises in relation to vessel traffic in Swansea Bay by Oakley et al. (2017) identified 26% of observed negative porpoise behaviour (e.g. porpoises moving away from sound source or exhibited prolonged diving) being significantly correlated with the number of vessels present. Behavioural reactions observed in the study by Wisniewska et al. (2018) include increased fluking, interrupted foraging and change to vocalisations.

This displacement can also be exemplified by surveying for harbour porpoise in an area with variable levels of vessel traffic, where reductions in local density suggest disturbance from the surrounding area. The study by Oakley et al. (2017) also revealed that vessel type was another important factor determining how porpoises react to vessel presence. Smaller motorised boats (e.g. jet ski, speed boat, small fishing vessels) were associated with more negative behaviours than larger cargo ships. As vessels associated with offshore wind farm construction are typically larger and move slower than these types of small, motorised vessels, it would therefore be anticipated that the behavioural response would not be as severe.

While porpoise may be sensitive to disturbance from other vessels, 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. As the area surrounding the proposed development already experiences high levels of vessel traffic the introduction of additional vessels during construction is not a novel impact for marine mammals present in the area.

5.3.2.5.1 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, whilst vessel presence may result in temporary exclusion of harbour porpoise from a localised area around each vessel or vessel cluster, the mobile nature of the animals is such that they will continue to use these areas after the vessel had moved away. Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the presence of vessels, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with vessel presence is not predicted to result in any “significant negative impacts” on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.5.2 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.6 Vessel collision risk (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during construction phase.

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in Irish waters that vessel collisions is an important source of mortality. The Cetacean Strandings Investigation Programme (CSIP) in UK documents the annual number of reported strandings, and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and Irish waters.

The harbour porpoise is deemed to be of low vulnerability to vessel collision, as this 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.

A maximum of 66 construction vessels may be on site simultaneously with a maximum total of 2386 return vessel trips to port throughout the construction phase. The majority of construction associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port.

5.3.2.6.1 Mitigation

All vessel traffic will move along predictable routes around the offshore development area, and to/from port to the array area and ECC site over the short periods of offshore construction activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Construction vessels are not expected to travel through the SAC outside of the project footprint and will take defined routes. It is thus not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

5.3.2.6.2 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, risk of vessel collision is limited to the footprint of the vessel and as such does not present a barrier to use of the site. Regarding Target 2, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.6.3 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel collision risk will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.7 Changes to Prey (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during construction phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During construction activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes or auditory masking in fish.

The key prey species of harbour porpoises in Ireland include small cod (*Trisopterus* spp.), various Clupeoids, whiting, herring, and cephalopods (Berrow and Rogan 1995, Hernandez-Milian et al. 2011), Most of these fish species are categorised as Group 3 fish receptors (Popper et al., 2014) which possess a swim bladder involving in hearing. While there may be certain species that comprise the main part of porpoise's diet, harbour porpoises are considered to be generalist feeders and are thus not reliant on a single prey species.

As for harbour porpoise, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general construction activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with piling or UXO clearance may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.2.7.1 Assessment

As identified above, the relevant CO for the SAC for impacts to prey is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2).

Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised changes to the fish communities that the harbour porpoise depend on which may occur from the construction of the project are not expected to result in the deterioration of the prey resource on which harbour porpoise depend. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.7.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.8 Accidental Pollution (Construction)

Activities relating to the construction of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regard to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.2.8.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration. Assessment

The relevant CO for the SAC for impacts from accidental pollution is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the harbour porpoise depend on or cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community within the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.8.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.9 Vessel Disturbance (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during operational and maintenance phase.

As for construction, the area surrounding the proposed development already experiences a high amount of vessel traffic and therefore, the introduction of additional vessels during the operational phase of the proposed development is not a novel impact for marine mammals present in the area.

As described above for the construction phase, while porpoise may be sensitive to disturbance from other vessels, 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. As the area surrounding the proposed development already experiences high levels of vessel traffic the introduction of additional vessels during construction is not a novel impact for marine mammals present in the area.

5.3.2.9.1 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2).

Regarding Target 1, whilst vessel presence may result in temporary exclusion of harbour porpoise from a localised area around each vessel or vessel cluster, the mobile nature of the animals is such that they will continue to use these areas after the vessel had moved away. Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the presence of vessels, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with vessel presence is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.9.2 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.10 Vessel Collision Risk (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during operational and maintenance phase.

A maximum of 21 operational and maintenance vessels may be on site simultaneously with a maximum total of 1018 return vessel trips to port throughout the operational and maintenance phase, less than the predicted number for construction phase. The majority of operational phase vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the operational and maintenance phase.

5.3.2.10.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of individual maintenance activities, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Operations and maintenance vessels are not expected to travel through the SAC outside of the project footprint and defined routes. It is thus not expected that the level of vessel activity during operation would cause an increase in the risk of mortality from collisions.

5.3.2.10.2 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, risk of vessel collision is limited to the footprint of the vessel and as such does not present a barrier to use of the site. Regarding Target 2, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.10.3 Conclusion of AEoI

Therefore, it is concluded that changes to vessel collision risk will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.11 Changes to Prey (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during operational and maintenance phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During operational and maintenance activities, there is the potential for impacts upon these fish species, including long-term loss of habitat, direct physical damage and disturbance, temporary increase in SSC and sediment deposition, increased hard substrate and structural complexity, EMF, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, changes to supporting seabed habitats arising from effects on physical processes.

The key prey species of harbour porpoises include small cod (*Trisopterus* spp.), various Clupeoids, whiting, herring, and cephalopods (Berrow and Rogan 1995, Hernandez-Milian et al. 2011). While there may be certain species that comprise the main part of porpoise's diet, harbour porpoises are considered to be generalist feeders and are thus not reliant on a single prey species.

As for harbour porpoise, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general maintenance activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). No studies have specifically examined fish responses to operational noise from turbines, however, MMO (2014) noted that there was no apparent change to fish populations within operational wind farms from the baseline.

5.3.2.11.1 Assessment

As identified above, the relevant CO for the SAC for impacts to prey is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), any small-scale, localised changes to the fish communities that the harbour porpoise depend on which may occur from maintenance of the project are not expected to result in the deterioration of the prey resource on which harbour porpoise depend. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.11.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.12 Accidental Pollution (Operation)

Operationally, the accidental release of pollutants is limited to oils and fluids contained within the WTGs and vessels. The potential for full inventory release from a turbine is considered extremely remote and would occur as a slow release, which would be almost undetectable and immediately dispersed, limiting the potential interactions between pollutants and marine mammals. For these reasons, localised, temporary changes to water quality will not have a significant impact on marine mammals.

5.3.2.12.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.2.12.2 Assessment

The relevant CO for the SAC for impacts from accidental pollution is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2).

Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the harbour porpoise depend on or cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community within the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.12.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.13 Underwater Noise (Decommissioning)

5.3.2.13.1 PTS, TTS and behavioural disturbance

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from decommissioning.

It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. The final method chosen will be dependent on the technologies available at the time of decommissioning. The indicative methodology includes:

- Deployment of ROV's or divers to inspect each pile footing and reinstate lifting attachments if necessary.
- Mobilise a jack-up barge/heavy lifting vessel.
- Remove any scour protection or sediment obstructing the cutting process. It may be necessary to dig a small trench around the foundation.
- Deploy crane hooks from the decommissioning vessel and attach to the lift points.
- Cut piles at just below seabed level.
- Inspect seabed for debris and remove debris where necessary.
- Considering the current technology, the decommissioned components are likely to be transported back to shore by lifting onto a jack-up or heavy lift vessels, freighter, barge, or by buoyant tow.
- Transport all components to an onshore site where they will be processed for reuse/recycling/disposal; and
- Inspect seabed and remove debris.

The exact methods to be adopting during decommissioning are yet to be confirmed, therefore the respective impact level of PTS, TTS and disturbance of decommissioning activities cannot be accurately determined at this time. However, it is predicted that the scale of impacts, both spatial and temporal, from decommissioning activities will be no greater than those from construction. Specifically, any PTS or TTS which may occur from decommissioning activities would likely occur in a region of the hearing ability of harbour porpoise which would not affect their fitness. Additionally, any disturbance would be no greater than that for construction, and likely over a reduced timescale, and as such the DEB modelling confirming no change to demographic parameters in the harbour porpoise population remains valid.

Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to harbour porpoise, prior to the start of any decommissioning activities involving high noise levels, ADDs may be used to displace harbour porpoise outwith the potential PTS-onset range. Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. MMOs and PAM may be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible.

These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, PTS, TTS and disturbance are not considered to present a permanent barrier to the use of the site and as such will not affect harbour porpoise access to the site. Regarding Target 2, PTS, TTS and disturbance will affect individuals within or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the underwater noise associated decommissioning is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that underwater noise from decommissioning will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.14 Vessel Disturbance (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during decommissioning phase.

Vessel noise from medium to large-sized vessels (travelling at a speed of 10knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SELcum dB re 1µPa@1m (rms), and in the frequency range of 10 to 100Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from decommissioning vessels is expected to produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of harbour porpoise is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for harbour porpoises as per Appendix 6 (UWN modelling report).

As described above for the construction phase, while porpoise may be sensitive to disturbance from other vessels, 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. As the area surrounding the proposed development already experiences high levels of vessel traffic the introduction of additional vessels during construction is not a novel impact for marine mammals present in the area.

5.3.2.14.1 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, whilst vessel presence may result in temporary exclusion of harbour porpoise from a localised area around each vessel or vessel cluster, the mobile nature of the animals is such that they will continue to use these areas after the vessel had moved away. Therefore, in line with NPWS (2013), it is not considered to present a barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site. Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the presence of vessels, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site.

Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with vessel presence is not predicted to result in any “significant negative impacts” on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.14.2 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.15 Vessel Collision Risk (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during decommissioning phase.

The majority of decommissioning phase vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the decommissioning phase.

5.3.2.15.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of individual activities, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Decommissioning vessels are not expected to travel through the SAC outside of the project footprint and defined routes. It is thus not expected that the level of vessel activity during decommissioning would cause an increase in the risk of mortality from collisions.

5.3.2.15.2 Assessment

As identified above, the COs for the SAC are to maintain species range within the site (Target 1) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Regarding Target 1, risk of vessel collision is limited to the footprint of the vessel and as such does not present a barrier to use of the site. Regarding Target 2, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any “significant negative impacts” on individuals and/or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Project Option 1 or Project Option 2.

5.3.2.15.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.16 Changes to Prey (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during decommissioning phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During decommissioning activities, there is the potential for impacts upon these fish species, including temporary physical loss and disturbance, temporary increases in SSC and sediment deposition and seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration.

The key prey species of harbour porpoises in Ireland include small cod (Trisopterus spp.), various Clupeoids, whiting, herring, and cephalopods (shellfish) (Berrow and Rogan 1995, Hernandez-Milian et al. 2011). While there may be certain species that comprise the main part of porpoise’s diet, harbour porpoises are considered to be generalist feeders and are thus not reliant on a single prey species.

As for harbour porpoise, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general decommissioning activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with decommissioning may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.2.16.1 Assessment

As identified above, the relevant CO for the SAC for impacts to prey is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), any small-scale, localised changes to the fish communities that the harbour porpoise depend on which may occur from decommissioning of the project are not expected to result in the deterioration of the prey resource on which harbour porpoise depend. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Option 1 or Option 2.

5.3.2.16.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.2.17 Accidental Pollution (Decomissioning)

Activities relating to the decommissioning of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the maintenance of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short-term duration.

5.3.2.17.1 Assessment

The relevant CO for the SAC for impacts from accidental pollution is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the harbour porpoise depend on or cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community within the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from either Option 1 or Option 2.

5.3.2.17.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC for Project Option 1 or Project Option 2.

5.3.3 Lambay Island SAC

5.3.3.1 Qualifying Interests and Conservation Objectives

The Lambay Island SAC lies 14.8km from the array and 15.7km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phocoena).*
- Grey seal (*Halichoerus grypus*); and

- Harbour seal (*Phoca vitulina*)

Harbour and grey seals are present within Lambay Island SAC throughout the year during all aspects of their annual life cycle which includes breeding, moulting, non-breeding, foraging and resting (NPWS, 2014).

Lambay Island SAC supports the principal breeding colony of grey seal on the east coast of Ireland, with minimum population estimate of between 196 and 252 grey seals of all ages (NPWS, 2014). The majority of grey seal pupping occurs among the bays largely along the south coast of the island, when breeding occurs from August to December approximately, followed by moulting from around December to April along the west and southwest coast. Grey seals are found to rest along the northeast and northwest coast of the island (NPWS, 2014). Whilst there have been several studies on grey seal abundance and distribution at haul outs around Ireland, there is a lack of at-sea density estimates due to a lack of telemetry data in Irish waters. Telemetry data for grey seals tagged in UK waters have shown connectivity between the east coast of the Republic of Ireland, Northern Ireland, Wales, Southwest England and the southwest coast of Scotland (Carter et al. 2020). The average at-sea density of grey seals within the Lambay Island SAC is estimated to be 0.17 seals/km^2 (extracted from Carter et al., 2020). The density estimate was obtained by averaging the values of the two density grid cells overlapping most with the Lambay Island SAC, provided all of the overlapped grid cells cover less than 50% area of the SAC.

The SAC also contains regionally significant numbers of harbour seal, of which up to 47 individuals have been counted at the site (NPWS, 2014). Harbour seal breeding occurs at site, primarily along the west coast of the island, from around May to July, followed by moulting from August to September approximately along the west and south coast of the island. Harbour seals are found to rest along the west coast of the island (NPWS, 2014). The average at-sea density of harbour seals within the Lambay Island SAC is estimated to be 0.19 seals/km^2 (extracted from Carter et al., 2022). Harbour seal densities in the vicinity of the Lambay Island SAC are higher compared to the Irish Sea in general, with density estimates for the cells adjacent to this SAC reaching up to 0.25 harbour seals/km^2 (extracted from Carter et al. 2022).

As a precautionary approach, the highest abundance/count and density estimates of grey seals and harbour seals, which are 252 grey seals and 0.17 grey seals/km^2, and 47 harbour seals and 0.19 harbour seals/km^2 respectively, were considered for further impact assessment.

5.3.3.1.1 Conservation Objectives of Qualifying Interests

The COs to maintain the favourable conservation condition of grey seal and harbour seal are defined by the following attributes and targets:

- Target 1: Access to suitable habitats: Species range within the site should not be restricted by artificial barriers to site use.
- Target 2: Breeding behaviour: the breeding sites should be maintained in a natural condition.
- Target 3: Moulting behaviour: the moult haul out sites should be maintained in a natural condition.
- Target 4: Resting behaviour: the resting haul out sites should be maintained in a natural condition; and
- Target 5: Disturbance: human activities should occur at levels that do not adversely affect the grey/harbour seal population at the site.

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Lambay Island SAC. Whilst no detailed conservation objectives are available for harbour porpoise at Lambay Island SAC, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.3.2 Assessment for Harbour Porpoise

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC (section 5.3.2), which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As the assessment for Rockabill to Dalkey Island SAC concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distanc of Lambay Island SAC to the proposed development and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts, on the harbour porpoise QI for this site from the proposed development.

The assessment provided below is therefore for grey seal and harbour seal only.

5.3.3.3 Underwater Noise from Piling (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from piling.

5.3.3.3.1 PTS and TTS

For the monopile foundation scenario (WTG and OSP foundations for Project Options 1 and 2) involving the installation of 12.5-m piles with a maximum blow energy of 5,500 kJ, PTS onset in grey seals and harbour seals is predicted to occur out to less than 100 m at all modelling locations. TTS onset in grey seals and harbour seals is predicted to occur out to 46km at the SW modelling location as the worst-case scenario.

While for the pin-pile foundation scenario (WTG foundations for Project Option 2, and OSG foundations for Project Options 1 and 2) with a maximum blow energy of 3,000 kJ, sequential installation of two 6-m piles instead of single pin-pile would be considered as per precautionary approach. PTS onset in grey seals and harbour seals is predicted to occur out to less than 100 m at all modelling locations. Cumulative TTS onset is predicted to occur out to 36km at the SW modelling location as the worst-case scenario.

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

The project site lies within the typical foraging range for both grey and harbour seals and as detailed above, the density estimates in the vicinity of the proposed development are higher compared to the Irish Sea in general given the proximity to Lambay Island SAC.

Whilst seals use sound both in air and water for communication, predator avoidance, and reproductive interactions, they are less dependent on hearing for foraging than cetaceans (Deecke et al., 2002). The seals also have very well developed tactile sensory systems used for foraging, but in certain conditions they may also listen to sounds produced by vocalising fish whilst hunting for prey (Dehnhardt et al., 2001; Shulte-Pelkum et al., 2007). Whilst PTS is a permanent effect which cannot be recovered from, experts concluded at an expert elicitation workshop in 2018 that PTS was not likely to significantly affect the survival and reproduction rates of seal species, when assuming an impact of 6dB PTS in the range of 2 to 10kHz (Booth and Heinis, 2018).

A study by Kastelein et al., (2013) measuring recovery rates of harbour seals following the exposure to a piling noise source of 193 dB re 1 μPa2s ($_{SELcum}$) over six hours, found that TTS recovery to pre-exposure baseline level was estimated to occur within 72 minutes following the noise exposure. Similar recovery rates were documented in SEAMARCO (2011), which reported seals recover rapidly (around 30 minutes) under small TTS values. For TTS there are no thresholds to determine a biologically significant effect from TTS-onset. Given the temporary and reversible nature of TTS, it is anticipated that any animals experiencing this temporary shift in hearing would recover at a point in time, after they are no longer exposed to elevated noise levels. This includes as the animal moving further away from the sound source, which is the most likely response of an animal exposed to TTS noise levels. Therefore, the range of behavioural response (e.g. disturbance and/or displacement) is likely to overlap with potential TTS onset ranges, and animals exposed to such sound sources are likely to actively avoid TTS by moving away from the sound source.

Mitigation
Notwithstanding the low risk of PTS resulting in any biologically relevant effects to grey or harbour seal, prior to the start of piling activities, acoustic deterrent devices (ADDs) will be used to displace marine mammals outwith the potential PTS-onset range (as predicted by updated noise modelling which will be undertaken closer to the point of construction). Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. The piling scenario used to inform the updated modelling will include any refinements to the maximum hammer energy required and confirm that soft-start which will be used to encourage marine mammals to flee prior to the use of the highest hammer energies (and consequently greatest received sound). Marine mammal observers (MMOs) and passive acoustic monitoring (PAM) will be used together, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the piling specific Marine Mammal Mitigation Protocol (MMMP) (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual grey or harbour seal to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment
As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). PTS and TTS will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, the onset of PTS or TTS is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI
Therefore, it is concluded that PTS and TTS arising from piling will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.3.2 Behavioural disturbance
As determined in Table 5.8, Project Option 1 has a greatest potential for adverse effects on marine mammals than Project Option 2 for behavioural disturbance.

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

A study of tagged harbour seals in The Wash has shown that they are displaced from the vicinity of piles during pile-driving activities. Russell et al. (2016) showed that seal abundance was significantly reduced within an area of radius of 25km from a pile, during piling activities, with a 19 to 83% decline in abundance during pile-driving compared to during breaks in piling.

The duration of the displacement was only short-term as seals returned to non-piling distributions within two hours after the end of a pile-driving event. Unlike harbour porpoise, both harbour and grey seals store energy in a thick layer of blubber, which means that they are more tolerant of periods of fasting when hauled out and resting between foraging trips, and when hauled out during the breeding and moulting periods. Therefore, they are unlikely to be particularly sensitive to short-term displacement from foraging grounds during periods of active piling, even if alternative foraging areas weren't available.

At an expert elicitation workshop in 2018 (Booth et al. 2019), experts agreed upon the most likely potential consequences of a six-hour period of zero energy intake.

This was under the assumption that disturbance (from exposure to low frequency broadband pulsed noise e.g. pile-driving, airgun pulses) resulted in missed foraging opportunities. In general, it was agreed that harbour seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores.

There are still limited data on grey seal behavioural responses to pile driving. The key dataset on this topic is presented in Aarts et al. (2018) where 20 grey seals were tagged in the Wadden Sea to record their responses to pile driving at two offshore wind farms: Luchterduinen in 2014 and Gemini in 2015. The grey seals showed varying responses to the pile driving, including no response, altered surfacing and diving behaviour, and changes in swimming direction. The most common reaction was a decline in descent speed and a reduction in bottom time, which suggests a change in behaviour from foraging to horizontal movement. The distances at which seals responded varied significantly; in one instance a grey seal showed responses at 45km from the pile location, while other grey seals showed no response within 12km. Differences in responses could be attributed to differences in hearing sensitivity between individuals, differences in sound transmission with environmental conditions, or the behaviour and motivation for the seal to be in the area. The telemetry data also showed that seals returned to the pile driving area after pile driving ceased.

The disturbance expert elicitation workshop in 2018 (Booth et al. 2019) concluded that grey seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores and that the survival of 'weaned of the year' animals and fertility were determined to be most sensitive parameters to disturbance (i.e. reduced energy intake). However, in general, experts agreed that grey seals would be much more robust than harbour seals to the effects of disturbance due to their larger energy stores and more generalist and adaptable foraging strategies. It was agreed that grey seals would require moderate-high levels of repeated disturbance before there was any effect on fertility rates to reduce fertility.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). Disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise from piling is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from underwater noise generated by piling will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.4 Underwater Noise from UXO Clearance (Construction)

As determined in Table 5.8, both Project Options have an equal potential for adverse effects on marine mammals when considering underwater noise impact from UXO clearance.

5.3.3.4.1 PTS and TTS

Most of the acoustic energy produced by a high-order detonation is below a few hundred Hz, decreasing on average by about SEL 10dB per decade above 100Hz, and there is a pronounced drop-off in energy levels above ~5-10kHz (von Benda-Beckmann et al. 2015, Salomons et al. 2021). Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for seals (Southall et al. 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates.

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water.

Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

As UXO detonation is defined as a single pulse, both the weighted SELss criteria and the unweighted SPLpeak criteria from Southall et al. (2019) were considered (see Tables 5-10 and 5-11 of Appendix 6: UWN Modelling Report). The maximum PTS impact range of UXO clearance on grey seal and harbour seal is 2.5km when considering the unweighted SPLpeak criteria, with maximum equivalent charge weights of 525kg (and an additional donor weight of 0.5kg to initiate detonation) and the adoption of 'high-order' clearance technique. The maximum TTS-onset impact range for UXO clearance on seals is 19km when considering the weighted SELss criteria, with maximum equivalent charge weights of 525kg (plus donor charge) for a high-order detonation.

There is no spatial overlap between this SAC and the PTS-onset impact ranges of UXO clearance works. Only the detonation of the largest expected UXO charge size would lead to an overlap of the TTS-onset ranges from UXO clearance. The modelling of UXO clearance impact range assumed no degradation of the UXO, and no smoothing of the impact wave over distances (meaning injurious potential of the impact wave at greater distances would be lower than just a reduction in absolute noise level, Cudahy and Parvin (2001)), which is a very precautionary approach. As such, the true impact ranges are likely to much smaller.

Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to grey or harbour seals, prior to any detonations, ADDs will be used to displace marine mammals outwith the potential PTS-onset range. NAS (e.g. bubble curtains) may also be used where high-order clearance techniques are required to be used for UXO, where the predicted impact ranges may exceed that over which ADDs are considered to be effective. The PTS-onset range for each detonation will be determined by the charge size of each specific UXO, as confirmed by an explosive ordnance (EOD) expert following target investigations. The ADD duration will be set to displace marine mammals from within the PTS-onset area for each UXO, rather than applying a fixed value for all UXO irrespective of charge size. MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aids in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the UXO specific MMMP (Appendix 10). Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual grey or harbour seal to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). PTS and TTS will affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, the onset of PTS or TTS is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from UXO clearance will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.4.2 Behavioural disturbance

As discussed within Southall et al. (2019), internationally recognised noise thresholds for determining behavioural impacts are not currently available. There is also currently no guidance available from NPWS or IWDG on the methodology to assess behavioural disturbance from UXO clearance.

Various methods could be used to determine whether there is a potential overlap from the noise from UXO clearance at the project with the SAC, including use of TTS-onset thresholds as a proxy, or a fixed 26km range (e.g. JNCC, NE, DEARA, 2020), with both options resulting in a spatial overlap with the SAC, although the 26km range was specifically focused on harbour porpoise and so may not be relevant to seals. However, considering the highly mobile nature of seal species, and the one-off pulses generated by UXO clearance, a qualitative assessment of the potential risk of behavioural effects is considered more appropriate rather than a specific spatial assessment.

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

It is noted in the JNCC (2020) guidance that, although UXO detonation is considered a loud underwater noise source, "...a one-off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement...". Whilst detonations will usually be undertaken as part of a campaign and, therefore, there may result in multiple detonations over several days (JNCC 2020), each detonation will be of a short-term duration. Therefore, it is not expected that disturbance from a single UXO detonation would result in any significant impacts, and that disturbance from a single noise event would not be sufficient to result in any changes to the vital rates of individuals.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). Disturbance will affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise generated by UXO clearance is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from UXO clearance will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.5 Underwater Noise from Other Noise Sources (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from other noise sources.

5.3.3.5.1 PTS and TTS

Noise sources resulting from non-piling works during construction, including from cable lying, dredging (backhoe/suction), drilling, rock placement, trenching, are considered non-impulsive and continuous noise. The impact ranges for these noise sources, considering the worst-case assessment scenario of constant operation for 24 hours, are detailed in Tables 5-4 and 5-5 of Appendix 6 (UWN modelling report).

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

The PTS- and TTS-onset ranges with non-impulsive weighted SELcum thresholds are shorter than 100 m for grey seals and harbour seals for all non-piling construction noise, assuming the seal species as fleeing animals. It is therefore expected that no grey seals and harbour seals within the SAC will be impacted by auditory injury (PTS) or TTS from non-piling noise.

Continuous noise from cable installation is generally considered to be unlikely to impact marine mammals due to its non-impulsive nature generated, and the fact that it is likely to be dominated by vessels from which installation takes place (Genesis, 2011). In general, support and supply and large-sized vessels tend to emit low frequency noise with the majority of energy below 1kHz (OSPAR, 2009). The energy of continuous and broadband noise from dredging activities is mainly below 1kHz, although its frequency and sound pressure level can vary considerably depending on the equipment used, activity carried out, and the environmental characteristics (Todd et al., 2015). Dredging will potentially be required for seabed preparation works for foundations, and the installations of export cable and inter-array cable for the proposed development. The frequency range of dredging has been described to vary between 45Hz and 7kHz (Evans, 1990; Thompson et al., 2009; Verboom, 2014). For noise from cable trenching activities, its sound levels at the North Hoyle OWF were generally low (10 to 15dB above background levels) with frequencies ranging from 100Hz to 1kHz (Nedwell et al. 2003). Noise generated by rock placement works is largely unknown. The study of rock placement activities in the Yell Sound in Shetland found that relevant noise produced low frequency tonal noise from the machinery, and that the measured noise levels were within background levels (Nedwell and Howell 2004). MMO (2015) provided information on the acoustic properties of anthropogenic continuous noise sources including from dredging, drilling and shipping.

The hearing sensitivity of grey and harbour seals below 1kHz is relatively poor, considering its estimated region of peak sensitivity ranges between 12 kHz and 140kHz (Southall et al., 2019). It is thus expected that any auditory injury or TTS arising from such low frequency sounds would result in little impact to porpoise vital rates due to the nature of the notch of PTS or TTS which may be caused by these sound sources (as discussed for piling and UXO). As described above for piling and UXO, harbour porpoise presence is known to be reduced around vessels of the type to be used for these construction activities (e.g. Benhemma-Le Gall et al., 2023).

Pre-construction surveys of the type used for offshore wind projects tend to comprise smaller scale equipment than that typically used for oil and gas surveys, with airguns not used for offshore wind surveys. The specifications of the survey equipment are described in section 4.6 above. These equipment are highly directional sound sources, with the energy directed towards the seabed (to maximum the returns and therefore data collection), which inherently results in very limited horizontal propagation of the sound source. Crocker and Fratantonio (2016) identified that typical spherical or conical spreading models do not accurately capture this highly constrained nature of propagation and have provided realistic impact ranges arising from this type of equipment. CSA (2020) presented modelled impact ranges for a wide range of geophysical survey equipment, based on the National Marine Fisheries Service (NMFS) User Spreadsheet (NMFS, 2018) which has been designed to account for the limited horizontal propagation of sound from these systems, with impacts to “Level A” harassment thresholds (equivalent to PTS-onset values from Southall et al. 2019), all less than 36.5m (Table 4 of CSA 2020). It is expected that the displacement effect of the vessels used for these works will be greater than any potential PTS effect (e.g. Benhemma-Le Gall et al., 2023). Whilst modelling is not available for TTS effects, the extremely small scale of PTS ranges suggests that TTS effects will be constrained to a similarly small area and likely fully within that arising from the vessel itself.

Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to grey or harbour seal, prior to any surveys commencing, MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Technical discussion of these specific measures is presented within the MMMP (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual seal to negligible. These measures will also reduce the number of individuals at risk of TTS.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). PTS and TTS will affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site.

Specifically, the onset of PTS or TTS is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from other installation activities will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.5.2 Behavioural Disturbance

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise will not be audible to seals when on land.

According to the generic threshold of pinniped behavioural avoidance (140dB re 1µPa SPL) (Southall et al., 2007), modelling results demonstrated that behavioural disturbance from dredging activity could extend out from 400m to 5km from the activity site (McQueen et al., 2020). Disturbance from dredging on seal species is however predicted to be short-term irrespective of disturbance distance.

There is a lack of information on disturbance impact from other non-piling construction activities including cable laying, trenching, drilling and rock placement. It is expected that any disturbance impact will be primarily dominated by the underwater noise from vessels for non-piling works. The nature of the offshore works are that they are often mobile and intermittent, therefore the impact within any specific area will be very temporally limited.

Considering the potential for disturbance from geophysical surveys, CSA (2020) present Level B harassment ranges for a wide range of geophysical survey equipment, which in the absence of more widely accepted behavioural thresholds (Southall et al. 2019), remain the best available option for considering the range within which behavioural effects could occur. Based on the modelling undertaken to inform the assessment therein, CSA (2020) identifies that Level B harassment ranges could extent up to 141m from the source. As noted above, this is expected to be fully contained within the potential disturbance/displacement effect of the vessels associated with the project (e.g. Benhemma-Le Gall et al., 2023).

While seal species may be sensitive to disturbance from non-piling activities, there is evidence that the displacement is largely limited to periods of piling activity (Russell et al., 2016). Russell et al. (2016) identified that seal usage close to the construction site of the Lincs Wind Farm was not significantly lower during breaks between pile driving, and that seals were found to return to the impacted area within two hours of piling.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). Disturbance will affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise generated by other construction activities is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from other construction activities will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.6 *Vessel Disturbance (Construction)*

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during construction phase.

Disturbance to marine mammals by vessels is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta et al., 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Both grey seals and harbour seals are known to haul out around Lambay Island (NPWS, 2014). There is potential for disturbance to both seal species at haul out sites from the construction of the proposed development as a result of the transit and physical presence of vessels. The COs for Lambay Island include Target 1 which states species range within the site should not be restricted by artificial barriers, this target relates to permanent exclusion and does not refer to short term or temporary restriction or access or range and as such is not considered further here. Targets 2, 3 and 4 relate to breeding sites, moult haul out sites and resting haul out sites respectively and are considered here in relation to disturbance of these sites within the SAC. Target 5 relates to maintaining human activities below levels which would adversely affect the grey and harbour seal community at the site.

Vessel disturbance studies on seals have demonstrated flushing of seals (Jansen et al., 2015) in response to large vessels occurring out as far as 1km (Young et al., 2014), and alertness in seals at haul outs increased when small vessels are within 300m of a seal (Henry and Hammill, 2001). It is noted that the SAC is situated more than 1km away from the ECC and the landfall site at Bremore. The area surrounding the proposed development already experiences high levels of vessel traffic, especially for fishing vessels and cargo ships between 2017 and 2022 (EMODnet, 2011), indicating that the background ambient noise level could be high at baseline level. The introduction of additional vessels during construction is therefore estimated to have minimal disturbance effect on grey seals and harbour seals present around the SAC.

In addition, both grey seals and harbour seals are able to shift to an energetically conservative state in response to vessel disturbance. Bishop et al. (2015) identified that breeding male grey seals exhibited similar activity (behavioural) budgets for non-active behaviours, i.e. resting or alert, versus active behaviours, i.e. aggressions or attempted copulation, regardless of the presence or absence of human activities and associated disturbance. Bishop et al. (2015) reported that the lack of behavioural response to disturbance was likely driven by increased mating success of males who maintained their position amongst groups of females for the longest time because of reduced energy expenditure, irrespective of human activity and associated disturbance. Although Bishop et al. (2015) classified alert behaviour under the non-active category, Karpovich et al. (2015) however indicated that increased alertness or vigilance could increase stress levels and heart rate of seals of both sexes and thereby their energy expenditure. Should vessel disturbance to grey seals be repetitive, this could potentially lead to increased heart rates over time and a prolonged energetic cost.

Karpovich et al. (2015) previously used heart rate responses to assess incidental and experimental vessel disturbance on harbour seals. Hauled out seals were found to exhibit vigilance behaviour (indicated as head-lift) and experience an increase of 4 bpm vessel-1 as a result of incidental vessel traffic, and an increase of 5 bpm vessel-1 from experimental vessel disturbance. The recorded increases in heart rate could be a result of seals switching from a sleeping to awake status as vessels approached or could indicate that the seals were experiencing stress responses. The heart rate of hauled out seals was also found to continue to increase with each additional approaching vessel, unless the seals entered the water following the approach of vessels, indicating that they were shifting to an energetically conservative state in water in response to the disturbance event. The effect of increased heart rate was still noticeable in seals in their following haul out, indicating that the disturbance had a prolonged energetic cost for harbour seals (Karpovich et al., 2015).

Vessel noise from medium to large-sized construction vessels (travelling at a speed of 10 knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SELcum dB re 1µPa@1m (rms), and in the frequency range of 10 to 100Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from support and supply vessels (50 to 100m in length) are expected to have broadband source levels ranging from 165 to 180dB re 1µPa, with the majority of energy below 1kHz (OSPAR, 2009).

Large commercial vessels (>100m in length) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of grey seals and harbour seals is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for grey seals and harbour seals as per Appendix 6 (UWN modelling report). It is therefore expected that no grey seals or harbour seals associated with this SAC will be impacted by PTS or TTS from vessel noise.

Vessel disturbance studies on seals have demonstrated avoidance behaviour in seals in response to large vessels occurring out as far as 1km (Young et al., 2014), whilst alertness in seals at haul-out site increased when small vessels are within 300 m from the animal (Henry and Hammill, 2001). As a precautionary approach, a 1-km disturbance range of vessel presence has been used to determine the scale of effect. It is estimated that no grey seal or harbour seal associated with this SAC will experience disturbance from vessel presence as the 1-km impact range does not overlap with the SAC. It should also be noted that vessel disturbance impact is of local spatial extent, short-term and reversible in nature, and is thus unlikely to cause impacts to alter seal population trajectory.

The study of grey seal pups in the Celtic Sea and adult grey seals in the English Channel (Trigg et al., 2020) found that no animal was exposed to cumulative shipping noise exceeding the PTS thresholds as per the threshold criteria by Southall et al. (2019). The study of vessel traffic and marine mammal presence conducted on the northwest of Ireland found insignificant decrease in grey seal sightings under increased vessel activity in the surrounding area (Anderwald et al., 2013), and the authors identified that relationships between seal sightings and vessel numbers were weaker than those with environmental variables such as sea state. The telemetry study of 28 harbour seals in UK by Jones et al. (2017) identified high exposure levels of seals to shipping noise. Twenty individuals might have experienced TTS due to cumulative sound exposure levels exceeding the TTS-threshold (as per the threshold criteria by Southall et al. (2007)) for pinnipeds under continuous underwater noise (183dB re 1μPa^2). Despite the spatial overlap with the vessel disturbance (especially within 50km from the coast) and high cumulative sound levels, there was no evidence of reduced harbour seal presence as a result of vessel traffic (Jones et al., 2017).

5.3.3.6.1 Mitigation

As part of the construction phase of the project, vessel management procedures will be implemented, which will comprise use of established vessel routes for construction vessels to follow which avoid the haul out sites, as well as the application of rules that vessel master’s must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary as set out within the EVMP.

5.3.3.6.2 Assessment

Regarding Targets 2 – 4, with vessel routing measures implemented to ensure vessels engaged in the regular construction phase will not transit near the known haul out sites, there are not expected to be any impacts to hauled out individuals. Specifically, it is not expected that there will be any significant interference or disturbance of breeding, moulting or resting behaviour with the vessels routed away from the haul out sites. There will also be no impact to the habitats used during breeding, moulting or resting. Regarding Target 5, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise from piling is not predicted to result in any “significant negative impacts” on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.6.3 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.7 Vessel Collision Risk (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during construction phase.

Impacts from collision risk are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Collision risk will not result in a permanent barrier to site use and will not affect seals when on land.

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in Irish waters that vessel collision is an important source of mortality. The CSIP in UK documents the annual number of reported strandings and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and Irish waters.

The grey seal and harbour seal are deemed to be of low vulnerability to vessel collision, given this 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 animals.

The majority of construction associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port.

5.3.3.7.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore construction activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Construction vessels are not expected to travel through the SAC outside of the project footprint and defined routes. It is thus not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

5.3.3.7.2 Assessment

Regarding Target 5, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the community at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any “significant negative impacts” on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the grey seal or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.7.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.8 Changes to Prey (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during construction phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During construction activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes, or auditory masking in fish.

The key prey species of grey seals include lamprey, eels, herring, salmonids, haddock, pollock, saithe, whiting, blue whiting, Norway pout, poor cod, bib, rockling, ling, hake, perch, scad, wrasse, sandeel, goby, mackerel, flounder, dab, sole, witch, halibut, and squid species (Gosch et al. 2014).

While there may be certain species that comprise the main part of porpoise diet, grey seals in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species. The key prey species consumed by harbour seals in Ireland include Atlantic herring, sprat, salmonids, pollock, haddock, saithe, whiting, poor cod, rockling, ling, wrasse, Atlantic horse mackerel, sandeel, dragonet, red bandfish, plaice, flounder, sole, squid and octopus species (Kavanagh et al. 2010). Similar to grey seals, harbour seals in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

As for grey and harbour seals, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general construction activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with construction may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.3.8.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 5 which is to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, any small-scale, localised changes to the fish communities that the Qis depend on which may occur from construction of the project are not expected to result in the deterioration of the prey resource on which grey seal and harbour seal Qis depend. It is considered that there will be no impact to the grey seal and harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.8.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.9 Accidental Pollution (Construction)

Activities relating to the construction of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.3.9.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.3.9.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 5 to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the grey seal or harbour seal depend on or cause death or injury to individuals to an extent that may ultimately affect the grey seal or harbour seal populations within the site. It is considered that there will be no impact to the grey seal or harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.9.3 Conclusion

Therefore, it is concluded that accidental pollution will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.10 Vessel Disturbance (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during operational and maintenance phase.

As detailed above for the construction phase, seals are relatively insensitive to disturbance from vessels, particularly when at sea. When hauled out, vessel approaches can result in raised alertness or increases in heat-rate (Bishop et al. 2015; Karpovich et al. 2015); whilst it is unclear what the long-term consequences of repeated vessel disturbance would be, it can be assumed that repeated disturbance may result in reductions in individual fitness through and increase in energy expenditure. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for grey seals and harbour seals as per Appendix 6 (UWN modelling report).

5.3.3.10.1 Mitigation

As part of the construction phase of the project, vessel management procedures will be implemented, which will comprise use of established vessel routes for construction vessels to follow which avoid the haul out sites, as well as the application of rules that vessel master’s must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary as set out within the EVMP.

5.3.3.10.2 Assessment

Regarding Targets 2 – 4, with vessel routing measures implemented to ensure vessels engaged in the regular operational and maintenance phase will not transit near the known haul out sites, there are not expected to be any impacts to hauled out individuals. Specifically, it is not expected that there will be any significant interference or disturbance of breeding, moulting or resting behaviour with the vessels routed away from the haul out sites. There will also be no impact to the habitats used during breeding, moulting or resting. Regarding Target 5, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise from piling is not predicted to result in any “significant negative impacts” on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.10.3 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel disturbance will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.11 Vessel Collision Risk (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during operational and maintenance phase.

Impacts from collision risk are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Collision risk will not result in a permanent barrier to site use and will not affect seals when on land.

As discussed above for the construction phase, the grey seal and harbour seal are deemed to be of low vulnerability to vessel collision, given this 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 animals.

The majority of operational and maintenance associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the operational and maintenance phase, in addition to those transiting between the site and the port.

5.3.3.11.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore operational and maintenance activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Operational and maintenance vessels are not expected to travel through the SAC outside of the project footprint and defined routes. It is thus not expected that the level of vessel activity during the operational and maintenance phase would cause an increase in the risk of mortality from collisions.

5.3.3.11.2 Assessment

Regarding Target 5, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the populations at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any" significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the grey seal or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.11.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.12 Changes to Prey (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during operational and maintenance phase.

As described above for the construction phase, seals are generalist feeders and so not reliant on single prey species. As for grey and harbour seals, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general operational and maintenance activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with operations and maintenance may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.3.12.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 5 which is to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from operations and maintenance of the project are not expected to result in the deterioration of the prey resource on which grey seal and harbour seal QIs depend. It is considered that there will be no impact to the grey seal and harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.12.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.13 Accidental Pollution (Operation)

Activities relating to the operations and maintenance of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the operation and maintenance of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.3.13.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.3.13.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 5 to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the grey seal or harbour seal depend on or cause death or injury to individuals to an extent that may ultimately affect the grey seal or harbour seal populations within the site. It is considered that there will be no impact to the grey seal or harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.13.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.14 Underwater Noise (Decommissioning)

5.3.3.14.1 PTS, TTS and behavioural disturbance

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from decommissioning.

It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. The final method chosen will be dependent on the technologies available at the time of decommissioning. The indicative methodology includes:

- Deployment of ROV's or divers to inspect each pile footing and reinstate lifting attachments if necessary.
- Mobilise a jack-up barge/heavy lifting vessel.
- Remove any scour protection or sediment obstructing the cutting process. It may be necessary to dig a small trench around the foundation.
- Deploy crane hooks from the decommissioning vessel and attach to the lift points.
- Cut piles at just below seabed level.
- Inspect seabed for debris and remove debris where necessary.
- Considering the current technology, the decommissioned components are likely to be transported back to shore by lifting onto a jack-up or heavy lift vessels, freighter, barge, or by buoyant tow.
- Transport all components to an onshore site where they will be processed for reuse/recycling/disposal; and
- Inspect seabed and remove debris.

The exact methods to be adopting during decommissioning are yet to be confirmed, therefore the respective impact level of PTS, TTS and disturbance of decommissioning activities cannot be accurately determined at this time. However, it is predicted that the scale of impacts, both spatial and temporal, from decommissioning activities will be no greater than those from construction.

Specifically, any PTS or TTS which may occur from decommissioning activities would likely occur in a region of the hearing ability of grey and harbour seals which would not affect their fitness. Additionally, any disturbance would be no greater than that for construction, and likely over a reduced timescale.

Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to grey and harbour seal, prior to the start of any decommissioning activities involving high noise levels, ADDs may be used to displace grey and harbour seal outwith the potential PTS-onset range. Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. MMOs and PAM may be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual grey and harbour seal to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). PTS, TTS and disturbance will affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, the onset of PTS or TTS and behavioural disturbance is not predicted to result in any “significant negative impacts” on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that underwater noise from decommissioning will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.15 Vessel Disturbance (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during decommissioning phase.

As detailed above for the construction phase, seals are relatively insensitive to disturbance from vessels, particularly when at sea. When hauled out, vessel approaches can result in raised alertness or increases in heat-rate (Bishop et al. 2015; Karpovich et al. 2015); whilst it is unclear what the long-term consequences of repeated vessel disturbance would be, it can be assumed that repeated disturbance may result in reductions in individual fitness through and increase in energy expenditure. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for grey seals and harbour seals as per Appendix 6 (UWN modelling report).

5.3.3.15.1 Mitigation

As part of the decommissioning phase of the project, vessel management procedures will be implemented, which will comprise defined routes for decommissioning vessels to follow which avoid the haul out sites, as well as the application of rules that vessel master’s must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary.

5.3.3.15.2 Assessment

Regarding Targets 2 – 4, with vessel routing measures implemented to ensure vessels engaged in the regular operational and maintenance phase will not transit near the known haul out sites, there are not expected to be any impacts to hauled out individuals. Specifically, it is not expected that there will be any significant interference or disturbance of breeding, moulting or resting behaviour with the vessels routed away from the haul out sites.

There will also be no impact to the habitats used during breeding, moulting or resting. Regarding Target 5, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise from piling is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.15.3 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from vessel disturbance will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.16 Vessel Collision Risk (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during decommissioning phase.

Impacts from collision risk are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Collision risk will not result in a permanent barrier to site use and will not affect seals when on land.

As discussed above for the construction phase, grey seal and harbour seal are deemed to be of low vulnerability to vessel collision, given this 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 animals.

The majority of decommissioning associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the decommissioning phase, in addition to those transiting between the site and the port.

5.3.3.16.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore decommissioning activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Decommissioning vessels are not expected to travel through the SAC outside of the project footprint and defined routes. It is thus not expected that the level of vessel activity during the decommissioning phase would cause an increase in the risk of mortality from collisions.

5.3.3.16.2 Assessment

Regarding Target 5, individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the populations at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the grey seal or harbour seal QIs of the SAC from either Project Option 1 or Project Option 2.

5.3.3.16.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.3.17 Changes to Prey (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during the decommissioning phase.

As described above for the construction phase, seals are generalist feeders and so not reliant on single prey species. As for grey and harbour seals, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general decommissioning activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with decommissioning may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.3.17.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 5 which is to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from decommissioning of the project are not expected to result in the deterioration of the prey resource on which grey seal and harbour seal QIs depend. It is considered that there will be no impact to the grey seal and harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.17.2 Conclusion of AEoI

Therefore, it is concluded that changes to prey will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2 for Project Option 1 or Project Option 2.

5.3.3.18 Accidental Pollution (Decommissioning)

Activities relating to the decommissioning of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the decommissioning of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.3.18.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the decommissioning of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short-term duration.

5.3.3.18.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 5 to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the grey seal or harbour seal depend on or cause death or injury to individuals to an extent that may ultimately affect the grey seal or harbour seal populations within the site. It is considered that there will be no impact to the grey seal or harbour seal QI of the SAC from either Project Option 1 or Project Option 2.

5.3.3.18.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC for Project Option 1 or Project Option 2.

5.3.4 Hook Head SAC

The Hook Head SAC lies 199km from the array and 205km from the ECC and is designated for the following marine mammal species:

- Bottlenose dolphin (*Tursiops truncatus*); and
- Harbour porpoise (*Phocoena phococena*)

5.3.4.1.1 Qualifying Interests and Conservation Objectives
In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding bottlenose dolphin and harbour porpoise at Hook Head SAC. No detailed conservation objectives are available for bottlenose dolphin and harbour porpoise at Hook Head SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise and bottlenose dolphin have been assumed, based on the conservation objectives for these species from Rockabill to Dalkey Island SAC and Lower River Shannon SAC respectively:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use.

- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise or bottlenose dolphin community at the site; and

- Target 3: Habitat use: critical areas: Critical areas, representing habitat used preferentially by bottlenose dolphin, should be maintained in a natural condition.

5.3.4.2 Assessment for Harbour porpoise
Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.5 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of this site from the proposed development.

The assessment provided below is therefore for bottlenose dolphin only.

5.3.4.3 Underwater Noise from Piling (Construction)
As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from piling.

5.3.4.3.1 PTS and TTS
For the monopile foundation scenario (WTG and OSP foundations for Project Option 1) involving the installation of 12.5m piles with a maximum blow energy of 5,500kJ, the modelled outputs show that PTS onset in bottlenose dolphins is predicted to occur out to less than 100m at all modelling locations. TTS onset in bottlenose dolphins is predicted to occur out to less than 100m at all modelling locations. It is expected that no bottlenose dolphin within the SAC will be impacted by auditory injury (PTS) or TTS from piling noise under the monopile foundation scenario.

While for the pin-pile foundation scenario (WTG foundations for Project Option 2,) with a maximum blow energy of 3,000kJ, sequential installation of two 6-m piles instead of single pin-pile would be considered as per precautionary approach. PTS onset in bottlenose dolphins is predicted to occur out to less than 100m at all modelling locations. TTS onset in bottlenose dolphins is predicted to occur out to less than 100 m at all modelling locations as the worst-case scenario. It is expected that no bottlenose dolphin within the SAC will be impacted by auditory injury (PTS) or TTS from piling noise under the scenario of sequential installation of two pin-piles.

Impacts from underwater noise are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

During the expert elicitation workshop in 2018 funded by BEIS, experts concluded that the probability of PTS significantly affecting the survival and reproduction rates of bottlenose dolphins was very low, when considering an impact of a 6dB PTS in the frequency range between 2 and 10kHz (Booth and Heinis, 2018).

Although no species-specific TTS recovery rate is available for bottlenose dolphins, there is no evidence to suggest that dolphin recovery will be significantly different from harbour porpoise recovery rates. The dolphins are expected to be able to recover from hearing shift when no longer exposed under piling noise.

Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to bottlenose dolphins, prior to the start of piling activities, ADDs will be used to displace marine mammals out with the potential PTS-onset range (as predicted by updated noise modelling which will be undertaken closer to the point of construction). Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. The piling scenario used to inform the updated modelling will include any refinements to the maximum hammer energy required and confirm that soft-start which will be used to encourage marine mammals to flee prior to the use of the highest hammer energies (and consequently greatest received sound). MMOs and PAM will be used together, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the piling specific MMMP (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). PTS and TTS may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site. Specifically, the onset of PTS or TTS is not predicted to result in any “significant negative impacts” on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Option 1 or Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from piling will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.3.2 Behavioural Disturbance

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering behavioural disturbance during the construction phase.

It is expected that no bottlenose dolphin within the SAC will be impacted by behavioural disturbance from piling noise due to the distance of the project from the SAC; therefore, effects will be limited to mobile individuals foraging outside of the SAC.

Impacts from underwater noise are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Bottlenose dolphins were shown to be displaced from an area as a result of the noise produced by offshore construction activities (Pirotta et al. 2013). It was however observed near the project site of the Nigg Energy Park in Cromarty Firth that dolphins were not excluded from the vicinity of the piling site (Graham et al., 2017). New et al. (2013) stated that bottlenose dolphins have some capability to adapt their behaviour and tolerate certain levels of temporary disturbance as a result of increased acoustic disturbance.

It is expected that dolphins are able to adapt their behaviour, with the impact most likely to result in potential changes in calf survival (but not expected to affect adult survival or future reproductive rates) from an extended period of disturbance, according to expert opinion from the expert elicitation workshop for iPCoD (Harwood et al. 2014).

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). Disturbance will affect individuals within and/or associated with the site, however, this is not predicted to result in any significant change to individual fitness or reproductive success due to the short periods of disturbance and low likelihood that the same individuals would be repeatedly disturbed and so is therefore not expected to impact on the population at the site. Specifically, disturbance from underwater noise from piling is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from piling will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.4 Underwater Noise from UXO Clearance (Construction)

As determined in Table 5.8, Project Option 1 and Project Option 2 are considered to have an equal potential for adverse effects on marine mammals when considering underwater noise impact from UXO clearance.

5.3.4.4.1 PTS and TTS

Most of the acoustic energy produced by a high-order detonation is below a few hundred Hz, decreasing on average by about SEL 10dB per decade above 100Hz, and there is a pronounced drop-off in energy levels above ~5-10kHz (von Benda-Beckmann et al. 2015, Salomons et al. 2021). Therefore, the primary acoustic energy from a high-order UXO detonation is below the region of greatest sensitivity for bottlenose dolphin (Southall et al. 2019). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates (as described above for Rockabill to Dalkey Island SAC).

Impacts from underwater noise are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

As UXO detonation is defined as a single pulse, both the weighted SEL_{ss} criteria and the unweighted SPL_{peak} criteria from Southall et al. (2019) were considered (see Tables 5-10 and 5-11 of Appendix 6: UWN Modelling Report). The maximum PTS impact range of UXO clearance on bottlenose dolphins is estimated to be 0.73km, when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of 'high-order' clearance technique. While for TTS, the maximum impact range of UXO clearance on bottlenose dolphins is estimated to be 1.3km when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525kg (and an additional donor weight of 0.5kg to initiate detonation) and the adoption of 'high-order' clearance technique. There is no spatial overlap between this SAC and the PTS- or TTS-onset impact ranges of UXO clearance works on bottlenose dolphins.

Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to bottlenose dolphins, prior to any UXO detonations, ADDs will be used to displace marine mammals outwith the potential PTS-onset range. NAS (e.g. bubble curtains) may also be used where high-order clearance techniques are required to be used for UXO, where the predicted impact ranges may exceed that over which ADDs are considered to be effective. The PTS-onset range for each detonation will be determined by the charge size of each specific UXO, as confirmed by an EOD expert following target investigations.

The ADD duration will be set to displace marine mammals from within the PTS-onset area for each UXO, rather than applying a fixed value for all UXO irrespective of charge size. MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aids in the validation of the efficacy of the ADD. Technical discussion of these specific measures is presented within the MMMP (Appendix 10). Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphins to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). PTS and TTS may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site. Specifically, PTS and TTS-onset is not predicted to result in any "significant negative impacts" on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from UXO clearance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.4.2 Behavioural Disturbance

As discussed within Southall et al. (2019), internationally recognised noise thresholds for determining behavioural impacts are not currently available. There is also currently no guidance available from NPWS or IWDG on the methodology to assess behavioural disturbance from UXO clearance. Various methods could be used to determine whether there is a potential overlap from the noise from UXO clearance at the project with the SAC, including use of TTS-onset thresholds as a proxy, or a fixed 26km range (e.g. JNCC, NE, DEARA, 2020), with both options resulting in a spatial overlap with the SAC, although the 26km range was specifically focused on harbour porpoise and so may not be relevant to bottlenose dolphin. However, considering the highly mobile nature of bottlenose dolphin, and the one-off pulses generated by UXO clearance, a qualitative assessment of the potential risk of behavioural effects is considered more appropriate rather than a specific spatial assessment. There is currently no guidance available from NPWS or IWDG on the methodology to assess behavioural disturbance from UXO clearance. As such, TTS-onset could be adopted as a proxy for behavioural disturbance, which is regarded as a very precautionary approach.

With an impact range of 1.3km for bottlenose dolphins considering the maximum charge weights of 525kg (plus donor weight of 0.5kg) and the adoption of 'high-order' clearance technique, there is no spatial overlap between this SAC and the TTS (as a proxy of behavioural disturbance) impact ranges of UXO clearance works on bottlenose dolphins.

It is noted in the JNCC guidance (2020) that UXO detonation is not expected to cause widespread and prolonged displacement of marine mammals. The impact is short-term and intermittent in nature with temporary behavioural effect, which is very unlikely to alter survival or reproductive rate to the extent to alter the population trajectory of bottlenose dolphins.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). Disturbance may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site.

Specifically, disturbance is not predicted to result in any “significant negative impacts” on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from UXO clearance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.5 Underwater Noise from Other Noise Sources (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from other noise sources.

5.3.4.5.1 PTS and TTS

Noise sources resulting from non-piling works during construction, including from cable lying, dredging (backhoe/suction), drilling, rock placement and trenching, are considered non-impulsive and continuous noise. The impact ranges for these noise sources, considering the worst-case assessment scenario of constant operation for 24 hours, are detailed in Tables 5-4 and 5-5 of Appendix 6 (UWN modelling report).

Impacts from underwater noise are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

The PTS- and TTS-onset ranges with non-impulsive weighted SEL_{cum} thresholds are shorter than 100 m for bottlenose dolphins for all non-piling construction noise, assuming the dolphins as fleeing animals. It is therefore expected that no bottlenose dolphin within the SAC will be impacted by auditory injury (PTS) or TTS from non-piling noise. In view of the far distances between the SAC and the estimated impact ranges arising from the aforementioned works, the impact magnitude of PTS and TTS has both been assessed as negligible under Project Option 1.

Continuous noise from cable installation is generally considered to be unlikely to impact marine mammals due to its non-impulsive nature generated, and the fact that it is likely to be dominated by vessels from which installation takes place (Genesis, 2011). In general, support and supply and large-sized vessels tend to emit low frequency noise with the majority of energy below 1kHz (OSPAR, 2009). The energy of continuous and broadband noise from dredging activities is mainly below 1kHz, although its frequency and sound pressure level can vary considerably depending on the equipment used, activity carried out, and the environmental characteristics (Todd et al., 2015). Dredging will potentially be required for seabed preparation works for foundations, and the installations of export cable and inter-array cable for the proposed development. The frequency range of dredging has been described to vary between 45Hz and 7kHz (Evans, 1990; Thompson et al., 2009; Verboom, 2014). For noise from cable trenching activities, its sound levels at the North Hoyle OWF were generally low (10 to 15dB above background levels) with frequencies ranging from 100Hz to 1kHz (Nedwell et al. 2003). Noise generated by rock placement works is largely unknown. The study of rock placement activities in the Yell Sound in Shetland found that relevant noise produced low frequency tonal noise from the machinery, and that the measured noise levels were within background levels (Nedwell and Howell 2004). MMO (2015) provided information on the acoustic properties of anthropogenic continuous noise sources including from dredging, drilling and shipping.

Pre-construction surveys of the type used for offshore wind projects tend to comprise smaller scale equipment than that typically used for oil and gas surveys, with airguns not used for offshore wind surveys. The specifications of the survey equipment are described in section 4.1 above. This equipment are highly directional sound sources, with the energy directed towards the seabed (to maximum the returns and therefore data collection), which inherently results in very limited horizontal propagation of the sound source. Crocker and Fratantonio (2016) identified that typical spherical or conical spreading models do not accurately capture this highly constrained nature of propagation and have provided realistic impact ranges arising from this type of equipment.

CSA (2020) presented modelled impact ranges for a wide range of geophysical survey equipment, based on the National Marine Fisheries Service (NMFS) User Spreadsheet (NMFS, 2018) which has been designed to account for the limited horizontal propagation of sound from these system, with impacts to "Level A" harassment thresholds (equivalent to PTS-onset values from Southall et al. 2019), all less than 36.5m (Table 4 of CSA 2020). It is expected that the displacement effect of the vessels used for these works will be greater than any potential PTS effect (e.g. Benhemma-Le Gall et al., 2023). Whilst modelling is not available for TTS effects, the extremely small scale of PTS ranges suggests that TTS effects will be constrained to a similarly small area and likely fully within that arising from the vessel itself.

Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to bottlenose dolphin, prior to any surveys commencing, MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Technical discussion of these specific measures is presented within the MMMP (Appendix 10). The MMMP would be updated prior to construction to ensure it captures the final project parameters. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin to negligible. These measures will also reduce the number of individuals at risk of TTS.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). PTS and TTS may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site. Specifically, PTS and TTS-onset is not predicted to result in any "significant negative impacts" on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from other construction activities will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.5.2 Behavioural Disturbance

Impacts from underwater noise are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Pirotta et al. (2013) identified an association of increased dredging activity with reduction in bottlenose dolphin presence at Aberdeen Harbour, with an absence of bottlenose dolphin occurrence for five weeks following the commencement of dredge operations. Based on the results of the same study (Pirotta et al., 2013), subsequent studies by Pirotta et al. (2015a) assumed that dredging activities excluded dolphins from a 1km radius from the dredging site. According to the generic threshold of pinniped behavioural avoidance (140dB re 1μPa SPL) (Southall et al., 2007), modelling results demonstrated that behavioural disturbance from dredging activity could extend out to 400m to 5km from the activity site (McQueen et al., 2020).

There is a lack of information on disturbance impact from other non-piling construction activities including cable laying, trenching, drilling and rock placement. It is expected that any disturbance impact will be primarily dominated by the underwater noise from vessels for non-piling works. The nature of the offshore works are that they are often mobile and intermittent, therefore the impact within any specific area will be very temporally limited.

Considering the potential for disturbance from geophysical surveys, CSA (2020) present Level B harassment ranges for a wide range of geophysical survey equipment, which in the absence of more widely accepted behavioural thresholds (Southall et al. 2019), remain the best available option for considering the range within which behavioural effects could occur. Based on the modelling undertaken to inform the assessment therein, CSA (2020) identifies that Level B harassment ranges could extent up to 141m from the source. As noted above, this is expected to be fully contained within the potential disturbance/displacement effect of the vessels associated with the project (e.g. Benhemma-Le Gall et al., 2023).

Bottlenose dolphin responses to dredging varied between sites in an urbanised estuary in Western Australia (Marley et al., 2017b). No bottlenose dolphin was sighted during the days of backhoe dredging at one monitoring site, while dolphins remained using the other sites of the study. Culloch et al. (2016) revealed that construction-related activities (including dredging) conducted in northwest Ireland did not result in any evidence of a negative impact to common dolphins.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). Disturbance will affect individuals within and/or associated with the site, however, this is not predicted to result in any significant change to individual fitness or reproductive success due to the short periods of disturbance and low likelihood that the same individuals would be repeatedly disturbed and so is therefore not expected to impact on the population at the site. Specifically, disturbance from underwater noise from construction activities is not predicted to result in any “significant negative impacts” on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that disturbance arising from other construction activities will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.6 Vessel Disturbance (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during construction phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Disturbance to marine mammals by vessels is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta et al., 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Vessel noise from medium to large-sized vessels (travelling at a speed of 10knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SEL_{cum} dB re 1µPa@1m (rms), and in the frequency range of 10 to 100 Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from construction vessels is expected to produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of bottlenose dolphins is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for bottlenose dolphins as per Appendix 6 (UWN modelling report). It is therefore expected that no bottlenose dolphins associated with this SAC will be impacted by PTS or TTS from vessel noise during construction. It should also be noted that vessel disturbance impact is predicted to be of local spatial extent, short-term and reversible, and is unlikely to cause impacts in which bottlenose dolphin population trajectory would be altered.

Vessel disturbance have been found to elicit a variety of responses in bottlenose dolphins including reduced foraging (but varied responses, Pirotta et al., 2013; Pirotta et al., 2015; Piwez, 2019), reduced or unchanged dolphin densities (Lusseau, 2006; Marley et al., 2017), increased swimming speeds (Marley et al., 2017; Piwez, 2019), reduced resting and socialising behaviour (Constantine et al., 2004; Marley et al., 2017) and changes in acoustic behaviour (La Manna et al., 2013; Marley et al., 2017). Tolerance to vessel disturbance within certain levels in bottlenose dolphins was however also observed in previous studies (La Manna et al., 2013; Pirotta et al., 2013). The degree to which an animal will be disturbed is likely linked to their baseline level of tolerance (Bejder et al., 2009). New et al. (2013) simulated the complex interactions of the coastal population of bottlenose dolphins in the Moray Firth by increasing vessel traffic from 70 to 470 vessels a year to simulate the potential increase in vessel operations from proposed offshore development. It was found that the increase was not anticipated to result in biologically significant disturbance as bottlenose dolphins were able to compensate for their immediate behavioural responses and, therefore their vital rates remained unaffected (New et al., 2013).

Mitigation

As part of the construction phase of the project, vessel management procedures will be implemented, which will comprise use of established vessel routes for construction vessels to follow which avoid the haul out sites, as well as the application of rules that vessel master's must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary as set out within the EVMP.

Assessment

Regarding Target 2, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from vessels is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that vessel disturbance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.7 Vessel Collision Risk (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during construction phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in Irish waters that vessel collision is an important source of mortality. The CSIP in UK documents the annual number of reported strandings and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and Irish waters.

Mitigation

The majority of construction associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port.

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore construction activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Construction vessels are not expected to travel through the SAC. It is thus not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

Assessment

Regarding Target 2, individuals associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the population at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.8 Changes to Prey (Construction)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during construction phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During construction activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes or auditory masking in fish.

Bottlenose dolphin in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

As for bottlenose dolphin, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general construction activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with construction may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

Assessment

The relevant CO for the SAC for impacts to prey is Target 2 which is to maintain human activities below levels which would adversely affect the populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from construction of the project are not expected to result in the deterioration of the prey resource on which bottlenose dolphin depend. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that changes in prey will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.9 Accidental Pollution (Construction)

Activities relating to the construction of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.4.9.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.4.9.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 2 to maintain human activities below levels which would adversely affect the populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the bottlenose dolphin depend on or cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population within the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.9.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.10 Vessel Disturbance (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during the operations and maintenance phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Disturbance to marine mammals by vessels is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta et al., 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Vessel noise from medium to large-sized vessels (travelling at a speed of 10 knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SEL_{cum} dB re 1µPa@1m (rms), and in the frequency range of 10 to 100 Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from operations and maintenance vessels is expected to produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of bottlenose dolphins is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for bottlenose dolphins as per Appendix 6 (UWN modelling report).

It is therefore expected that no bottlenose dolphins associated with this SAC will be impacted by PTS or TTS from vessel noise during operations and maintenance. It should also be noted that vessel disturbance impact is predicted to be of local spatial extent, short-term and reversible, and is unlikely to cause impacts in which bottlenose dolphin population trajectory would be altered.

Vessel disturbance have been found to elicit a variety of responses in bottlenose dolphins including reduced foraging (but varied responses, Pirotta et al., 2013; Pirotta et al., 2015; Piwez, 2019), reduced or unchanged dolphin densities (Lusseau, 2006; Marley et al., 2017), increased swimming speeds (Marley et al., 2017; Piwez, 2019), reduced resting and socialising behaviour (Constantine et al., 2004; Marley et al., 2017) and changes in acoustic behaviour (La Manna et al., 2013; Marley et al., 2017). Tolerance to vessel disturbance within certain levels in bottlenose dolphins was however also observed in previous studies (La Manna et al., 2013; Pirotta et al., 2013). The degree to which an animal will be disturbed is likely linked to their baseline level of tolerance (Bejder et al., 2009). New et al. (2013) simulated the complex interactions of the coastal population of bottlenose dolphins in the Moray Firth by increasing vessel traffic from 70 to 470 vessels a year to simulate the potential increase in vessel operations from proposed offshore development. It was found that the increase was not anticipated to result in biologically significant disturbance as bottlenose dolphins were able to compensate for their immediate behavioural responses and, therefore their vital rates remained unaffected (New et al., 2013).

5.3.4.10.1 Mitigation

As part of the construction phase of the project, vessel management procedures will be implemented, which will comprise use of established vessel routes for construction vessels to follow which avoid the haul out sites, as well as the application of rules that vessel master's must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary as set out within the EVMP.

5.3.4.10.2 Assessment

Regarding Target 2, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from vessels is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.10.3 Conclusion of AEoI

Therefore, it is concluded that vessel disturbance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.11 Vessel Collision Risk (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during the operations and maintenance phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in Irish waters that vessel collision is an important source of mortality. The CSIP in UK documents the annual number of reported strandings, and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and Irish waters.

5.3.4.11.1 Mitigation

The majority of operations and maintenance associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the operations and maintenance phase, in addition to those transiting between the site and the port. All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore construction activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Operations and maintenance vessels are not expected to travel through the SAC. It is thus not expected that the level of vessel activity during operations and maintenance would cause an increase in the risk of mortality from collisions.

5.3.4.11.2 Assessment

Regarding Target 2, individuals associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the population at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.11.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.12 Changes to Prey (Operation)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during the operations and maintenance phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During operations and maintenance activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes or auditory masking in fish.

Bottlenose dolphin in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

As for bottlenose dolphin, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general operations and maintenance activities. Whilst disturbance associated with underwater noise/vessels may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.4.12.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 2 which is to maintain human activities below levels which would adversely affect the populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from operations and maintenance of the project are not expected to result in the deterioration of the prey resource on which bottlenose dolphin depend. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.12.2 Conclusion of AEoI

Therefore, it is concluded that changes in prey will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.13 Accidental Pollution (Operation)

Activities relating to the operations and maintenance of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the operations and maintenance of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.4.13.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.4.13.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 2 to maintain human activities below levels which would adversely affect the populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the bottlenose dolphin depend on or cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population within the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.13.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.14 Underwater Noise (Decommissioning)

5.3.4.14.1 PTS, TTS and Behavioural Disturbance

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering underwater noise impact from decommissioning.

It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. The final method chosen will be dependent on the technologies available at the time of decommissioning. The indicative methodology includes:

- Deployment of ROV's or divers to inspect each pile footing and reinstate lifting attachments if necessary.
- Mobilise a jack-up barge/heavy lifting vessel.
- Remove any scour protection or sediment obstructing the cutting process. It may be necessary to dig a small trench around the foundation.
- Deploy crane hooks from the decommissioning vessel and attach to the lift points.
- Cut piles at just below seabed level.
- Inspect seabed for debris and remove debris where necessary.
- Considering the current technology, the decommissioned components are likely to be transported back to shore by lifting onto a jack-up or heavy lift vessels, freighter, barge, or by buoyant tow.
- Transport all components to an onshore site where they will be processed for reuse/recycling/disposal; and
- Inspect seabed and remove debris.

The exact methods to be adopting during decommissioning are yet to be confirmed, therefore the respective impact level of PTS, TTS and disturbance of decommissioning activities cannot be accurately determined at this time. However, it is predicted that the scale of impacts, both spatial and temporal, from decommissioning activities will be no greater than those from construction. Specifically, any PTS or TTS which may occur from decommissioning activities would likely occur in a region of the hearing ability of bottlenose dolphin which would not affect their fitness. Additionally, any disturbance would be no greater than that for construction, and likely over a reduced timescale.

Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to bottlenose dolphin, prior to the start of any decommissioning activities involving high noise levels, ADDs may be used to displace bottlenose dolphin outwith the potential PTS-onset range. Bubble curtains may also be used in the event the predicted impact ranges may exceed that over which ADDs are considered to be effective. MMOs and PAM may be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone, which also aid in the validation of the efficacy of the ADD. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). PTS, TTS and disturbance may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the population at the site. Specifically, underwater noise associated with decommissioning is not predicted to result in any "significant negative impacts" on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

Conclusion of AEoI

Therefore, it is concluded that underwater noise from decommissioning will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.15 Vessel Disturbance (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel disturbance during the decommissioning phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Disturbance to marine mammals by vessels is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta et al., 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Vessel noise from medium to large-sized vessels (travelling at a speed of 10 knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SELcum dB re 1µPa@1m (rms), and in the frequency range of 10 to 100 Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery.

In general, noise from decommissioning vessels is expected to produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of bottlenose dolphins is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for bottlenose dolphins as per Appendix 6 (UWN modelling report). It is therefore expected that no bottlenose dolphins associated with this SAC will be impacted by PTS or TTS from vessel noise during decommissioning. It should also be noted that vessel disturbance impact is predicted to be of local spatial extent, short-term and reversible, and is unlikely to cause impacts in which bottlenose dolphin population trajectory would be altered.

Vessel disturbance have been found to elicit a variety of responses in bottlenose dolphins including reduced foraging (but varied responses, Pirotta et al., 2013; Pirotta et al., 2015; Piwez, 2019), reduced or unchanged dolphin densities (Lusseau, 2006; Marley et al., 2017), increased swimming speeds (Marley et al., 2017; Piwez, 2019), reduced resting and socialising behaviour (Constantine et al., 2004; Marley et al., 2017) and changes in acoustic behaviour (La Manna et al., 2013; Marley et al., 2017). Tolerance to vessel disturbance within certain levels in bottlenose dolphins was however also observed in previous studies (La Manna et al., 2013; Pirotta et al., 2013). The degree to which an animal will be disturbed is likely linked to their baseline level of tolerance (Bejder et al., 2009). New et al. (2013) simulated the complex interactions of the coastal population of bottlenose dolphins in the Moray Firth by increasing vessel traffic from 70 to 470 vessels a year to simulate the potential increase in vessel operations from proposed offshore development. It was found that the increase was not anticipated to result in biologically significant disturbance as bottlenose dolphins were able to compensate for their immediate behavioural responses and, therefore their vital rates remained unaffected (New et al., 2013).

5.3.4.15.1 Mitigation

As part of the decommissioning phase of the project, vessel management procedures will be implemented, which will comprise defined routes for decommissioning vessels to follow which avoid the haul out sites, as well as the application of rules that vessel masters must follow where marine mammals are identified along transit routes, including slowing down and taking avoidance action where the mammals are stationary.

5.3.4.15.2 Assessment

Regarding Target 2, vessel disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from vessels is not predicted to result in any “significant negative impacts” on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.15.3 Conclusion of AEoI

Therefore, it is concluded that vessel disturbance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.16 Vessel Collision Risk (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering vessel collision risk during the decommissioning phase.

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in the Irish waters that vessel collision is an important source of mortality. The CSIP in UK documents the annual number of reported strandings, and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and RoI.

The majority of decommissioning associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the decommissioning phase, in addition to those transiting between the site and the port.

5.3.4.16.1 Mitigation

All vessel traffic will move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore decommissioning activity, as detailed within the Environmental Vessel Management Plan (Appendix 11). Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Decommissioning vessels are not expected to travel through the SAC. It is thus not expected that the level of vessel activity during decommissioning would cause an increase in the risk of mortality from collisions.

5.3.4.16.2 Assessment

Regarding Target 2, individuals associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the project is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the population at the site. Specifically, the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.16.3 Conclusion of AEoI

Therefore, it is concluded that vessel collision risk will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.17 Changes to Prey (Decommissioning)

As determined in Table 5.8, Project Option 1 has a greater potential for adverse effects on marine mammals than Project Option 2 when considering changes to prey during the decommissioning phase.

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During decommissioning activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes or auditory masking in fish.

Bottlenose dolphin in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

As for bottlenose dolphin, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general decommissioning activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with decommissioning may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

5.3.4.17.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 2 which is to maintain human activities below levels which would adversely affect the populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from construction of the project are not expected to result in the deterioration of the prey resource on which bottlenose dolphin depend. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.17.2 Conclusion of AEoI

Therefore, it is concluded that changes in prey will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.4.18 Accidental Pollution (Decommissioning)

Activities relating to the decommissioning of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the decommissioning of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

5.3.4.18.1 Mitigation

The project will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the project and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. The proposed development is committed to the use of best-practice techniques and due diligence throughout all construction, operation and decommissioning activities. This commitment includes the implementation of an Offshore EMP (Appendix 7), which includes a Marine Pollution Contingency Procedure and an Emergency Incident Response Procedure to prevent, manage and mitigate the accidental release of pollutants into the marine environment. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

5.3.4.18.2 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 2 to maintain human activities below levels which would adversely affect the populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the bottlenose dolphin depend on or cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin population within the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from either Project Option 1 or Project Option 2.

5.3.4.18.3 Conclusion of AEoI

Therefore, it is concluded that accidental pollution will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC for Project Option 1 or Project Option 2.

5.3.5 Codling Fault Zone SAC

The Codling Fault SAC lies 28km away from the array and 38km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phocena*)

5.3.5.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Codling Fault SAC. No detailed conservation objectives are available for bottlenose dolphin and harbour porpoise at Codling Fault SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.5.2 Appropriate Assessment of Codling Fault SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and/ or severity of the effect experienced locally is considered to be negligible.

Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development for Project Option 1 or Project Option 2.

5.3.6 North Anglesey Marine/ Gogledd Môn Forol SAC

The North Anglesey Marine/ Gogledd Môn Forol SAC is 34.7km from the array and 42.9km from the ECC and is a UK site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.6.1 Conservation Objectives of Qualifying Interests

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:

Harbour porpoise is a viable component of the site

- There is no significant disturbance of the species; and
- The condition of supporting habitats and processes, and the availability of prey is maintained.

5.3.6.2 Appropriate Assessment of North Anglesey Marine/ Gogledd Môn Forol SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.7 Murlough SAC

The Murlough SAC lies 41.3km from the array and 47.1km from the ECC and is a UK site designated for the following marine mammal species as QI:

- Harbour seal (*Phoca vitulina*)

5.3.7.1 Conservation Objectives of Qualifying Interests

The COs to maintain the favourable conservation condition of harbour seals are defined by the following attributes and targets:

- Maintain (and if feasible enhance) population numbers and distribution of harbour Seals. In specific, a population of at least 106 seals and a pup percentage of at least 25% should be maintained; and
- Maintain and enhance, as appropriate, physical features used by harbour seals within the site.

5.3.7.2 Appropriate Assessment of Murlough SAC

This site has been screened in due to it being within the harbour seal foraging range, and therefore an individual from this site has the potential to be anywhere within 50km of the site, some of which falls within the ZoI for the proposed development. Given that the range of habitat for harbour seal available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible.

Consideration is given to the assessment for Lambay Islands SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.3concluded no AEoI on harbour seal QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour seal QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.8 North Channel SAC

The North Channel SAC is 48.4km from the array and 63.2km from the ECC and is a UK site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.8.1 Conservation Objectives of Qualifying Interests

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:

Harbour porpoise is a viable component of the site

- There is no significant disturbance of the species; and
- The condition of supporting habitats and processes, and the availability of prey is maintained.

5.3.8.2 Appropriate Assessment of North Channel SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development.

5.3.9 Glannau Ynys Gybi/ Holy Island Coast SAC

The Glannau Ynys Gybi/ Holy Island Coast SAC is 82.34km from the array and 91.79km from the ECC and is a UK site designated the following marine mammal species as QI:

- Grey seal (*Halichoerus grypus*).

5.3.9.1 Conservation Objectives of Qualifying Interests

To maintain the favourable conservation condition of the grey seal in Glannau Ynys Gybi/ Holy Island Coast SAC, which is defined by the following list of attributes and targets:

- Its natural range and areas it covers within that range are stable or increasing.
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
- The conservation status of its typical species is favourable.
- The conservation status will be taken as 'favourable' when:

- population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.3.9.2 Appropriate Assessment of Glannau Ynys Gybi/ Holy Island Coast SAC

This site has been screened in due to it being within the grey seal foraging range, and an individual from this site has the potential to be found anywhere within 100km, which includes some of the ZoI for the proposed development. Given that the range of habitat for grey seal available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Lambay Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.3 concluded no AEoI on grey seal QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the grey seal QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.10 West Wales Marine/Gorllewin Cymru Forol SAC

The West Wales Marine/ Gorllwein Cymru Forol SAC is 100.7km from the array and 110.6km from the ECC and is a UK site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.10.1 Conservation Objectives of Qualifying Interests

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that:

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

5.3.10.2 Appropriate Assessment of West Wales Marine/Gorllewin Cymru Forol SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.11 Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC

The Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC lies 106.7km from the array and 116.8km from the ECC and is a UK site designated with the following marine mammal species as QI:

- Bottlenose dolphin (*Tursiops truncatus*).

5.3.11.1 *Conservation Objectives of Qualifying Interests*

The COs to maintain the favourable conservation condition of the bottlenose dolphin within the Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC, are defined by the following list of attributes and targets:

- The bottlenose dolphin are maintained on a long-term basis as viable components of their natural habitat by, ensuring contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
- The species populations within the SAC are such that their natural ranges are not being reduced or likely to be reduced for the foreseeable future. In specific,
  - the population ranges within the SAC and adjacent inter-connected areas are not constrained or hindered.
  - there are appropriate and sufficient food resources within the SAC and beyond; and
  - the sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.
- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. As part of this objective,
  - the abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
  - the management and control of activities or operations likely to adversely affect the species QIs is appropriate for maintaining it in favourable condition and is secure in the long term.
  - contamination of potential prey species should be below concentrations potentially harmful to their physiological health; and
  - disturbance by human activity is below levels that suppress reproductive success, physiological health, or long-term behaviour.

5.3.11.2 *Appropriate Assessment of Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC*

Bottlenose dolphin

Given that the range of habitat for bottlenose dolphin available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Hook Head SAC, which is designated for the same QI and concluded no AEoI on bottlenose dolphin QIs for all screened in impacts as seen in Section 5.3.4. Despite the somewhat greater distance to the site than this SAC, the conclusions from Hook Head SAC regarding likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC still remain valid and it is considered that the potential for AEoI is the same for this site. Therefore, it is concluded that there is no AEoI from any impacts on the bottlenose dolphin QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.12 Blackwater Bank SAC

The Blackwater Bank SAC is 121km from the array and 128km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.12.1 *Conservation Objectives of Qualifying Interests*

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Blackwater Bank SAC. No detailed conservation objectives are available for bottlenose dolphin and harbour porpoise at Blackwater Bank SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.12.2 Appropriate Assessment of Blackwater SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.13 Carnsore Point SAC

The Carnsore Point SAC is 154km away from the array and 160km away from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.13.1 Conservation Objective of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Carnsore Point SAC. No detailed conservation objectives are available for bottlenose dolphin and harbour porpoise at Carnsore Point SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.13.2 Appropriate Assessment of Carnsore Point SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.14 Cardigan Bay/ Bae Ceredigion SAC

The Cardigan Bay/ Bae Ceredigion SAC is 161.9km from the array and 171.6km from the ECC and is a UK site designated the following marine mammal species as QI:

- Bottlenose dolphin (*Tursiops truncatus*)

5.3.14.1 *Conservation Objectives of Qualifying Interests*

The COs to maintain the favourable conservation condition of the bottlenose dolphin within the Cardigan Bay/ Bae Ceredigion SAC, are defined by the following list of attributes and targets:

- The bottlenose dolphin population is maintained on a long-term basis as viable components of its natural habitat by, ensuring contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
- The species population within the SAC is such that its natural range is not being reduced or likely to be reduced for the foreseeable future. In specific,
  - the population range within the SAC and adjacent inter-connected areas is not constrained or hindered.
  - there are appropriate and sufficient food resources within the SAC and beyond; and
  - the sites and amount of supporting habitat used by this species are accessible and its extent and quality is stable or increasing.
- The presence, abundance, condition and diversity of habitats and species required to support this QIs is such that the distribution, abundance, and populations dynamics of the species within the site and population beyond the site is stable or increasing. As part of this objective,
  - the abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
  - the management and control of activities or operations likely to adversely affect the species QIs is appropriate for maintaining it in favourable condition and is secure in the long term.
  - contamination of potential prey species should be below concentrations potentially harmful to their physiological health; and
  - disturbance by human activity is below levels that suppress reproductive success, physiological health, or long-term behaviour.
- To achieve restoration and recovery of the QI, bottlenose dolphin population should be increasing.

5.3.14.2 *Appropriate Assessment of Cardigan Bay/ Bae Ceredigion SAC*

Given that the range of habitat for bottlenose dolphin available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Hook Head SAC, which is designated for the same QI and concluded no AEoI on bottlenose dolphin QIs for all screened in impacts as seen in Section 5.3.4. Despite the slightly greater distance to the site than this SAC, the conclusions from Hook Head SAC regarding likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC still remain valid and it is considered that the potential for AEoI is the same for this site. Therefore, it is concluded that there is no AEoI from any impacts on the bottlenose dolphin QI for this site from the Proposed Development for Project Option 1 or Project Option 2.

5.3.15 Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC

The Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC lies 223.0km from the array and 232.2km from the ECC and is a UK site designated the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.15.1 *Conservation Objectives of Qualifying Interests*

To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise.

- To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:
- Harbour porpoise is a viable component of the site.
- There is no significant disturbance of the species; and
- The condition of supporting habitats and processes, and the availability of prey is maintained.

5.3.15.2 Appropriate Assessment of Bristol Channel Approaches/ Dynesfeydd Môr Hafren

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.16 Roaringwater Bay and Islands SAC

The Roaringwater Bay and Islands SAC lies 320.0km from the array and 317.6km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.16.1 Conservation Objectives of Qualifying Interests

To maintain the favourable conservation condition of the harbour porpoise in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

- Access to suitable habitats: species range within the site should not be restricted by artificial barriers to site use; and
- Disturbance: human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.16.2 Appropriate Assessment of Roaringwater Bay and Islands SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.17 Blasket Islands SAC

The Blasket Island SAC lies 346.6km from the array and 331.8km from the ECC and is designated for the following marine mammals as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.17.1 *Conservation Objectives of Qualifying Interests*

To maintain the favourable conservation condition of the harbour porpoise in Blasket Islands SAC, which is defined by the following list of attributes and targets:

- Access to suitable habitats: species range within the site should not be restricted by artificial barriers to site use; and
- Disturbance: human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.17.2 *Appropriate Assessment of Blasket Islands SAC*

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.18 Kenmare River SAC

The Kenmare River SAC lies 453km from the array and 459km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.18.1 *Conservation Objectives of Qualifying Interests*

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Kenmare River SAC. No detailed conservation objectives are available for harbour porpoise at Kenmare River SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.18.2 *Appropriate Assessment of Kenmare River SAC*

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed Development for Project Option 1 or Project Option 2.

5.3.19 Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC

The Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC lies 436km from the array and 444km from the ECC and is designated for the following marine mammals as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.19.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC. No detailed conservation objectives are available for harbour porpoise at Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.19.2 Appropriate Assessment of Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.20 Nord Bretagne DH SAC

The Nord Bretagne SAC lies 470.8km from the array and 479.7km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.20.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat is, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.20.2 Appropriate Assessment of Nord Bretagne DH SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site.

Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.21 West Connacht Coast SAC

The West Connacht Coast SAC lies 477km from the array and 486km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.21.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at West Connacht Coast SAC. No detailed conservation objectives are available for harbour porpoise at West Connacht Coast SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.21.2 Appropriate Assessment of West Connacht Coast SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). AsSection 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.22 Mers Celtiques – Talus du golfe de Gascogne SAC

The Mers Celtiques SAC lies 499.9km from the array and 502.1km from the ECC and is a transboundary site designated for the following marine mammal species:

- Harbour porpoise (*Phocoena phococena*)

5.3.22.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.22.2 Appropriate Assessment of Mers Celtiques - Talus du golfe de Gascogne SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.23 Récifs et landes de la Hague SAC

The Récifs et landes de la Hague SAC lies 503.8km from the array and 513.6km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.23.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.23.2 Appropriate Assessment of Récifs et landes de la Hague SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.24 Anse de Vauville SAC

The Anse de Vauville SAC lies 511.8km from the array and 521.6km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.24.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.

- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.24.2 Appropriate Assessment of Anse de Vauville SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC).

As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.25 Banc et récifs de Surtainville SAC

The Banc et récifs de Surtainville SAC lies 529.6km from the array and 536.0km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.25.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.25.2 Appropriate Assessment for Banc et récifs de Surtainville SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.26 Tregor Goëlo SAC

The Tregor Goelo SAC lies 535.1km from the array and 544.0km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.26.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.26.2 Appropriate Assessment of Tregor Goelo SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.27 Belgica Mound Province SAC

The Belgica Mound SAC lies 545km from the array and 552km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.27.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Belgica Mound SAC. No detailed conservation objectives are available for harbour porpoise at Belgica Mound SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use.
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.27.2 Appropriate Assessment of Belgica Mound SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site.

Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.28 Baie de Morlaix SAC

The Baise de Morlaix SAC lies 551.2km from the array and 559.0km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.28.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.28.2 Appropriate Assessment of Baie de Morlaix SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.29 Abers-Côtes des légendes SAC

The Abers–Côte des légendes SAC is 554.0km from the array and 560.8km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.29.1 Conservation Objectives of Qualifying Interests

Maintain or restore the favourable conservation status of harbour porpoises in the Abers-Côtes des légendes SAC, as well as their functional habitats; maintain the colony of harbour porpoises which is informed by the number of reported opportunistic sightings of porpoises.

5.3.29.2 Appropriate Assessment of Abers–Côte des légendes SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.30 Ouessant-Molène SAC

The Ouessant- Molène SAC lies 572.2km from the array and 567.5km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.30.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.30.2 Appropriate Assessment of Ouessant-Molène SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.31 Chausey SAC

The Chausey SAC lays 578.7km lies from the array and 589.4km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.31.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.31.2 Appropriate Assessment of Chausey SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Sectoin 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.32 Baie de Saint-Brieuc – Est SAC

The Baie de Saint-Brieuc-Est SAC lies 592.8km from the array and 602.2km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.32.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.32.2 Appropriate Assessment of Bair de Saint-Brieuc – Est SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.33 Côtes de Crozon SAC

The Côtes de Crozon SAC lies 598.1km from the array and 604.3km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.33.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.33.2 Appropriate Assessment of Côtes de Crozon SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.34 Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC

The Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC lies 605.0km from the array and 614.5km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.34.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.34.2 Appropriate Assessment of Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.35 Baie du Mont Saint-Michel SAC

The Baie du Mont Saint-Michel SAC lies 607.1km from the array and 616.8km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.35.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.35.2 Appropriate Assessment of Baie du Mont Saint-Michel SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible.

Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.36 Kilkieran Bay and Islands SAC

The Kilkieran Bay and Islands SAC lies 615km away from the array and 623km from the ECC and is designated for the following marine mammals as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.36.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Kilkieran Bay and Islands SAC. No detailed conservation objectives are available for harbour porpoise at Kilkieran Bay and Islands SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.36.2 Appropriate Assessment of Kilkieran Bay and Islands SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.37 Chaussée de Sein SAC

The Chaussée de Sein SAC lays 617.0km from the array and 622.6km from the ECC and is a transboundary site designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.37.1 Conservation Objectives of Qualifying Interests

In view of the absence of COs for harbour porpoises and relevant habitat QIs, the vision for the porpoise population is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain the species population on a long-term basis.

5.3.37.2 Appropriate Assessment of Chaussée de Sein SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.3.38 Inishmore Island SAC

The Inishmore Island SAC lies 636km from the array and 644km from the ECC and is designated for the following marine mammal species as QI:

- Harbour porpoise (*Phocoena phococena*)

5.3.38.1 Conservation Objectives of Qualifying Interests

In March 2024 NPWS added cetacean Qualifying Interests to a number of existing SACs, including adding harbour porpoise at Inishmore Island SAC. No detailed conservation objectives are available for harbour porpoise at Inishmore Island SAC, therefore, conservation objectives for other Irish SACs designated for harbour porpoise have been assumed:

- Target 1: Access to suitable habitat: Species range within the site should not be restricted by artificial barriers to site use; and
- Target 2: Disturbance: Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

5.3.38.2 Appropriate Assessment of Inishmore Island SAC

This site has been screened in due to it being within the harbour porpoise MU, and therefore an individual from this site has the potential to be found anywhere within the MU, including within the impact range of the proposed development. However, given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 5.3.2 concluded no AEoI on harbour porpoise QIs for all screened in impacts, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI for this site from the proposed development for Project Option 1 or Project Option 2.

5.4 Ornithology

5.4.1 Approach

This section of the assessment considers European sites designated for ornithological QIs that are potentially impacted by the onshore and offshore elements of the proposed development and have been screened in for the ornithology section of the NIS (as set out in Section 3.2). Where the assessment of effects on ornithological QIs relies on other relevant sections of the NIS, namely the Coastal and Marine Habitats and the Migratory Fish Species sections, reference is made to these sections.

The assessment approaches presented within this report were established based upon a review of available Irish guidance and best practices in conjunction with that of the wider offshore renewable industry. These methodologies were then aligned to be suitable for the assessment of potential impacts on marine and intertidal ornithological receptors in the western Irish sea from both the onshore and offshore development areas.

The approaches presented within this report are largely derived from UK (Natural England and NatureScot) guidance, this being the nearest established industry and highly relevant to the ornithological receptors within the region (Natural England (2022), Natural England and JNCC (2012), NatureScot (2023c)). The UK guidance is supported by research and evidence and provides a precautionary approach in assessing ornithological impacts. In considering the potential impacts in Ireland, five developers and their experienced consultants provided NPWS with a joint methodology for the proposed assessment on ornithology (hereafter 'Irish Phase 1 Methodology Statement). This methodology considers lessons learnt from the UK and provides justification on the proposed approach for these projects in Ireland. The benefit of which is ensuring alignment between projects so that assessment conclusions are consistent throughout projects. Consideration is also given to feedback from NPWS on this statement as presented in Appendix 15: NPWS Review of Method Statement, with relevant comments and justifications to feedback provided in Appendix 16: Method Statement Review Consultation and Justification Log.

The list of SPAs that have been screened in and considered within this assessment are shown in Table 5.9 below. For screened in sites, a detailed assessment for relevant impacts is provided below, though for sites where only migratory CRM has been screened in as a impact, an assessment is provided in Section 0 to improve readability.

Table 5.9: European sites screened in for ornithology receptors.

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
North West Irish Sea cSPA	Common scoter; Red-throated diver; and Great northern diver.	Offshore and onshore disturbance and displacement; Spatial distribution and disturbance; Dust deposition; Suspended sediment; Accidental pollution; and Indirect effects via impacts on prey.	Migratory collision risk; Barrier effects; Offshore disturbance and displacement; Indirect effects via impacts on prey; and Spatial distribution.
	Fulmar; Kittiwake; Lesser black-backed gull; and Herring Gull	Spatial distribution and disturbance; Indirect effects via impacts on prey; Dust deposition; Surface water run-off of suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and displacement.	Collision risk; Spatial distribution and disturbance; Indirect effects via impacts on prey; and Barrier effects
	Shag; and Cormorant	Dust deposition; Suspended sediment; Accidental pollution; and Onshore disturbance and displacement.	N/a
	Great black-back gull; Manx shearwater; Little gull; Little tern; Roseate tern; Common tern; and Arctic tern.	Indirect effects via impacts on prey; and Spatial distribution.	Collision risk; Spatial distribution and disturbance; Indirect effects via impacts on prey; and Barrier effects.
	Manx shearwater	Offshore disturbance and displacement.	N/a

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
	Razorbill; and Guillemot	Offshore and onshore disturbance and displacement; Spatial distribution and disturbance; Dust deposition; Suspended sediment; Accidental pollution; and Indirect effects via impacts on prey.	Barrier effects; Offshore disturbance; Indirect effects via impacts on prey; and Spatial distribution.
Malahide Estuary SPA	Bar-tailed godwit; Black-tailed godwit; Dunlin; Golden plover; Goldeneye; Great crested grebe; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Pintail; Red-breasted merganser; Redshank; and Shelduck.	Dust deposition; Surface water run-off of suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and displacement.	Migratory collision risk.
	Wetlands and waterbirds		N/A
Rockabill SPA	Common tern; Roseate tern; and Arctic tern.	N/A	Collision risk; Barrier effects; and Indirect effects via impacts on prey.
	Purple sandpiper.	Offshore and onshore disturbance and displacement.	Migratory collision risk

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
Rogerstown Estuary SPA	Black-tailed godwit; Dunlin; Grey plover; Greylag goose; Knot; Light-bellied brent goose; Oystercatcher; Redshank; Ringed plover; Shelduck; and Shoveler.	• Dust deposition; • Surface water run-off of suspended sediment/ deposition; • Accidental pollution; and • Onshore Disturbance and displacement	Migratory collision risk
	Wetlands and waterbirds		N/A
Baldoyle Bay SPA	Bar-tailed godwit; Golden plover; Grey plover; Light-bellied brent goose; Ringed plover; and Shelduck.	Suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and displacement	Migratory collision risk
	Wetlands and waterbirds		N/A
North Bull Island SPA	Bar-tailed godwit; Black-tailed godwit; Curlew; Dunlin; Golden plover; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Pintail; Redshank; Sanderling;	Onshore Disturbance and displacement.	N/A

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
	Shelduck; Shoveler; Teal; Turnstone; and Black-headed gull.		
River Nanny Estuary and Shore SPA	Golden plover; Knot; Oystercatcher; Ringed plover; and Sanderling.	Onshore Disturbance and displacement	Migratory collision risk
South Dublin Bay and River Tolka Estuary SPA	Black-headed gull; Bar-tailed godwit; Dunlin; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Redshank; Ringed plover; and Sanderling.	Onshore Disturbance and displacement	N/A
Skerries Islands SPA	Herring gull.	Onshore Disturbance and displacement	Collision risk.
	Light-bellied Brent Goose; Purple Sandpiper; and Turnstone;	N/A	Migratory collision risk
	Cormorant; and Shag.	Onshore Disturbance and displacement	N/A
Ireland's Eye SPA	Guillemot; and Razorbill.	Offshore disturbance & displacement.	Offshore disturbance & displacement.
	Herring gull; and Kittiwake.	N/A	Collision risk.

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
Saltee Islands SPA	Kittiwake; and Lesser black-backed gull;	N/A	Collision risk.
	Gannet;	Offshore disturbance and displacement.	Collision risk; and offshore disturbance and displacement
	Razorbill; and Guillemot.		Offshore disturbance and displacement
Howth Head Coast SPA	Kittiwake	N/A	Collision risk.
Lambay Island SPA	Guillemot; and Razorbill.	Offshore and onshore disturbance & displacement.	Offshore disturbance & displacement.
	Cormorant; and Shag.	Onshore Disturbance and displacement	N/A
	Herring gull; Kittiwake; and Lesser black-backed gull.		Collision risk
	Fulmar.	N/A	
	Greylag goose.	N/A	Migratory collision risk;.
Boyne Estuary SPA	Black-tailed godwit; Golden plover; Grey plover; Knot; Lapwing; Oystercatcher; Redshank; Sanderling; Shelduck; and Turnstone.	Onshore Disturbance and displacement	Migratory collision risk
Poulaphouca Reservoir SPA	Greylag goose	N/A	Migratory collision risk

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
Wicklow Head SPA	Kittiwake	N/A	Collision risk.
Morecambe Bay & Duddon Estuary SPA	Lesser black-backed gull	N/A	Collision risk.
Rathlin Island SPA	Kittiwake; Lesser black-backed gull.	N/A	Collision risk.
Ailsa Craig SPA	Gannet	Offshore disturbance & displacement	Offshore disturbance & displacement; and Collision risk
	Lesser black-backed gull; and Kittiwake	N/A	Collision risk.
Helvick Head to Ballyquin SPA	Kittiwake	N/A	Collision risk
Ribble & Alt Estuaries SPA	Lesser black-backed gull	N/A	Collision risk.
Skomer, Skokholm & the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA	Lesser black-backed gull; and kittiwake.	N/A	Collision risk
Grassholm SPA	Gannet	Offshore disturbance and displacement.	Offshore disturbance and displacement; and Collision risk.
Blackwater Callows SPA	Whooper swan; Bewick's swan; Wigeon; Teal; Mallard; Shoveler; Black-tailed godwit; Lapwing; Curlew.	N/A	Migratory collision risk
Horn Head to Fanad Head SPA	Kittiwake	N/A	Collision risk.
Cork Harbour SPA	Shelduck; Wigeon; Teal; Mallard; Pintail;	N/A	Migratory collision risk

Designated site	Features screened in for further assessment	Impacts screened in for Construction and Decommissioning	Impacts that have been screened in for Operation and Maintenance
	Shoveler; Red-breasted merganser; Little grebe; Great crested grebe; Grey heron; Oystercatcher; Black-tailed godwit; Bar-tailed godwit; Redshank; Golden plover; Grey plover; Lapwing; Dunlin; and Curlew.		
Courtmacsherry SPA	Shelduck; Wigeon; Red-breasted merganser; Black-tailed godwit; Bar-tailed godwit; Golden plover; Lapwing; Dunlin; Curlew; and Great northern diver.	N/A	Migratory collision risk
North Colonsay & Western Cliffs SPA & Assemblage	Kittiwake	N/A	Collision risk.
Clonakilty SPA	Shelduck; Black-tailed godwit; Curlew; Dunlin.	N/A	Migratory collision risk

5.4.1.1 Assessment Criteria

In addition to the screening criteria presented in the SISAA Report, specific assessment criteria have been used for this ornithology assessment. The assessment has been based on relevant guidance for conducting an AA and assessing offshore wind farms (e.g., European Commission, 2021; DCCAE, 2017; Maclean et al., 2009) and has applied the criteria contained in the guidance where relevant to the QIs under consideration.

Existing regional datasets from national organisations namely Bird Watch Ireland (BWI) and the British Trust for Ornithology (BTO) were also reviewed alongside relevant guidance and literature (e.g., Bradbury et al., 2014; Furness and Wade, 2012; Furness et al., 2013; Dierschke et al., 2016 and MIG-Birds, 2022), to identify the species sensitive to disturbance and/or displacement; or sensitive to collision within the offshore development area. See the Ornithology Technical Baseline in Appendix 12 for the full list of regional datasets reviewed.

Various site-specific surveys were conducted including Digital Aerial Surveys (DAS), vessel-based surveys, vantage point surveys and intertidal bird surveys. For further information regarding the site-specific surveys see the Ornithology Technical Baseline Appendix 12. The data collected during these surveys, from the array area and a 4km buffer, were used to identify key species more susceptible to the potential impacts arising from the proposed development during different seasons, due to their abundance on the site. For an overview of species recorded during the site-specific surveys see the SISAA Report. It should be noted 29 months of DAS data have been collected for the proposed development application, covering three full breeding seasons. Typically, 24 months of survey data are collected and so these data should be considered as forming a robust baseline from which to form the ornithological assessment.

A range of bird populations use Irish sea waters. The use of Irish waters and of specific sites and habitats varies throughout the year depending on species' requirements. Therefore, to increase the accuracy of the assessments, any predicted impacts are considered separately for each relevant biological season (bio-seasons) for each species (e.g., breeding, spring/autumn migration and wintering). See the Ornithology Technical Baseline Appendix 12 for a full description of the ornithological baseline.

The abundance of birds in the survey area has been estimated from site-specific survey data carried out for the proposed development. Two methods were used to estimate the abundance of birds in the array and relevant buffer zone. The abundance for all species was calculated using design-based estimates as laid out in the Technical Baseline. In addition, guillemot and razorbill abundance and distribution within the survey area was predicted using a model-based approach which provides an alternative method of estimating abundance by including environmental information and data to inform the predictions. These two auk species were chosen because they were the most frequently sighted species within the survey area and were observed in varying densities throughout all months of the year, which lends itself to model-based estimates using MRSea. In general, MRSea results predicted lower monthly abundances for both species but more so for guillemot with a reduction in estimates abundance of greater than 30% using the modelled approach. A summary of the mean-peak seasonal abundances of these two auk species based on design-based and model-based abundance estimates are presented in Table 5.10 below.

Table 5.10: Mean-peak bio-seasonal abundance estimates for auks in the array plus 2km buffer calculated using design-based and model-based methodologies. Breeding seasons are described in full in the Technical Baseline.

Species	Bio-season	Design-based	Model-based	Percentage difference (%)
Guillemot	Breeding (project)	1,813	1,497	17.4
	Breeding (Furness)	13,703	8,642	36.9
	Non-breeding	29,765	20,791	30.1
	Total	43,468	29,433	32.3
Razorbill	Breeding	168	114	32.3
	Autumn	3,371	2,341	30.6
	Winter	2,079	2,249	-8.2

Species	Bio-season	Design-based	Model-based	Percentage difference (%)
	Spring	483	389	19.5
	Total	6,101	5,093	16.5

The determination of AEoI on Natura 2000 sites is based on the contributing factors to the definition of maintaining and/or restoring integrity, namely that ecological structure and site function is not adversely affected. Likewise, determination of AEoI is framed around whether the ability of the habitat to sustain QIs is not adversely affected (i.e., maintaining breeding, roosting, foraging locations, and food sources), and that the population of the QI is maintained in terms of numbers and in some cases, distribution.

Increases to baseline mortality lower than 1% , assessed for the proposed development alone, are deemed to be undetectable in the context of natural variation in baseline mortality. Should the predicted impacts indicate an increase in baseline mortality greater than 1%, further consideration of the significance of the mortality is required to determine if AEoI can be ruled out, for example through Population Viability Analysis (PVA). This approach is recommended by Natural England (Parker et al., 2022c) and can incorporate known population trends and density dependence, where considered appropriate, to assess the impacts on a population more accurately. Similarly, NatureScot recommend undertaking PVA if the survival rate of an assessed species is adversely affected as a result of the predicted impact (NatureScot, 2023a). The above approaches to consideration of increases in baseline mortality are standard practice at UK developments, and as such it is deemed to be an appropriate approach here.

The PVA results throughout this assessment are presented as the counterfactual population growth rate (CPR) and counterfactual population size (CPS). The former is the median of the ratio of the annual GR of the impacted to un-impacted population and the latter is the median of the ratio of end-point size of the impacted to un-impacted (baseline) population; both are expressed as a proportion. These ratios of impacted to un-impacted scenarios are used to interpret the predicted impact upon the population (Cook and Robinson, 2016) as the model does not incorporate density dependence as a result interpretation of the final predicted impacted population sizes would not be appropriate. For further details regarding the PVA presented here see the PVA Appendix 13.

Density dependence regulates population size by adjusting demographic rates to maintain a population around a carrying capacity. If impacts from OWFs decrease survival rates, the resulting decrease in competition for resources might lead to increased survival and/or productivity in the remaining population, consequently boosting population growth. The importance of density dependence is evident in natural ecosystems, where without it, populations would exhibit exponential growth. However, the mechanisms as to how this operates in seabird populations are largely uncertain. Misinterpretation of density dependence in population assessments can result in unreliable predictions. As such, PVA models used in this assessment were density independent, despite ecological evidence suggesting the presence of density dependence in large populations (Horswill et al., 2017). While density-independent models lack the capacity for population recovery once it falls below a certain threshold, they are preferred for impact assessments due to their precautionary nature (Ridge et al. 2019). Please see the PVA Appendix 13 for further justification.

When interpreting results of PVA in terms of impact significance, CGR is used as the main threshold. Where the CGR for an impact is above 0.995 (or a reduction in population growth rate of below 0.5%), the impact is considered to be indistinguishable from natural fluctuations in the population.

5.4.1.2 Description of Designation

The description of designated sites and the conservation objects for each site can be found in the SISAA Report. Conservation objectives and relevant QIs for each SPA are provided in SPA sections below. Designated sites were included based on connectivity to species which are considered vulnerable to potential impacts as a result of the proposed development, with connectivity determined based on mean maximum foraging range plus 1 standard deviation (as presented in Woodward et al. (2019).

5.4.1.3 Project Option 1 and Project Option 2 Determination Greatest Potential for AEoI on Designated Sites

For ornithology an assessment has been completed to determine which of the two project options (Project Option 1 or Project Option 2) presents the greatest potential for AEoI on designated sites. Table 5.11 shows the outcome of this assessment. The onshore development area does not have project options as the associated onshore infrastructure and works will be the same for both project options. Potential impacts arising from the onshore development area are therefore not included in the table below, despite having no options.

Table 5.11: Potential impacts and the Project Option which has the greatest potential for AEoI on Ornithology Receptors. The Project Option that has the greatest potential for AEoI is Identified in Blue.

Potential impact	Project Option 1 (49 WTG)	Project Option 2 (35 WTG)	Rationale for the project option with the greatest magnitude of impact
Construction			
Disturbance and displacement in the ECC and/or array area	Vessel activity (ECC installation): • ECC area size of 67.8km^2 • 1 cable laying vessel; • 1 burial vessel; • 1 support vessel; • 12 work boats/Rigid Inflatable Boat (RIBs); • 1 work boat for landfall HDD installation; • 1 small JUV for landfall HDD installation; and • 1 guard vessel for HDD and cable installation. • Vessel activity (cable installation – array) • 1 main laying vessel; • 1 burial vessel; • 1 main support vessel; and • 1 main SOV/CTV vessel. Vessel activity (WTG Installation): • 2 installation vessels; • 6 support vessels; • 2 transport vessels; and • 1 support helicopter. Array area: • Array area size of 88.5km^2	Vessel activity (ECC installation): • ECC area size of 67.8km^2 • 1 cable laying vessel; • 1 burial vessel; • 1 support vessel; • 12 work boats/RIBs; • 1 work boat for landfall HDD installation; • 1 small JUV for landfall HDD installation; and • 1 guard vessel for HDD and cable installation. • Vessel activity (cable installation – array) • 1 main laying vessel; • 1 burial vessel; • 1 main support vessel; and • 1 main SOV/CTV vessel. Vessel activity (WTG Installation): • 2 installation vessels; • 6 support vessels; • 2 transport vessels; and • 1 support helicopter. Array area: • Array area size of 88.5km^2	Both project options have the same magnitude of impact with regard to the number of vessels present for displacement impacts in the ECC, and the size of the offshore development area for displacement due to presence of offshore infrastructure.
Disturbance and displacement from the onshore development area	Disturbance and displacement will occur at the landfall site and Malahide estuary from works including HDD drilling and duct pull-back, grid facility construction, road breaking out, cable trenching and backfilling, installation of joint bays and road resurfacing.	Disturbance and displacement will occur at the landfall site and Malahide estuary from works including HDD drilling and duct pull-back, grid facility construction, road breaking out, cable trenching and backfilling, installation of joint bays and road resurfacing.	The onshore development area does not have project options as the associated onshore infrastructure and works will be the same for both project options. Therefore, Project 1 and Project 2 will result in the same potential for AEoI on integrity of designated sites in relation to this impact.
Indirect impacts due to impacts on prey species	See Potential Impacts table for Migratory Fish Species	See Potential Impacts table for Migratory Fish Species	Project Option 2 Presents the greatest magnitude of impact when considering multiple impact pathways (see Migratory Fish Species section for details).

Indirect impacts due to accidental pollution	WTGs: 49 Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design. The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6. A maximum of 2,386 return vessel trips will occur during construction activities.	WTGs: 35 Each WTG will contain components that require lubricating oils, hydraulic oils and coolants for operations such as grease, synthetic oil, nitrogen, transformer oil, sulphur hexafluoride (SF6) and glycerol. The volume of oils and fluids will vary depending on the WTG design. The OSP will contain diesel for the emergency diesel generators contained in tanks, oil for transformers, deionised water for cooling systems, glycol, lead acid for UPS and batteries, engine oil and SF6. A maximum of 1,898 return vessel trips will occur during construction activities.	Project Option 1 presents the greatest magnitude of impact with regard to vessel movement during the construction period. These parameters present the maximum volumes of compounds which could be associated with the proposed development infrastructure.
Operation			
Disturbance and displacement in the array area (including barrier effects)	Array Array area size of 88.5km² WTGs: 49 WTGs Vessel activity 1 JUV vessels; 1 SOV vessels; 1 CTV vessels; 1 lift vessels; 1 cable vessels; and 7 aux vessels. Construction duration – 36 months	Array Array area size of 88.5km² WTGs: 35 WTGs Vessel activity 1 JUV vessels; 1 SOV vessels; 1 CTV vessels; 1 lift vessels; 1 cable vessels; and 7 aux vessels. Construction duration 36 months	Both project options have the same magnitude of impact based on the displacement assessment, which is based on the size of the offshore development area which is the same across both options.
Collision risk	WTGs: 49 WTGs Minimum air draft 40m (LAT) Rotor diameter 250m Max blade width 7m Rotor max rotational speed 8.3 m/s	WTGs: 35 WTGs Minimum air draft 35m (LAT) Rotor diameter 276m Max blade width 7.5m Rotor max rotational speed 7.5 m/s	Predominantly option 1, but considered on a species-by-species basis with the project option with the greatest magnitude of impact presented for each species
Combined collision and displacement risk	Array area: – Array area size of 88.5km² WTGs: 49 WTGs Minimum air draft 40m (LAT) Rotor diameter 250m Max blade width 7m Rotor max rotational speed 8.3 m/s	Array area: – Array area size of 88.5km² WTGs: 35 WTGs Minimum air draft 40m (LAT) Rotor diameter 276m Max blade width 7.5m Rotor max rotational speed 7.5 m/s	This impact is assessed only for gannet, for which Project Option 1 represents the project option with the greatest magnitude of impact for collision impacts (with no differences for displacement impacts)

Migratory collision risk	WTGs: 49 WTGs Minimum air draft 40m (LAT) Rotor diameter 250m Max blade width 7m Rotor max rotational speed 8.3 m/s	WTGs: 35 WTGs Minimum air draft 40m (LAT) Rotor diameter 276m Max blade width 7.5m Rotor max rotational speed 7.5 m/s	Project Option 1 is the project option with the greatest magnitude of impact for migratory collision risk based on modelling for both Project Options.
Indirect impacts due to impacts on prey species	See Table 5.4 Potential impacts and the project option that has the greatest potential AEoI on migratory fish.	See Potential Impacts table for Fish and Shellfish and Benthic Ecology	Project Option 2 Presents the greatest magnitude of impact when considering multiple impact pathways (see Migratory Fish Species section for details).
Impacts arising from artificial light	Artificial lighting will be used continuously during HDD drilling activities. During construction, temporary lighting will be used to mark any surface piercing structures and will have a 2.5 second yellow flash visible for at least 2nm with a 360-degree visibility.	Artificial lighting will be used continuously during HDD drilling activities. During construction, temporary lighting will be used to mark any surface piercing structures and will have a 2.5 second yellow flash visible for at least 2nm with a 360-degree visibility.	Project Option 1 is considered to have a greater magnitude of impact due to the higher number of surface piercing structures
Decommissioning			
Disturbance and displacement in the ECC and/or array area	The greatest potential for a likely significant effect is identical (or less) to that of the construction phase	The greatest potential for a likely significant effect is identical (or less) to that of the construction phase	Equal magnitude of impact across both options
Indirect impacts due to impacts on prey species	See Table 5.4 Potential impacts and the project option that has the greatest potential AEoI on migratory fish.	See Potential Impacts table for Migratory Fish Species	Project Option 2 Presents the greatest magnitude of impact when considering multiple impact pathways (see Migratory Fish Species section for details).
Indirect impacts due to accidental pollution	The greatest potential for a likely significant effect is identical (or less) to that of the construction phase	The greatest potential for a likely significant effect is identical (or less) to that of the construction phase	Equal magnitude of impact across both project options

5.4.1.3.1 Approach to the assessment

Disturbance and Displacement

The screening process has identified the QIs and sites to have potential for disturbance and displacement during the construction and decommissioning and operational phases (LSE cannot be ruled out). The relevant SPAs, identified based on connectivity to the proposed development and from site-specific DAS data, are presented in Table 5.12 below.

Table 5.12: Sites Identified for Potential AEoI for Disturbance and Displacement within the Construction and Decommissioning and Operational Phase with Associated Designed QIs, and Bio-season.

Site	Qualifying Interests screened in	Bio-season	Relevant area
Republic of Ireland sites			
Ireland’s Eye SPA	Guillemot, Razorbill	Breeding and non-breeding	Array area
Lambay Island SPA	Guillemot, Razorbill	Breeding	Array area Onshore area
	Cormorant; Shag; Lesser Black-backed Gull; Herring Gull; Kittiwake	Breeding	Onshore area

Site	Qualifying Interests screened in	Bio-season	Relevant area
Saltee Island SPA	Gannet	Breeding and non-breeding	Array area
	Guillemot, Razorbill	Non-breeding	Array area
North-west Irish Sea cSPA	Guillemot, Razorbill, Manx shearwater	Breeding and non-breeding	Array area Onshore area
	Red-throated diver, Great northern diver, Common scoter	Breeding and non-breeding	Offshore ECC Intertidal ECC Onshore area
	Kittiwake, Lesser black-backed gull, Black-headed gull, Common gull, Herring gull, Guillemot, Razorbill, Shag and Cormorant.	Breeding and non-breeding	Onshore area
Rockabill SPA	Purple sandpiper	Non-breeding	Intertidal ECC Onshore area
Saltee Islands SPA	Cormorant, Shag, Light-bellied Brent Goose, Purple Sandpiper, Turnstone, Herring Gull	Non-breeding	Intertidal ECC
Malahide Estuary SPA	Bar-tailed godwit, Black-tailed godwit, Dunlin, Golden plover, Goldeneye, Great crested grebe, Grey plover, Knot, Light-bellied brent goose, Oystercatcher, Pintail, Red-breasted merganser, Redshank, Shelduck, Wetlands and Waterbirds.	Non-breeding	Intertidal ECC Onshore area
Rogerstown Estuary SPA	Black-tailed godwit, Dunlin, Grey plover, Greylag goose, Knot, Light-bellied brent goose, Oystercatcher, Redshank, Ringed plover, Shelduck, Shoveler, Wetlands and Waterbirds.	Non-breeding	Onshore area
Baldoyle Bay SPA	Bar-tailed godwit; Golden plover; Grey plover; Light-bellied brent goose; Ringed plover; Shelduck, Wetlands and Waterbirds.	Non-breeding	Intertidal ECC Onshore area
North Bull Island SPA	Bar-tailed godwit; Black-tailed godwit; Curlew; Dunlin, Golden plover; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Pintail; Redshank; Sanderling; Shelduck; Shoveler; Teal; Turnstone.	Non-breeding	Intertidal ECC Onshore area
South Dublin Bay and River Tolka Estuary SPA	Black-headed gull, Bar-tailed godwit, Dunlin, Grey plover, Knot, Light-bellied brent goose, Oystercatcher, Redshank, Ringed plover, Sanderling	Non-breeding	Onshore area
River Nanny Estuary and Shore SPA	Golden plover; Knot; Oystercatcher; Ringed plover; and Sanderling.	Non-breeding	Onshore area
Skerries Islands SPA	Light-bellied Brent Goose; Purple Sandpiper; Turnstone; Herring Gull; Cormorant and Shag.	Breeding and non-breeding	Onshore area
Boyne Estuary SPA	Black-tailed godwit; Golden plover; Grey plover; Knot; Lapwing; Oystercatcher; Redshank; Sanderling; Shelduck; and Turnstone.	Non-breeding	Onshore area
UK sites			
Ailsa Craig SPA	Gannet	Breeding and non-breeding	Array area

Site	Qualifying Interests screened in	Bio-season	Relevant area
Grassholm SPA	Gannet	Breeding and non-breeding	Array area

In the absence of specific Irish guidance, the assessments of seabird disturbance and displacement for the proposed development are in line with UK SNCB guidance (MIG-Birds, 2022). As recommended in the Natural England guidance (Parker et al., 2022c; MIG-Birds, 2022) and the NatureScot guidance (NatureScot, 2023b) overall mean seasonal peaks (averaged over the years of survey) in the array area and an appropriate buffer were used in the displacement assessment. Defined bio-seasons were used, either informed by site-specific data or following the definitions in Furness (2015).

Sensitivity to displacement varies considerably between seabird species. The Developer has followed the assessment approach presented within the Irish Phase 1 Method Statement, which was informed by UK guidance (Parker et al., 2022c; MIG-Birds, 2022). Therefore, species were ranked according to their sensitivity to displacement and the degree of habitat specialisation. Displacement assessments were performed on any species scoring at least three in either category (see MIG-Birds, 2022), based on a review of count data gathered during site-specific surveys, and associated expert ornithological judgement on those species likely to be sensitive to displacement (e.g., Bradbury et al., 2014; Dierschke et al., 2016). For the array area, these species were gannet, guillemot and razorbill.

As part of the precautionary approach to the assessment, Manx Shearwater have also been screened in for displacement assessment due to their designation in the North-West Irish Sea (NWIS) candidate SPA (cSPA) despite the species' vast foraging ranges (mean max +1SD 2,365.5km) (Woodward et al., 2019), very low vulnerability to displacement by offshore wind farms, a score of 1 by Bradbury et al. (2014) and a species concern index value of 2 as per Furness et al. (2013).

Puffin were screened out for displacement within the array area due to the low numbers recorded during the DAS. A total of 14 puffin were observed within the array area plus 2km buffer during the full 29 months of DAS (May 2020 – October 2022).

As per the Irish Phase 1 Method Statement, kittiwake were screened out for displacement assessments in the SISAA due to their large foraging ranges (mean max +1SD 300.6km) (Woodward et al., 2019), over which alternative suitable foraging habitat are likely to be found in combination with their low habitat specificity. Furthermore, there is limited evidence to suggest kittiwake are displaced by OWF and this species is not considered within displacement assessments across England and Wales as per MIG-Birds (2022).

Red-throated diver and great northern diver were also screened out for displacement in the array area due to the trivial numbers of birds (<10 individuals) recorded during the DAS. A total of seven great northern diver and two red-throated diver was recorded within the array area plus a 4km buffer during the 29 months of DAS (May 2020 – October 2022). Despite the low abundances of divers (and common scoter) within the array, these species were screened in for the NWIS cSPA in relation to the ECC due to their population size but screened out for all other SPAs.

For onshore elements of the proposed development, noise impacts with potential to cause disturbance and displacement to ornithological features in the intertidal and marine habitats at the landfall site and Malahide Estuary were assessed based on information contained in Cutts et al. (2009). Other sources of information for disturbance and displacement effects specific to Dublin Bay birds was taken from Dublin Bay Birds Project 2013-2016 report Tierney et al. (2017) and Phelan & Nairn (2007). Site specific conservation objects and supporting information for the European sites has also been relied upon to support the assessment.

5.4.1.3.2 Approach to Construction and Decommissioning

Disturbance and Displacement

During the construction and decommissioning phases of the proposed development, the installation of foundations, towers, blades, export cables and other infrastructure as well as the movement of vessels and helicopters have the capability to disturb birds. This disturbance may result in displacement of birds from the offshore development area, driving a temporary habitat loss and reducing the area available to birds for foraging, loafing, and moulting.

The effects of disturbance and displacement from construction are likely to be limited spatially and temporally, primarily affecting birds foraging within the construction area (consisting of the array area, ECC and intertidal zone), with the extent of effects depending on the nature of the activities taking place. The effects are also likely reversible in nature, with birds returning to the area following the end of construction phase.

Array area

Where relevant, the displacement assessment within the array area is undertaken based on DAS data collected for the proposed development. For full details of species vulnerabilities and justifications for the displacement rates used within the assessment please see the operation and maintenance section below.

In the array area, the impacts of displacement during the construction and decommissioning phases of the proposed development are unlikely to equal those estimated during operation of the proposed development because construction will be relatively localised within the array and WTG will not be operational. Therefore, any potential displacement impacts from construction in the array area are assumed to be half that of operation. This is because, on average, approximately half the array will be constructed. This is standard practice for UK assessments and assumed to be precautionary because WTG blades will be static and not cause the same level of displacement as a fully operational wind farm.

Offshore and Intertidal ECC

To assess impacts in the ECC, data from Jessop et al. (2018) were used, which encompasses fine-scale aerial data on the distribution and abundance of seabirds in the western Irish Sea. Due to the orientation of transects, Jessop aerial survey data had a very low coverage (2.3%) of the ECC. To increase coverage, and therefore the representativeness of density estimates in the ECC, a 4km buffer was applied to the ECC when determining the density of common scoter and divers. This increased aerial survey coverage to 10.5% of the ECC plus 4km buffer (due to a higher proportion of survey transects falling into the relevant study area), therefore increasing the representativeness of resulting density estimates. Since the ECC study area covers the ECC alone (with no surrounding buffer), the resulting density across the ECC plus 4km buffer was considered representative of the ECC alone, with these density estimates forming the basis of the ECC assessment.

Divers and seaducks

Divers (red throated diver and great northern diver) and seaducks (common scoter) are considered to have a high vulnerability to disturbance and displacement impacts. They have shown to be highly susceptible to disturbance from shipping and helicopter traffic (Garthe and Huppop, 2004), with birds showing disturbance responses at distances of over 1km from boats (Kaser et al., 2006; Schwemmer et al., 2011). However, evidence on displacement impacts resulting from permanent infrastructure is more limited. Dierschke et al., (2016) indicates only a weak avoidance behaviour of OWFs for these species (with most impacts resulting from boat and helicopter traffic), while post-consent monitoring at the Gwynt y Mor OWF found limited evidence of displacement impacts on these species (APEM, 2019).

Diver species were not differentiated during the surveys undertaken by Jessop et al. (2018); to carry out the assessment the recorded diver species needed to be apportioned to species level. Since very low numbers of divers (<10 individuals) were recorded during the 29 months of DAS for the proposed development it was not possible to apportion the Jessop et al (2018) data using the site-specific data. Therefore, the recorded diver species were apportioned to species level according to the relevant Biologically Defined Minimum Population Scale (BDMPS) population sizes provided in Furness (2015). Based on the peak non-breeding population size of 300 great northern diver (NW England and Wales BDMPS; Furness, 2015) and a peak non-breeding population size of 4,673 red-throated diver (UK Western Waters plus Channel BDMPS; Furness, 2015) it was predicted that 93.6% of divers in Jessop et al. (2018) were red-throated diver and 6.4% were great northern diver. This approach is precautionary as it assumes all diver species are red-throated diver or great northern diver, as opposed to also apportioning some individuals to black-throated diver, which are also, albeit rarely, found around Ireland during the winter. Notably, all surveys by Jessop et al. (2018) were undertaken within the autumn migration bio-season. Densities of red-throated diver within the spring migration bio-season were therefore assumed to be the same as those recorded within the autumn migration bio-season. For great northern diver, only one bio-season is considered relevant (the non-breeding bio-season).

Therefore, this assessment considers the peak density of the autumn and winter surveys to represent the full non-breeding season density. This can be considered precautionary as densities were lower during other months within these periods, yet impacts across these periods were derived from peaks.

Furthermore, Jessop et al. (2018) presented counts of common scoter, and of scoter species which were not identifiable to species level. As a precautionary approach, this assessment uses the combined count of common scoter and scoter species.

In the absence of Irish-specific guidance regarding red-throated diver displacement and mortality rates, the available evidence has been reviewed and it has been concluded that a mortality rate of 1% is appropriately precautionary. A displacement rate of 100% has also been proposed to reflect this species high vulnerability to displacement, presented alongside a range of 90% to 100%.

A review undertaken for the Norfolk Vanguard DCO examination concluded that a displacement rate of 90% (to a 2km buffer) and a mortality rate of 1% is the strongest evidence-led approach (MacArthur Green, 2019). Furthermore, a range of displacement rates for this species have been observed within offshore wind projects around the UK (and Europe) namely, Percival (2013) reported a 82% reduction in density within the Thanet Wind Farm, 89% within the Kentish Flats Extension (Percival and Ford, 2018), 50% (Horns Rev 2) (Petersen et al., 2014), <50% within the London Array (APEM, 2016), and 90% (Alphha Ventus) (Welcker & Nehls, 2016).

MacArthur Green and Royal Haskoning DHV (2021) used survey data collected from the Outer Thames region prior to the construction of any OWFs through to the completion of the construction of Kentish Flats, Gunfleet Sands, London Array, Thanet and Greater Gabbard (i.e., 2002 to 2018), to conduct modelling analysis on behalf of East Anglia ONE North (EA1N) and East Anglia TWO. The model predicted a 42.4% and a 44.2% decrease in density within the EA1N array area when using the 2013 and 2018 density distributions, respectively. No reduction in density was predicted beyond 8km from the array area when using the 2013 data or beyond 9km based on the 2018 data. Similar numbers of displaced birds were predicted for EA1N when 100% displacement from the array area plus a 4km buffer was applied (MacArthur Green and Royal Haskoning DHV, 2021).

Recent reviews by MacArthur Green (2019) and MacArthur Green & Royal Haskoning DHV (2021) focused on the ecological impacts of displacement on red-throated diver and highlighted evidence that red-throated diver populations are not constrained by resources in wintering grounds, but by available breeding habitat. Therefore, an increase in density in wintering areas as a result of displacement would not have a negative impact on survival, as there is more than sufficient resource to maintain the current population. It should be noted this is based on red-throated diver populations within the North Sea. Both MacArthur Green (2019) and MacArthur Green & Royal Haskoning DHV (2021) conclude that 1% mortality rate is likely to be precautionary, based on the evidence available. The energetic requirements of red-throated diver on non-breeding grounds were assessed by JNCC (Thompson et al, 2023). Divers were found to forage for approximately 6 hours per day, including some periods of darkness, with other times spend resting. This suggests that divers are not obliged to feed all day, meaning that their energetic requirements are met relatively comfortably. As such, displaced birds are likely to have sufficient flexibility in their energy budget to cope with the demands of displacement.

It should be noted that SNCBs in the UK have advised that a highly precautionary 10% mortality rate (and 100% displacement) should be applied when assessing bird displacement as a result of cable laying vessels however, this approach is not considered to be supported by evidence. In light of the available evidence above, an evidence-led approach of 1% mortality and 100% displacement (and a range of 90% to 100% displacement) is proposed.

Though not included within the Irish Phase 1 Method Statement (due to being less commonly observed in OWF development areas), common scoter are considered to have the same disturbance susceptibility and habitat specialization scores as red-throated diver and great northern diver in Bradbury et al. (2014) and are therefore assessed using the same parameters recommended for this species within the UK Joint SNCB Guidance (MIG-Birds, 2022) which is recommended for use by both Natural England and NatureScot, presenting a range of 90% to 100% displacement and a range of 1% to 5% mortality. A displacement rate of 100% and a mortality rate of 1% has been used.

Rates used

The assessment for displacement has been carried out for the proposed development based on the UK guidance (Parker et al., 2022c; MIG-Birds, 2022) following a range of scenarios that take account of construction activities being restricted both temporally and spatially:

- Export cable laying activities will be undertaken by a maximum of one vessel cluster across the entire ECC.
- Construction activities are restricted both temporally and spatially to approximately four-years for a single phase of offshore construction.
- Where construction activities do not occur, such as locations without WTG foundations, cables, or OSP installation, such areas shall remain largely uninfluenced by construction activities.
- Consequently, in the array area, the displacement rates during the construction and decommissioning phases of the proposed development are half that of operation.

The displacement and mortality rates used for the displacement assessment for divers and seaducks, gannet, guillemot and razorbill, during the construction and decommissioning phases are presented in Table 5.13. See the Approach to Operation section below for further information regarding the justification for the species-specific displacement and mortality rates used for seabirds.

Table 5.13: Displacement and Mortality Rates Used for the Assessment in Construction and Decommissioning Phases of NISA Based on Half of those Used in the Operational Phase.

Species	Displacement rate (%)	Mortality rate (%)
Gannet	35 (range of 30% to 40% presented)	1
Guillemot	25 (range of 15% to 35% presented)	1 (range of 1% to 5% presented)
Razorbill	25 (range of 15% to 35% presented)	1 (range of 1% to 5% presented)
Red-throated diver	100 (range of 90% to 100% presented)	1 (range of 1% to 5% presented)
Great northern diver	100 (range of 90% to 100% presented)	1 (range of 1% to 5% presented)
Common scoter	100 (range of 90% to 100% presented)	1 (range of 1% to 10% presented)
Manx shearwater	5	1

Forage spatial distribution, extent, abundance and availability

Indirect impacts on prey species were assessed to address the conservation objectives for the NWIS cSPA and Rockabill SPA. This section briefly assesses the predicted impact of the proposed development on the key prey species of seabirds to aid the assessment within the relevant SPA sections. This includes any impacts that may arise during the construction, operation, and decommissioning phases associated with the offshore development area on key fish prey species. The environment in the vicinity of the offshore development area is naturally dynamic, and as such will exhibit some level of natural variation and change over time whether the proposed development proceeds or not.

Sandeel

Due to their burrowing habit and reliance on specific substrates (e.g., Green, 2017; Wright et al., 2000), sandeel are susceptible to seabed disturbance impacts, inclusive of impacts from increased SSCs and sediment deposition, habitat damage and disturbance of the seabed, and the loss of benthic habitat. Analysis of site-specific and regional sediment data indicate the presence of suitable sandeel habitats along most of the ECC and in the wider region to the south of the offshore development area, while sediments within the array area are mostly unsuitable for sandeel (Appendix 21).

Therefore, any temporary damage or disturbance of the seabed during construction and any long-term or permanent loss of seabed habitats during operation will likely be small in the context of available suitable substrates within the offshore development area and wider region. Similarly, sediment plumes are expected to quickly dissipate after cessation of construction activities due to settling and wider dispersion, with SSCs reducing to background levels within a couple of tidal cycles.

With regards to underwater noise, sandeel belong to hearing Group 1 in accordance with the Popper et al. (2014) classification (see Section 5.2.2), based on their restricted hearing abilities and low susceptibility to pressure-related injuries. However, given their burrowing nature and demersal spawning behaviour, sandeel may have limited capacity to vacate the area during piling operations, and therefore they may experience some mortality and/or recoverable injury in addition to TTS and behavioural responses.

Based on the underwater noise modelling (Appendix 6), mortality and potential mortal injury to sandeel (Group 1, stationary receptor model) may occur up to 1.1km from the installation of monopile foundations and up to 800m from the sequential installation of two pin-piles for jacket foundations (>219dB SELcum). Recoverable injury in Group 1 stationary receptors during the course of piling is predicted to occur up to 1.7km from the installation of monopile foundations and 1.3km from piling of multileg foundations (>216dB SELcum). As discussed above, site-specific PSA data suggest that sediments within the array area are mostly unsuitable for sandeel (Appendix 21), and therefore the number of sandeel within the predicted impact ranges for mortal and recoverable injuries is likely to be low. Based on this combined with the low susceptibility of sandeel to pressure-related injuries, the risk of lethal or sublethal injuries in sandeel during piling is assessed as being low, with any effects considered to be undiscernible from baseline conditions.

TTS in sandeel is predicted to occur up to 69km from the installation of monopile foundations and up to 59km from multileg foundation piling (>>186dB SELcum) (Appendix 6), while the relative risk of behavioural changes is likely to be high at the near field (10s of meters) distance from the noise source, medium at intermediate (100s of meters) distance and low at far (1,000s meters) distances from the piling operations (Popper et al., 2014). Any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Effects of TTS would also be temporary, with existing studies suggesting that fish affected by TTS recovered to normal hearing levels within a few hours to several days after noise exposure (Popper et al., 2014; Popper and Hawkins, 2019). Therefore, any potential TTS or behavioural reactions in sandeel are not predicted to result in any significant impacts on sandeel populations within the offshore development area and wider region.

Herring

Herring are demersal spawners, reliant upon the presence of suitable substrates for spawning and egg development (Frost and Diele, 2022). Their eggs are most susceptible to seabed disturbances and sediment deposition as they would be unable to avoid the impact. However, the closest known active herring spawning ground is located north of Dundalk Bay (Mourne spawning ground) outside the offshore development area and the areas affected by elevated SSC and sediment deposition (Appendix 21). Therefore, no effects on herring spawning grounds are predicted to arise from increased SSC, sediment deposition, habitat disturbance and habitat loss.

With regards to underwater noise, herring belong to hearing Group 4, based on the presence of a swim bladder that is directly involved in hearing through its connection to the inner ear. Group 4 species are considered to be the most sensitive to underwater noise, with direct detection of sound pressure, rather than just particle motion. The presence of a swim bladder makes them highly susceptible to physical injuries, and given their good hearing ability, they are also at higher risk to experience physiological and behavioural effects (Popper et al., 2014; Popper and Hawkins, 2019).

Herring are mobile and would be able to move away from piling noise during soft-start and ramp-up procedures before sound levels reach levels that may result in irreversible injuries. However, the likelihood of herring leaving the area may be reduced when engaged in spawning activity. On the basis of the static receptor modelling there is no overlap between the Mourne herring spawning ground where eggs would be deposited and the predicted impact ranges for mortality and potential mortal injury (up to 6.5 km for mortal injuries and 11km for recoverable injuries (Appendix 6)). Consequently, spawning adults over the Mourne herring ground and herring eggs are not predicted to experience mortality and mortal injury during the piling of foundations.

Noise emitted during impact piling may however disrupt normal spawning behaviour in herring through behavioural reactions or changes in hearing sensitivities through TTS. On the basis of the static receptor modelling, TTS may occur up to 69km from single monopile installation and up to 59km from the sequential installation of two pin-piles for jacket foundations (Appendix 6). The relative risk of behavioural responses at these distances is likely to be moderate (Popper et al., 2014). There is therefore overlap between the predicted impact ranges for TTS in stationary herring with the Mourne herring spawning ground. As for sandeel, any TTS and behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviour after piling has ceased (Popper et al., 2014; Popper and Hawkins, 2019). Moreover, existing data suggest that while herring can be highly reactive to underwater noise, the type and strength of behavioural responses may vary depending on the activity individuals were involved in during noise exposure. For example, studies examining the effects of seismic airguns and naval sonars showed strong response during overwintering but limited change in swimming behaviour during feeding migrations (Doksaeter et al., 2009; Pena et al., 2013). Similarly, strong vessel avoidance has been observed in overwintering herring (Vabø et al., 2002), while no avoidance behaviour was observed in spawning herring (Skaret et al., 2005). Whilst there are currently no studies on TTS and behavioural changes in spawning herring during pile driving specifically, it is likely that similar damping of behavioural reactions would occur as for other stimuli. Based on this combined with the temporary (i.e., less than one year) and intermittent nature of piling operations, underwater noise from piling is not predicted to result in significant adverse effects on the herring population within the offshore development area and wider eastern Irish Sea region.

Sprat

Sprat are mobile and expected to move away from localised sediment plumes, with individuals expected to return shortly after sediment plumes have dissipated. Moreover, spart do not depend upon the seabed for part or all of their life cycle, and therefore they are not susceptible to the physical damage or disturbance of the seabed during construction and the long-term loss of benthic habitats during operation. With regards to underwater noise, sprat belong, like herring, to hearing Group 4, and are therefore highly susceptible to physical injuries, and at higher risk to experience physiological and behavioural effects. However, as a mobile species, sprat are considered able to move away from piling operations during soft-start and ramp-up procedures before sound energies reach levels that may cause physical injuries or death. Any TTS and behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Based on this combined with the temporary (i.e., less than one year) and intermittent nature of piling operations, underwater noise from piling is not predicted to result in significant adverse effects on sprat within the offshore development area and wider eastern Irish Sea region.Approach to Operation

Disturbance and Displacement

WTGs and associated infrastructure and maintenance activity may directly disturb and displace vulnerable seabirds during the operational phase that would otherwise be found within and around the offshore development area. Displacement may result in temporary or permanent indirect habitat loss for sensitive seabirds and therefore reduce the area available to forage, rest and/or moult. Birds that do not intend to utilise the operational proposed development but that would have previously flown through it to reach a foraging, resting or nesting area, and which detour around it or stop short, are subject to barrier effects. Both impact pathways can cause reductions in individual survival and/or breeding success as birds may experience fitness consequences.

Whilst barrier effects are considered a separate impact to displacement, any impacts as a result of barrier effects are incorporated within the displacement assessment. As per the Irish Phase 1 Method Statement, both sitting and flying birds are considered within the displacement assessment, with the inclusion of flying birds allowing for assessment of any potential barrier impacts to birds traveling through the offshore development area. This approach is considered a precautionary approach and is recommended by the UK SNCBs (MIG-Birds, 2022). In addition, the latest NatureScot guidance (NatureScot, 2023c) also advocates for this approach to displacement assessment as all distributional responses, namely displacement effects and barrier effects are accounted for. However, a precautionary approach has been taken including a review of available (species-specific) tracking data from the region to assess if there are any foraging hotspots for QIs of the NWIS cSPA beyond the offshore development area, the results of which are presented in the relevant species sections within Section 5.4 and section 6.4.

Responses to the presence of OWFs and the associated infrastructure, including vessel activity, can vary between seabird species. To date there is a lack of evidence of the impacts of OWF to seabirds specific to Ireland, therefore evidence associated with UK offshore wind projects and other European projects has been reviewed and considered for the proposed development. It is reasonable to assume that evidence used in the UK and Europe is equally applicable in Ireland. Behaviour of a bird species is relatively consistent across its range, and phenology is influenced by latitude to a small degree. Where Irish colonies are at the same latitude as UK colonies, phenology will broadly be consistent between the two.

Table 5.12 provides the list of sites identified for AEoI from displacement during the operational phase of the proposed development, with the associated designated QIs, and bio-season.

Natural England and JNCC issued a joint Interim Displacement Guidance Note (Natural England and JNCC 2012), which provided recommendations for presenting information to enable displacement analysis in relation to offshore wind farm developments. This has since been replaced by a more recent joint SNCB interim displacement advice note (MIG-Birds, 2022) which provides the latest guidance for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs. The assessment approach followed is presented within the Irish Phase 1 Method Statement which was informed by the more recent joint SNCB interim displacement advice note (MIG-Birds, 2022).

Gannet

There is evidence to suggest gannet exhibit a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). In contrast, there is evidence of this species avoiding OWFs (e.g., Dierschke et al. 2016, Leopold et al. 2013, Vanermen et al. 2013, Vanermen et al. 2016, Garthe et al. 2017a, b). Radar and visual observations during the post-construction monitoring of the Egmond aan Zee (OWEZ) OWF indicated that gannet demonstrated macro-avoidance, with 64% of individuals avoiding entering the wind farm (Krijgsveld et al., 2011). In addition, APEM conducted a more recent study (APEM, 2014) that evidenced most gannets would avoid flying into areas with operational WTGs (macro-avoidance) during their migration, with the estimated macro-avoidance being 95%. More recently, gannet were found to exhibit high levels of avoidance from the Beatrice OWF during the project's second year of post-construction monitoring (MacArthur Green, 2021).

Auks

According to Garthe and Hüppop (2004), Furness and Wade (2012), Langston (2010), and Bradbury et al. (2014) guillemot and razorbill demonstrate a medium level of sensitivity to ship and helicopter traffic. Further evidence presented by Dierschke et al. (2016) indicated that guillemot and razorbill show 'weak displacement' from OWFs, however this was highly variable across the thirteen European OWFs included in the study. More recently, displacement of auks (guillemot and razorbill) has been reported in association with several OWF (e.g., APEM, 2017; Webb et al., 2017; Vanermen et al., 2019; Peschko et al., 2020; MacArthur Green, 2021). Furthermore, APEM recently undertook a review (APEM, 2022) which found auk displacement rates to be highly variable, ranging from attraction to displacement effects. This study reported a displacement rate of up to 50% for the array area and 2km buffer for OWFs would be most applicable, and suitably precautionary. Similarly, this rate was reported to be appropriate by Peschko et al., (2020) following a review of OWF data in the German North Sea.

Displacement rates

Based on the evidence available and the UK guidance (MIG-Birds, 2022) the displacement rates for the proposed development are as follows (See Displacement Appendix 17 for further information regarding the displacement analysis):

- 70% for gannet during the operational phase, plus a range of 60% to 80% is also presented to reflect the most recent SNCB guidance (MIG-Birds, 2022); and
- 50% for guillemot and razorbill with a range of 30% to 70% as recommended in the most recent SNCB guidance (MIG-Birds, 2022) as advised by Natural England (Parker et al. 2022c).

Recent work by APEM (2022) considered all post-consent monitoring studies undertaken in the UK and wider work within Europe to date, and similarly found variable responses. However, further analysis revealed that studies finding high displacement rates were often found not to be using the most appropriate statistical modelling methods (e.g., finding high displacement rates due to low abundance and high numbers of zero counts, resulting in reduced reliability of model outcomes), and the outcome from this study was that a displacement rate of 50% was most applicable to auk species, and still sufficiently precautionary. This rate was also supported by a recent review on German North Sea data by Peschko et al., (2020), with this review also finding guillemot displacement rates were reduced by ~20% in the breeding season compared to the non-breeding season, which is an important consideration given that the mean displacement rates derived from the Dierschke et al., (2016) review was predominantly from data collected in the non-breeding season. Similarly, SNCB guidance in UK windfarms (MIG-Birds, 2022) has suggested a displacement range of 30% to 70% should be presented for auk species, with 50% generally presented by Developers as a central value. However, recent post-construction monitoring of the Beatrice OWF found little evidence of any displacement impacts on auk species, with guillemot and razorbill even showing potential attraction responses to WTGs (Trinder et al. 2024). These results are also relevant for the proposed development, considering the similar size (84 WTGs at Beatrice), and similar distance from shore (13km for Beatrice). Surveys in the Belgian North Sea zone initially detected displacement in guillemot and razorbill. However, later surveys with a revised design found no evidence of any strong displacement for guillemot and evidence of attraction for razorbill, but it is unknown whether this was due to habituation or habitat selection.

Similarly, a displacement rate of 44% has been reported from four windfarms in the vicinity of Helgoland (APEM 2022). In spite of an observed displacement rate of 44% from four windfarms in the vicinity of Helgoland, numbers of birds breeding at local colonies continues to rise, suggesting that the impact from (and as such the mortality rate related to) this displacement is not strong.

Auk species can also forage over a range of water depths, meaning they have access to a variety of food sources. Dunn et al. (2020) identified flexibility in both foraging behaviour and energy budgets of guillemot, meaning that displaced birds are likely to have the energetic flexibility to deal with displacement, and the behavioural flexibility to exploit alternative food sources in the event of displacement.

Considering rates suggested for OWFs in the UK, Natural England have endorsed a precautionary displacement rate of 70%, and NatureScot have endorsed a precautionary displacement rate of 60%. However, the recent studies referenced above suggest displacement rates are lower than these rates, and that the higher displacement rates calculated may be unreliable due to the use of zero inflated data, and the fact that they were calculated during the non-breeding season, when displacement has been evidenced as being stronger. Taking the evidence above into account, the use of a value of 50% for all auk species can be considered a suitably precautionary approach.

Mortality rates

A mortality rate of 1% has been applied to each of the species assessed (See Displacement Appendix 17), based on expert judgement and available evidence (APEM, 2022). It should be noted gannet have a large mean-maximum (315km) and maximum (709km) foraging range (Woodward et al., 2019) and feed on a variety of prey items that provide sufficient alternative foraging opportunities despite the potential loss of habitat within the array area. Therefore, gannet are deemed to be able to find alternative food sources in the event of displacement, and as such, the mortality rate of 1% is deemed to be precautionary.

For auks, a mortality range of 1-10% has been recommended within the SNCBs guidance (MIG-Birds, 2022) however several UK OWFs have proposed a 1% or 2% mortality rate to be more appropriate for these species, based on expert judgement (Norfolk Boreas Limited, 2019; SPR, 2019; Ørsted, 2018; van Kooten et al., 2019). A mortality rate of 1% and a range of up to 5% have been applied within the displacement assessments presented here (see Table 5.14 below) based on the recent evidence review carried out by APEM (2022) on behalf of the Hornsea Project Four OWF.

APEM (2022) predicted mortality rates using simulation models for the Flamborough and Filey Coast SPA from displacement impacts from Hornsea Four. These models predicted mortality with a maximum of 1%, which was likely to be an overestimate, due to the distance between the SPA and the array area. Recent studies assessing impacts from OWFs modelled guillemot mortalities of 0.2% (at the Buchan Ness and Collieston Coast SPA) and –2.7% (at the St Abb's Head to Fast Castle SPA).

The table below presents the displacement and mortality rates used for guillemot and razorbill in recently submitted projects for UK OWFs. With the exception of Hornsea Four, the maximum rates recommended are 70% displacement and 2% mortality. Though the SNCB preference for Hornsea Four was 5% mortality, within the Appropriate Assessment for Hornsea Four the SoS concluded that a mortality rate of 2% was appropriate for guillemot and razorbill, suggesting that the UK authority's view is that 10%, and even 5% is over precautionary. Although the rates recommended by SNCBs and agreed by the relevant regulator are larger than those proposed by developers, these recently submitted project rates demonstrate SNCB and the regulator's reluctance to endorse mortality rates above 2% which provides support for this as a realistic maximum mortality rate.

Table 5.14: Displacement and Mortality Rates for auk species from Recently Submitted UK Projects.

Project	Applicant position on displacement : mortality rates (%)	SNCB position on displacement : mortality rates (%)	SoS position on displacement : mortality rates (%)
Outer Dowsing	50:1	70:2	Not available
SEP and DEP	50:1	70:2	70:2
Five Estuaries	50:1	70:2	Not available
Hornsea 4	50:1	70:5	70:2
Norfolk projects	50:1	70:2	70:2

Prior to the submission of Hornsea Four (for which a without prejudice case was submitted for guillemot), derogation in relation to seabird displacement was not considered, so it is only recently that the SNCB displacement and mortality rates have been scrutinised. As such, and based on the above presented evidence, it is concluded that presenting displacement impacts at 50% displacement and 1% mortality is suitably precautionary. Additionally, as seen in Beatrice post-construction monitoring (Trinder *et al.*, 2024), the lack of displacement response (and potential attraction to WTGs) suggests limited potential for any displacement consequent mortality occurring, and therefore 1% is also considered precautionary based on this evidence.

Therefore, though UK SNCB guidance has suggested the use of 10% mortality as a maximum, decisions from consented OWFs show that 2% is a more realistic worst-case scenario to consider. Further to this, available evidence and monitoring as outlined above show that actual displacement consequent mortality is expected to be lower than 1%, and therefore a rate of 1% is considered appropriate and sufficiently precautionary.

As described above, studies published after more recent decisions (such as APEM 2022, Norfolk Boreas Limited, 2019; SPR, 2019; Ørsted, 2018; van Kooten et al., 2019) suggest that 70% displacement is likely to be an overestimate as this was calculated using zero-inflated data; measured displacement is lower than 50%, and modelled mortality is lower than 1%.

An overview of displacement and mortality rates used in the assessment for the array area during operation and maintenance are provided in Table 5.15 below. Any impacts from vessel disturbance in the ECC on divers and seaducks during operation are considered to have the same displacement and mortality rates as those presented in Table 5.13.

Table 5.15: Displacement and Mortality Rates Used for the Assessment of the Operational Phase of NISA.

Species	Displacement rate (%)	Mortality rate (%)
Gannet	70 (range of 60% to 80% presented)	1
Guillemot	50 (range of 30% to 70% presented)	1 (range of 1% to 5% presented)
Razorbill	50 (range of 30% to 70% presented)	1 (range of 1% to 5% presented)
Manx shearwater	10	1

The detailed methods and results of the displacement assessment are presented in Displacement Appendix 17.

The assessments provided within this NIS include a number of assumptions that contribute to the predicted impacts and potential effects being considered appropriately precautionary, including:

- The abundance assessed within each bio-season being the mean of the peaks from each survey year. This makes the assumption that such a high population is maintained for each of the months within the bio-season, whereas in reality the abundance of each species is likely to be considerably less for much of the bio-season. Using the mean of peaks and applying it across the whole bioseason (as opposed to taking an average across the whole bio-season) means that the mortalities attributed to each 'non-peak' month are at the peak rate, and are therefore over precautionary.
- The maximum extent of displacement considered for each species within the assessment is likely to be greater than actually experienced within the array area and (relevant) buffer zone (i.e., birds are not likely to experience displacement impacts across the entire array area and relevant buffer in reality).
- The 1% mortality of displaced birds is highly unlikely, as the species assessed in this NIS are not solely dependent upon the area within the array area and buffer for all their foraging needs either within the breeding or non-breeding bio-seasons (APEM, 2022). The maximum of 5% mortality of birds displaced during the non-migratory breeding bio-season is not realistic (APEM, 2022).
- That adult birds that are actively breeding will respond to displacement by putting themselves to further stress to the extent of dying rather than ceasing to breed (i.e., abandoning eggs or young) and surviving to breed in a later year; and
- The abundance of birds within the array area and relevant buffer was apportioned to relevant SPAs and colonies using the methods set out in the Apportioning Appendix 20. The apportionment assumptions using this method are highly precautionary.

Collision Risk

Birds that fly through the array area whilst foraging, commuting between breeding sites and foraging areas, or when on migration are at risk of collision. The birds are at risk from colliding with the WTG rotors and associated infrastructure which could lead to injury or fatality.

The potential for collision mortalities to result in an AEoI relates to the designated sites and the relevant QIs found in Table 5.16.

It should be noted Manx shearwater were also screened in to assess the potential for collision risk from the proposed development on a precautionary basis, despite the species 'low' sensitivity to collision impacts (Garthe and Huppop, (2004), Furness and Wade (2012), Bradbury et al., (2014), and Wade et al. (2016). However, following the Collision Risk Modelling (CRM) assessment (presented in Collision Risk Modelling Appendix 18 and 19) a total of zero (0.0) collision mortalities were predicted for Manx shearwater. This level of impact can be considered non-material and will, therefore, not affect the achievement of the COs for the SPA and as a result will not have AEoI of the SPA, so this species has not been considered further.

Table 5.16: Sites and Associated Qualifying Interests Identified for Potential AEoI for Collision Risk within the Operational Phase

Site	Qualifying Interests Screened In	Bio-season
Republic of Ireland sites		
Ireland's Eye SPA	Kittiwake, Herring gull	Breeding, and non-breeding
Lambay Island SPA	Kittiwake, Herring gull, Lesser black-backed gull, Fulmar	Breeding, and non-breeding
Saltee Island SPA	Kittiwake, Gannet, Lesser black-backed gull.	Breeding, and non-breeding
Wicklow Head SPA	Kittiwake	Breeding, and non-breeding

Site	Qualifying Interests Screened In	Bio-season
Howth Head Coast SPA	Kittiwake,	Breeding, and non-breeding
Skerries Island SPA	Herring gull	Breeding, and non-breeding
Rockabill SPA	Common tern, Roseate tern, Arctic tern	Breeding, and non-breeding
Helvick Head SPA	Kittiwake	Breeding, and non-breeding
Horn Head to Fanad Head	Kittiwake	Breeding, and non-breeding
North- west Irish Sea cSPA	Kittiwake, Herring gull, Lesser black-backed gull, Common gull, Little gull, Great black-backed gull, Black headed gull, Fulmar, Common tern, Roseate tern, Arctic tern, Little tern, Manx shearwater	Breeding, and non-breeding
UK sites		
Rathlin Island	Kittiwake	Breeding, and non-breeding
Ailsa Craig SPA	Kittiwake, Gannet, Lesser black-backed gull	Breeding, and non-breeding
North Colonsay and Western Cliffs SPA	Kittiwake*	Breeding
Grassholm SPA	Gannet	Breeding
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA	Kittiwake*, Lesser black-backed gull,	Breeding
Ribble and Alt Estuaries SPA	Lesser black-backed gull	Breeding
Morecambe Bay & Duddon Estuary SPA	Lesser black-backed gull	Breeding

*Seabird Assemblage QI

Collision Risk Modelling (CRM) has been used to estimate the potential risk to birds associated with the proposed development. The approach to CRM is presented in CRM Appendix 18 and 19 and provides the methodology, data input and results of the CRM. The Stochastic Collision Risk Model (sCRM) developed by Marine Scotland Science (McGregor, 2018), has been used to carry out the modelling, applied through the 'Shinyapp' interface using the density of flying birds measured by 29 months of DAS to produce species-specific predictions of mortality across set time periods (biological seasons) and annually. This most recent version of the Band (2012) CRM has been designed specifically to address uncertainty in developments and other key input parameters as progressed initially by Masden (2015) for application to the assessment of collision risk to seabirds from offshore wind farm developments. The use of sCRM is standard in industry across UK projects, and therefore is also considered the most relevant approach for Irish projects.

Several different species-specific behavioural aspects of assessed birds, including the height at which birds fly, their ability to avoid moving or static structures and how active they are diurnally and nocturnally, respectively as accounted for by the CRM. Details of these considerations are also provided CRM Appendix 18 and 19.

CRM follows an evidence-led approach taking into account site-specific DAS data collected from within the array area along with the up-to-date literature on seabirds and their behaviour in relation to OWFs (CRM Appendix 18 and 19). However, there is limited evidence available, regarding impacts of OWFs to seabird species specific to Ireland, therefore evidence from UK and European OWFs has been considered, which is considered applicable here due to the proximity of this evidence-base to Irish waters/ornithological receptors.

The Band Option 2 has been relied upon as the model to carry through to the assessment of collision risk for all the assessed species presented here (see Table 5.16 for the list of collision risk species assessed). Option 2 assumes a uniform distribution of bird flights between the lowest and the highest levels of the rotors and uses generic flight height data presented in Johnston et al. (2014). Site-specific flight height data was collected; however, these data were not used in the assessment following inconsistencies within the data (see CRM Appendix (18 and 19) and the Ornithology Technical Baseline Appendix (12) for further information regarding the use of Option 2). Option 2 has been relied upon for all UK projects (e.g., East Anglia TWO; Rampion 2 Wind Farm; Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Project and West of Orkney Wind Farm) and the use of the Johnston et al. (2014) flight height data is recommended by Natural England (Natural England, 2022) and NatureScot (NatureScot, 2023c).

Precautionary Nature of CRM

Several different species-specific behavioural aspects of the seabirds being assessed, including the height at which birds fly, their ability to avoid moving or static structures and how active they are diurnally and nocturnally are considered in CRM. Owning to the lack of Irish-specific evidence the parameters used are advocated for by Natural England (Natural England, 2022) and NatureScot, notably accounting for updates to avoidance rates and nocturnal activity factors provided in this recent guidance. These values are provided in CRM Appendix 18 and 19.

Avoidance rates are an important CRM parameter that account for bird behavioural responses to OWFs. Avoidance to OWFs can occur at three scales micro-avoidance, meso-avoidance, and macro- avoidance, according to Cook et al. (2014), see CRM Appendix 18 and 19 for further information regard avoidance behaviour. The avoidance rates used within this assessment were drawn up in consultation with NPWS. The result of this consultation was a recommendation to use species-specific avoidance rates from Ozsanlev-Harris et al. (2022) (as opposed to the lower and more precautionary grouped rates. For example, using the species-specific avoidance rate for great black-backed gull of 0.9991, as opposed to the using the ‘large gull’ avoidance rate of 0.994 recommended by Natural England, results in an 85% reduction in collisions from altering one parameter alone. Since the use of species-specific avoidance rates would have resulted in substantially reduced impacts, the more precautionary group rates as recommended by Natural England in the latest interim guidance (Natural England, 2022) were used. However, given the levels of precaution in each input parameter within the model, the results presented should be considered as a worst, worst case and not representative of the expected collision rate, which based on the most up to date evidence will be up to 90% lower for some species. This is further evidenced by collision monitoring at the Aberdeen Offshore Wind Farm Facility (AOWFL) which found no collisions or near misses of any bird species across over 10,000 videos (the study used radar monitoring combined with camera/video footage) (AOWFL, 2023). The avoidance rates used within this assessment for the proposed development are presented in the CRM Appendix 18 and 19.

For flight speed, RoyalHaskoningDHV (2020) undertook a review for the proposed Norfolk Boreas Offshore Wind Farm and estimated that the flight speed of 13.1m/s applied for kittiwake is an overestimate, and that a value of 10.8m/s (±0.9m/s) is more realistic based on a range of monitoring methods. In contrast, Skov et al. (2018) presented an even lower value of 8.7m/s (±3.2m/s) to be more appropriate, based on large sample sizes of bird species recorded in the Thanet OWF. Skov et al. (2018) also suggested a value of 13.3m/s (± 4.2m/s) would be more appropriate for gannet than the current flight speed applied (14.9m/s), and a value of 9.8m/s (± 3.6m/s) for large gull species.

As per the most recent interim guidance from Natural England (Natural England, 2022) and NatureScot (NatureScot, 2023c) the flight speeds applied to the CRM were derived from Alerstam et al. (2007) and Pennycuick (1987). Flight speeds for all assessed species, except for gannet, were taken from the former and the latter provided the gannet flight speed. These flight speeds are presented in CRM Appendix 18 and 19 and were agreed upon following consultation with NPWS.

Nocturnal activity factors (NAF) are applied during CRM to account for nighttime activity of seabirds, for further information regarding this see CRM Appendix 18 and 19. The NAF used in this assessment were derived from the most robust scientific evidence and expert judgement, namely Garthe and Hüppop (2004) and Furness et al. (2018), as per the most recent Natural England guidance (Natural England, 2022).

The former provided the mean NAF values for all the assessed species (Table 5.16) except for gannet which was taken from the latter. These NAF values are presented in the CRM Appendix 18 and 19 and were drawn up following consultation with NPWS, with the conclusion to follow the precautionary established guidance.

Whilst the collision risk assessment for the proposed development is in line with the current guidance, it should be noted that the application of the lower flight speeds (presented above) and lower nocturnal activity factors would result in considerably lower collision rates (~40% lower). Therefore, it is considered that the CRM input parameters used in the assessment of collision risk to seabirds for the proposed development and those from other projects at the in-combination level, incorporate a high degree of precaution.

Barrier effects

Detailed consideration of barrier effects is provided for the North-West Irish Sea SPA and Rockabill SPA qualifying interests only. For other SPAs, the greater distance from the proposed development is such that connectivity with the array area will be reduced. Therefore, there is low potential for the proposed development to create a barrier to movement and limit access to the SPA or ecologically important sites outside the SPA. Additionally, impacts arising from barrier effects are already accounted for within the assessment of displacement impacts for relevant species (as outlined in Section 0).

Assessment Data

Information used to inform the apportioning of impacts to individual SPAs is provided in Apportioning Appendix 20, including the following:

- Bio-seasons assumed in the assessment.
- Adult proportions of birds within the array area.
- Distances from the centre of the array area to relevant SPAs.
- The at sea foraging area available to birds from each SPA.
- The proportion of adults apportioned to each SPA in the breeding and non-breeding bio-seasons; and
- SPA population sizes (both citation counts and more recent counts where relevant).

5.4.2 North-west Irish Sea cSPA

The array area and ECC are located within the NWIS cSPA which covers an area of 2,333km^2 and is designated for 21 species of seabird, including four tern species, three auk species, seven gull species, two diver species, fulmar, Manx shearwater, shag, cormorant and common scoter. All designated species have been considered in the ornithology assessment presented here.

Twelve QIs of North-West Irish Sea cSPA have been screened in for the assessment of impacts arising from the onshore elements of the proposed development, where the landfall site is immediately adjacent to the cSPA, and due to their presence within the ZoI during baseline surveys. Whereas, for impacts arising from the offshore elements of the proposed development all species were screened in with the exception of cormorant and shag, which are not considered at risk of offshore impacts of collision effects (based on flight height data) or displacement impacts (with evidence of birds even being attracted to OWFs and roosting on the structures) (Bradbury et al¸2014, Dierschke et al., 2016), on puffin and Sandwich tern due to low numbers recorded across 29-months of DAS data, and therefore no significant effects are expected for these species (only one Sandwich tern was recorded, and a peak count of 12 puffin).

Where breeding colony SPAs abut the NWIS cSPA, assessment of AEoI on breeding populations has been carried out against three different breeding season populations: (1) the individual populations from abutting SPAs; (2) the NWIS cSPA Citation population (as stated in the COs); and (3) the regional population for the relevant bio-season (as described and defined within the Ornithology Technical Baseline (Appendix 12)).

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC.

Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the North-West Irish Sea cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

5.4.2.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the North-west Irish Sea cSPA are considered within this section:

Table 5.17:Qualifying Interests and Conservation Objectives of North-west Irish Sea cSPA

Qualifying Interests Screened In	Conservation Objectives
Red-throated Diver [A001] Great Northern Diver [A003] Common Scoter [A065] Black-headed Gull [A179] Common Gull [A182] Little gull [A177] Great black-backed gull Lesser Black-backed Gull [A183] Herring Gull [A184] Fulmar [A009] Kittiwake [A188] Manx shearwater [A013] Little tern [A195] Roseate tern [A92] Common tern [A193] Arctic tern [A194] Guillemot [A199]; and Razorbill [A200].	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this cSPA, which is defined by the following attributes and targets: Population size (number): No significant decline. Distribution (hectares, timing, and intensity of use of areas): Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population. Forage spatial distribution, extent, and abundance (Location and hectares, and forage biomass): Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target. Disturbance across the site (Intensity, frequency, timing, and duration): The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution. Barriers to connectivity and site use (Number; location; shape; area (hectares)): The number, location, shape and area of barriers do not significantly impact the site population's access to the cSPA or other ecologically important sites outside the cSPA.

5.4.2.2 Guillemot

Guillemot has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from the proposed development alone.

Guillemot are a qualifying interest at two SPAs that abut the NWIS cSPA: Lambay Island SPA; and Ireland's Eye SPA. Breeding guillemot from these SPAs are highly likely to utilise the habitat encompassed within the cSPA while foraging. Therefore, any impacts from displaced guillemot within the NWIS cSPA will be apportioned to the breeding populations at these SPAs. As such the 'Population size' CO has been measured against three defined populations: (1) the individual populations from abutting SPAs, (2) the NWIS cSPA Citation population (as stated in the COs), and (3) the regional population for the relevant bio-season (as described and defined within the Ornithology Technical Baseline (Appendix 12)).

Guillemot are susceptible to potential distributional responses to OWF(s) therefore, this species may be vulnerable to changes in habitat availability and range within the NWIS cSPA. Therefore, guillemot were screened in to assess for changes in distribution, during the construction, operation and decommissioning phases within the array area. To assess potential changes in distribution of guillemot and in turn changes in habitat availability and range within the NWIS cSPA, the increase in densities outside of the array area within the rest of the NWIS cSPA, following a displacement of 50% of birds, has been calculated. Additionally, the quality and quantity of appropriate Auk foraging habitat outside of the array area to support the population has been assessed. Guillemot diet and energy budgets are flexible (Dunn et al. 2020), which enables them to cope with the demands of displacement from preferred foraging areas.

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). Including sitting birds within the displacement analysis accounts for those birds potentially displaced from an area of sea they reside, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for within the displacement assessment below. This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). However, available tracking data of guillemot from the region have also been reviewed also been reviewed to determine whether there are any site-specific foraging hotspots or distributional trends that should be considered in the assessment.

5.4.2.2.1 Mitigation

Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

Array refinements have also been considered in relation to the North-West Irish Sea (NWIS) cSPA, which was recently (2023) designated and fully encompasses the proposed development. The cSPA covers an area of 2,333km^2. The original MAC boundary array area (195.9km^2) would represent 8.4% of the NWIS cSPA, however with array refinements, the final array area covers just 3.8% of the NWIS cSPA. Array area refinements have therefore considerably reduced the potential impacts on the NWIS cSPA.

5.4.2.2.2 Disturbance and Displacement (Construction and Decommissioning)

As determined in Table 5.11, Project Option 1 has a greater potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from construction and decommissioning activities.

The impacts of displacement during the construction and decommissioning phases of the proposed development on guillemot are unlikely to equal those estimated during the operational phase of the proposed development due to the localised nature of construction activities and the reduced size of the Project's footprint. During construction, any potential displacement impacts in the array area are assumed to be half that of operation. This is because, on average, approximately half the array will be constructed. This is standard practice for UK assessments and assumed to be precautionary because WTG blades will be static and not cause the same level of displacement as a fully operational wind farm. Consequently, it is reasonable to assume the potential disturbance and displacement impacts on the guillemot QI of the NWIS cSPA regarding population size, during the construction and decommissioning phases will be small and are likely to be limited temporally; with the extent of effects depending on the activities taking place. For the full assessment of the potential AEoI from displacement from the proposed development alone, during the operational phase, in relation to the Population size CO for the guillemot QI of the NWIS cSPA see the section below.

Conclusion of AEoI

The construction and decommissioning phase impacts are estimated to be half those presented in the following section for the operation phase. Given that no AEoI to the Population size CO of the guillemot QI of NWIS cSPA has been concluded during the operational phase (see Section 5.4.2.2.3), subject to natural change, the guillemot QI will be maintained in the long term.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.2.3 Disturbance and displacement (Operation)

As determined in Table 5.11 Project Option 1 has greater potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from operation and maintenance activities.

The summed mean peak abundance of guillemot in the array area plus a 2km buffer during the breeding and non-breeding bio-seasons is estimated at 31,578. Based on 50% displacement and 1% mortality this equates to 157.89 guillemot mortalities per annum across all bio-seasons (Table 5.18).

Displacement impacts apportioned to the guillemot populations of Ireland's Eye and Lambay Island SPAs during the breeding and non-breeding bio-seasons can be found in Sections 5.4.11.2 and 5.4.14.2, respectively. The assessments for both sites concluded no AEoI during the breeding and non-breeding bio-seasons.

There is no clear citation count for guillemot at the NWIS cSPA. The conservation objectives state a population of 93,191 guillemot and razorbill (combined) and the site synopsis presents a population of 13,914 guillemot for either the autumn or the winter. The Developer cannot conclude on impacts on 31,578 birds (from DAS data) against a citation population of 13,914 individuals. Likewise, it is not possible to conclude on impacts relating to a conservation objective of 'no significant decline' when no population is cited in the conservation objectives (or elsewhere). The developer has assessed against a population of guillemots derived from the guillemot/razorbill numbers cited in the NWIS cSPA guillemot conservation objectives, with site specific DAS guillemot/razorbill ratios applied, resulting in a population of 86,024 individuals. However, this is not a citation count and so no conclusions regarding integrity can be drawn from this assessment. When assessing the full unapportioned impacts on guillemot to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (86,024 individuals), the increase in baseline mortality relative to this citation count (86,024 individuals) and an associated background mortality of 11,871 individuals calculated using a mortality rate averaged across all age groups would be 1.330%. However, early in the non-breeding season (ObSERVE surveys were carried out in September or November), at a site so close to large breeding colonies, it is likely that a relatively large proportion of the birds are juveniles. With a population of 86,024 birds, and a productivity rate of 0.823 (the 'western' productivity rate for guillemot from Horswill and Robinson (2015)), populations of 61,070 adults and 24,954 juveniles can be calculated. Applying the relevant adult and juvenile mortality rates to these populations gives a combined adult and juvenile mortality of 14,704 individuals. An impact of 157.89 (mean mortality calculated for 50% displacement and 1% mortality) would represent an increase of 1.073% on this more likely scenario. The more precautionary increase in baseline mortality of 1.330% is used in the assessment here.

Table 5.18 presents the displacement consequent mortalities as per the range recommended within the UK SNCBs guidance and within the Irish Phase 1 methodology note (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). This non-breeding NWIS cSPA count informed by the ObSERVE surveys (86,024 individuals) is derived from a sample of birds using NWIS cSPA during a single survey. Bird numbers at any given time and place can be influenced by presence of food, weather, or the presence of birds migrating through the area. As such, the population for the area described by the ObSERVE data merely present a snapshot, as opposed to a population aggregating at the site regularly, averaged over a number of years. As such, the number presented from this snapshot may not be representative of the population regularly using the site. As the birds within the NWIS cSPA and wider area are not constrained during the non-breeding season, these birds are likely to be from a much wider population that use the NWIS cSPA sporadically, as opposed to being resident there in the non-breeding season. Tracking studies from Scottish colonies have shown that individual birds may wander widely during the non-breeding season (e.g. Harris et al. 2015).

As such, the Developer does not consider it appropriate to assess against this population size. As detailed in the Apportioning Appendix 20, the appropriate post-breeding population is 326,348 based on kernel analysis presented in Buckingham et al. (2022).

When assessing the full unapportioned impacts of the proposed development on guillemot to the regional population of 326,348 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 45,036 individuals would be 0.351%. This level of impact would be indistinguishable from natural fluctuations in the population. Table 5.18 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the guillemot QI of NWIS cSPA when assessed at the regional population scale, based on disturbance and displacement effects from the proposed development alone, during the operational phase. Therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.18: Range-Based Displacement Mortalities During the Operational Phase for Guillemot at NWIS cSPA Based on a Range of Displacement Impacts and the Latest ObSERVE Autumn Population and the Regional Population.

SPA	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (ObSERVE Autumn Population)		% increase in baseline mortality (Regional Population)	
		50% displacement 1% mortality	30-70% displacement 1 – 5% mortality	50% displacement 1% mortality	30-70% displacement 1 – 5% mortality	50% displacement 1% mortality	30-70% displacement, 1 – 5% mortality
UCI							
NWIS	40,150.9	200.75	120.45 – 1,450.28	1.691	1.051 – 11.838	0.446	0.267 – 3.120
Mean							
NWIS	31,578.1	157.89	94.73 – 1,105.23	1.330	0.798 – 9.310	0.351	0.210 – 2.454
LCI							
NWIS	22,904.9	114.52	68.71 – 801.97	0.965	0.579 – 6.753	0.254	0.153 – 1.780

5.4.2.2.4 Spatial distribution (Construction, Operation and Decommissioning)

The array area and the array plus 2km buffer occupy 3.8% and 8.6% of the NWIS cSPA, respectively. Therefore, when considering 8.6% (array plus 2km buffer) of the NWIS cSPA may contain a reduced abundance of guillemot due to displacement impacts. It should be noted that the original array boundary occupied over double the 3.8% proportion (8.4%) of the cSPA. As such, the updated array area is 64% smaller than the original boundary. The reduction in project boundary size resulted in a 49.2% reduction in raw count of guillemot in the proposed development boundary (based on data between May 2020 and August 2022). It is therefore considered that the proportion of foraging area lost as a result of the proposed development has already been significantly reduced through project design.

In order to calculate the number of guillemot within the NWIS cSPA and, in turn, that would potentially be at risk of a change in spatial distribution. from the array area during the construction, operation and decommissioning phases, the density of guillemot within the NWIS cSPA were estimated using data presented in Jessop et al. (2018). These data were used as the assessment measures the overall proportion of birds within the cSPA that are potentially subjected to change in spatial distribution.

As the Developer's DAS data does not cover the whole cSPA area, the Jessop et al. (2018) dataset is used. Guillemot and razorbill were not differentiated between during the surveys from which the Jessop et al. (2018) data were collected. Recorded guillemot and razorbill were therefore apportioned to species level according to the numbers recorded within the proposed development DAS data. There were 35,631 guillemot and 2,494 razorbill recorded during the 29 months of DAS, it was therefore assumed 93.5% of individuals in the Jessop et al. (2018) data were guillemot in this season and 6.5% were razorbill.

The overall density of guillemot within the NWIS cSPA was estimated to be 7.4 birds/km^2 during the summer, 38 birds/km2 during the autumn and 7.3 birds/km^2 during the winter (seasonal population of SPA divided by the total NWIS cSPA area of 2,333km^2).

The largest area from which guillemot could be displaced was the array area plus a 2km buffer which is 201.3km^2. Assuming 50% of the guillemot are displaced from this area, 226, 5,654 and 181 (depending on seasons) birds would be displaced from the array area (plus 2km buffer) into the remainder of the NWIS cSPA (2,132km^2), during the summer, autumn, and winter. This would result in a maximum increase in density within the remainder of the NWIS cSPA of 8.0%, 2.3% and 8.3%, respectively. See Table 5.19 for the increase in density within the remainder of the NWIS cSPA as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement).

In addition, habitat modelling of guillemot distribution throughout the survey area (MAC boundary and 4km buffer) showed a clear hotspot of guillemots in proximity to Lambay Island during the core breeding season months of May and June, with no clear overlap or hotspots within the array area (see Appendix 23: MRSea Modelling for Offshore Ornithology). During the non-breeding season guillemot dispersed more widely and were evenly distributed across the full survey area during most months. Consequently, it is clear that usage of the array area is limited in the breeding season and that there is a large extent of alternative habitat in the wider region during the non-breeding season when guillemot movements are less constrained.

The area over which guillemot could be at risk of change in spatial distribution within the NWIS cSPA as a result of the construction, operation and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA. Furthermore, based on tracking data, it is clear that guillemot have a large foraging range (mean max +1SD of 153.7km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is expected to cause minimal alteration to foraging habitat usage, given that individuals often travel beyond the NWIS cSPA boundaries to forage.

According to seabird sensitivity rankings reported in Bradbury et al. (2014) and Humphreys et al. (2015) guillemots are at moderate/medium risk of barrier effects and/or displacement. Furthermore, evidence from several OWFs, primarily located in the southern North Sea, suggests that guillemot can exhibit varying responses to these structures; with numbers increasing, decreasing, and remaining unchanged (Dierschke et al., 2016). However, it should be noted that these results likely reflect wintering distributions of guillemot instead of breeding distribution and therefore it is likely responses to OWFs will vary throughout the year (MacArthur Green, 2021). More recently, findings from spatial monitoring from the second year of post-construction surveys for the Beatrice Offshore Wind Farm have indicated that guillemot did not avoid the turbines and therefore were not displaced from the array area (MacArthur Green, 2021). Beatrice is a similar situation to NISA as it is a project relatively close inshore, near to substantial colonies. Furthermore, the foundations of offshore WTG can act like an artificial reef and in turn increase prey species abundance and density (Stenberg et al., 2015). Commercial fishing activity may also decline within the proposed development boundary which could increase prey availability and therefore improve foraging potential and attract birds to the area in and around the OWF (Dierschke et al., 2016). Considering the evidence available from existing OWFs the extent to which guillemot will be displaced from the array area is unknown but will almost certainly be to a lesser extent than the 50% assumed within the assessment. As per the evidence presented above, the proposed development may provide benefits namely, increasing prey and foraging opportunities for seabirds within the array area.

There is evidence to suggest that seabirds may habituate to the presence of OWF in their environment (Dierschke & Garthe,2006; Drewitt & Langston 2006; Fox et al. 2006; Petersen & Fox 2007). According to observations from surveys at various OWFs (e.g., Horns Rev 2, Luchterduinen OWF and Beatrice Wind Farm) species including common scoter, common guillemot and razorbill are already demonstrating behaviour to suggest these birds are becoming habituated to the presence of these projects in their foraging environment (Leopold & Verdaat, 2018; Degraer et al., 2019).

Therefore, birds may be displaced from the array area initially but would then return to the OWF within a few years; according to Leopold and Verdaat (2018) auks were observed utilising the marine environment within the Luchterduinen OWF three years following commercial operation in 2015. Likewise, post construction monitoring data at Beatrice Wind Farm in the Moray Firth showed that both guillemot and razorbill did not avoid WTG, irrespective of the WTG operational status.

Auks have flexibility in their foraging strategies and energy budgets throughout the year (Dunn et al. 2020). As such, these are relatively small (and precautionary) changes in density across the wider cSPA area. Densities supported in autumn are much higher than in the breeding and winter periods, likely as a result of dispersing breeding birds rather than increased abundance in food. The densities in autumn are considerably higher than the predicted post construction densities (i.e. those increased by changes in spatial distribution), meaning that the cSPA should be able to support the relatively much smaller increases in the breeding season and the winter. In the autumn, where densities are highest, the increase in density across the whole cSPA is 2.3%. It is considered that the flexibility in auk foraging strategy and energy budgets, and the temporary nature of the effect (densities are high only when birds are dispersing through the site, and birds do not linger within the cSPA for long (see declines in density from Autumn to Winter), will allow them to cope with these small increases in bird density.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of NWIS cSPA in relation to spatial distributional from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for impacts on spatial distributional.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.19: Range-Based Increase in Density of Guillemot Within the Remainder of the NWIS cSPA During the Summer, Autumn, and Winter Following 50%, 30%, and 70% Displacement.

Season	Estimated number of individuals displaced from array area (plus 2km buffer)		Estimated increase in density in remainder of NWIS cSPA (%)	
	50% displacement	**30-70% displacement**	**50% displacement**	**30-70% displacement**
Summer	226.2	135.7 – 316.6	8.0	8.6 – 7.4
Autumn	5,654.4	3,392.6 – 7,916.1	2.3	5.1 – -0.6
Winter	180.9	108.6 – 253.3	8.3	8.7 – 7.8

5.4.2.2.5 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

During the breeding bio-season, guillemot typically feed on micronektonic prey ranging from two to 25cm in length, predominantly items measuring six to 10cm. These prey items include fish such as sand eel, clupeids, and gadoids, as well as large copepods and squid (Ainley et al., 2021). As such, guillemot exhibit a reasonably varied diet, with an even greater diversity observed during the non-breeding bio-season. Moreover, based on tracking data, guillemot have a large foraging range (mean max +1SD of 153.7km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above guillemot are considered to be adaptable to potential localised changes to prey species abundance (relative to the large foraging range) and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case guillemot can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.2.6 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). Including sitting birds within the displacement analysis accounts for those birds potentially displaced from an area of sea they reside, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for in the disturbance & displacement section. This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). However, available tracking data of guillemot from the region has also been reviewed to determine whether there are any site-specific foraging hotspots or distributional trends that should be considered in the assessment.

Tracking data of guillemot from Lambay Island SPA, recorded across 10 days between 2010 and 2011 were presented in Baer and Newton (2012). The majority of foraging activity by guillemot from this colony was concentrated within 29km of the island, with the maximum distance travelled from the colony being 45km, this indicates a potential partial overlap with the proposed development (located 14.4km from Lambay Island SPA). However, through Kernal analysis, three foraging hotspots were identified, the largest being due east of Lambay Island SPA on a 20km north-south axis (Baer and Newton, 2012) which does not overlap with the array area (plus a 2km buffer). Much (if not all) of the tracking data was collected during the guillemot incubation period. Although birds are constrained during this time, they are less constrained than during the chick rearing period, where foraging intensifies (shorter, more frequent trips) in order to provision young. As such, overall interaction between this species and the proposed development during the breeding season is likely to be lower than demonstrated by these tracking data.

Guillemot densities during the breeding season (Jessop et al., 2018) were highest to the south and east of Lambay Island SPA. This suggests that the majority of birds from Lambay and other nearby colonies will have limited interaction with, and are very unlikely to forage beyond, the proposed development, thus eliminating the possibility of barrier effects occurring.

The high densities to the south and east of Lambay suggest that there is likely to be suitable foraging to sustain the relatively small number of birds that will potentially be displaced by the proposed development. Likewise, the relatively consistent densities to the north west of the highest density areas suggest that these areas can also support reasonable numbers of auks, and as such, accommodate the relatively small numbers displaced by the proposed development. Very high densities of auks were noted in this area during autumn surveys (in September) (Jessop et al., 2018). This suggests that this area is well used by birds in the post breeding dispersal period, therefore it can be assumed that it can provide foraging habitat suitable to sustain much higher numbers of birds than use these areas during the breeding season. Again, this suggests that any displaced birds should be able to find alternative suitable foraging areas without expending excessive additional energy.

Tracking of guillemot during the breeding season (e.g. Carroll et al., 2019) shows that they can exploit a range of different foraging sites in a relatively short period of time. Thus, displacement from one particular area is unlikely to have sustained impact as a displaced bird will simply relocate to another suitable area, and barrier effects are unlikely to be encountered on numerous occasions (assuming that birds learn when a particular area is no longer available to them), thus reducing the energetic cost of having to fly around a perceived barrier. Although it cannot be completely ruled out that, on occasion, guillemot from the colony at Lambay Island SPA might forage in the waters on the far side of the array area, the evidence suggests that this would be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

As the majority of birds foraging from Lambay Island will not encounter the array area, the potential for barrier effects is minimal.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.3 Razorbill

Razorbill has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from the proposed development alone.

According to the Site Synopsis, razorbill are a qualifying interest at two SPAs that abut the NWIS cSPA, Lambay Island SPA and Ireland's Eye SPA. Breeding razorbill from these SPAs are highly likely to utilise the habitat encompassed within the cSPA while foraging. Therefore, any impacts from displaced razorbill within the NWIS cSPA will be apportioned to the breeding populations at these SPAs. As such the 'Population size' CO has been measured against three defined populations: (1) the individual populations from abutting SPAs, (2) the NWIS cSPA Citation population (as stated in the COs), and (3) the biogeographic population for the relevant bio-season (as described in the Ornithology Technical Baseline).

Razorbill are susceptible to potential distributional responses to OWF(s) therefore, this species may be vulnerable to changes in habitat availability and range within the NWIS cSPA. Therefore, razorbill were screened in to assess for changes in distribution, during the construction, operation and decommissioning phases within the array area. To assess potential changes in distribution of razorbill and in turn changes in habitat availability and range within the NWIS cSPA, the increase in densities outside of the array area within the rest of the NWIS cSPA, following a displacement of 50% of birds, has been calculated. Additionally, the quality and quantity of appropriate Auk foraging habitat outside of the array area to support the population has been assessed.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). Including sitting birds within the displacement analysis accounts for those birds potentially displaced from an area of sea they reside, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for within the displacement assessment below.

This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). However, available tracking data of razorbill from the region has also been reviewed to determine whether there are any site-specific foraging hotspots or distributional trends that should be considered in the assessment.

5.4.2.3.1 Mitigation
Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

Array refinements have also been considered in relation to the North-West Irish Sea (NWIS) cSPA, which was recently (2023) designated and fully encompasses the proposed development. The cSPA covers an area of 2,333km^2. The original MAC boundary array area (195.9km^2) would represent 8.4% of the NWIS cSPA, however with array refinements, the final array area covers just 3.8% of the NWIS cSPA. Array area refinements have therefore considerably reduced the potential impacts on the NWIS cSPA.

5.4.2.3.2 Disturbance and Displacement (Construction and Decommissioning)
As determined in Table 5.11 Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from construction and decommissioning activities.

The impacts of displacement during the construction and decommissioning phases of the proposed development on razorbill are unlikely to equal those estimated during operational phase of the proposed development due to the localised nature of construction activities and the reduced size of the Project's footprint. During construction, any potential displacement impacts in the array area are assumed to be half that of operation. This is because, on average, approximately half the array will be constructed. This is standard practice for UK assessments and assumed to be precautionary because WTG blades will be static and not cause the same level of displacement as a fully operational wind farm. Consequently, it is reasonable to assume the potential disturbance and displacement impacts on the guillemot QI of the NWIS cSPA regarding population size, during the construction and decommissioning phases will be small and are likely to be limited temporally; with the extent of effects depending on the activities taking place. For the full assessment of the potential AEoI from displacement from the proposed development alone, during the operational phase, in relation to the Population size CO for the razorbill QI of the NWIS cSPA see the section below.

Conclusion of AEoI
The construction and decommissioning phase impacts are estimated to be half those presented in the following section for the operation phase. Given that no AEoI to the Population size CO of the razorbill QI of NWIS cSPA was concluded during the construction and decommissioning phase, subject to natural change, the razorbill QI will be maintained in the long term.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.3.3 Disturbance and Displacement (Operation)
As determined in Section 5.4.1.3, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from operation and maintenance activities.

The summed mean peak abundance of razorbill in the array area plus a 2km buffer during the breeding and non-breeding bio-seasons is estimated at 6,101. Based on 50% displacement and 1% mortality this equates to 30.50 razorbill mortalities per annum across all bio-seasons (Table 5.20).

Displacement impacts apportioned to the razorbill populations of Ireland's Eye and Lambay Island SPAs during the breeding and non-breeding bio-seasons can be found in Sections 5.4.11.2 and 5.4.14.2, respectively. The assessments for both sites concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on razorbill to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (5,980 individuals), the increase in baseline mortality relative to this citation count (5,980 individuals) and an associated background mortality of 783 (783.4) individuals would be 3.894%. Table 5.20 presents the displacement consequent mortalities as per the range recommended within the UK SNCBs guidance and within the Irish Phase 1 methodology note (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix 20, the appropriate regional population is 632,453 individuals.

When assessing the full unapportioned impacts on razorbill to the regional population of 632,453 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 114,474 individuals would be 0.027%. This level of impact would be indistinguishable from natural fluctuations in the population. Table 5.20 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the razorbill QI of NWIS cSPA, based on disturbance and displacement effects from the proposed development alone, during the operational phase. Therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.20: Annual Range-Based Displacement Mortalities During the Operational Phase for Razorbill at NWIS cSPA Based on a Range of Displacement Impacts and the Latest ObSERVE Autumn Population and the Regional Population.

	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (ObSERVE Autumn Population)		% increase in baseline mortality (Regional Population)	
		50% displacement 1% mortality	**30-70% displacement, 1 – 5% mortality**	**50% displacement, 1% mortality**	**30-70% displacement, 1 – 5% mortality**	**50% displacement, 1% mortality**	**30-70% displacement, 1 – 5% mortality**
UCI							
NWIS	9,278.9	46.4	27.8 – 324.8	5.922	3.553 – 41.453	0.041	0.024 – 0.284
Mean							
NWIS	6,101.0	30.5	18.3 – 213.5	3.894	2.336– 27.257	0.027	0.016 – 0.187
LCI							
NWIS	3,117.5	15.6	9.4 – 109.1	1.990	1.194 – 13.928	0.014	0.008 – 0.095

5.4.2.3.4 Spatial Distribution (Construction, Operation and Decommissioning)

The array area and the array plus 2km buffer occupy 3.8% and 8.6% of the NWIS cSPA, respectively. Therefore, under the worst-case scenario 8.6% of the NWIS cSPA may contain a reduced abundance of razorbill due to displacement impacts. It should be noted, appropriate mitigation has already been taken, with the original array boundary occupying over double the 3.8% proportion (8.4% of the NWIS cSPA). The reduction in project boundary size almost halved the number of guillemots within the array area (49.2% reduction in raw count based on data between May 2020 and August 2022). It is therefore considered that the proportion of foraging area lost as a result of the proposed development has already been significantly reduced through appropriate mitigation.

In addition, habitat modelling of razorbill distribution throughout the survey area (MAC boundary and 4km buffer) showed a clear hotspot of razorbill in proximity to Lambay Island during the core breeding season months of May and June, with no clear overlap or hotspots within the array area (see Appendix 23: MRSea Modelling for Offshore Ornithology). During the non-breeding season razorbill dispersed more widely and were evenly distributed across the full survey area during most months. Consequently, it is clear that usage of the array area is limited in the breeding season and that there is a large extent of alternative habitat in the wider region during the non-breeding season when guillemot movements are less constrained.

In order to calculate the number of razorbill within the NWIS cSPA and, in turn, that would potentially be at risk of displacement from the array area during the construction, operation and decommissioning phases, the density of razorbill within the NWIS cSPA were estimated using data presented in Jessop et al. (2018). Guillemot and razorbill were not differentiated between during the surveys from which the Jessop et al. (2018) data were collected. Recorded guillemot and razorbill were therefore apportioned to species level according to the numbers recorded within the proposed development DAS data. There were 35,631 guillemot and 2,494 razorbill recorded during the 29 months of DAS, it was therefore assumed 93.5% of individuals in the Jessop et al. (2018) data were guillemot in this season and 6.5% were razorbill.

The overall density of razorbill within the NWIS cSPA was estimated to be 2.7 birds/km^2 during the summer, 13.7 birds/km^2 during the autumn and 2.7 birds/km^2 during the winter (seasonal population of SPA divided by the total NWIS cSPA area of 2,333km2).

The 'worst case' area from which razorbill could be displaced was the array area plus a 2km buffer which is 201.3km^2. Assuming 50% of the razorbill are displaced from the array area, 84, 2,105 and 67 birds would be displaced from the array area (plus 2km buffer) into the remainder of the NWIS cSPA (2,132km^2), during the summer, autumn, and winter. This would result in a maximum increase in density within the remainder of the NWIS cSPA of 8.0%, 2.3% and 8.3%, respectively. See Table 5.21 for the increase in density within the remainder of the NWIS cSPA as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement).

The area over which razorbill could be displaced within the NWIS cSPA as a result of the construction, operation and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA. Furthermore, based on tracking data, it is clear that razorbill have a large foraging range (mean max +1SD of 164.6km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is expected to cause minimal alteration to foraging habitat usage, given that individuals often travel beyond the NWIS cSPA boundaries to forage.

Similarly, to guillemot Bradbury et al. (2014) and Humphreys et al. (2015) deemed razorbill to be at moderate/medium risk of barrier effects and/or displacement from offshore wind farms. This species has also exhibited varying responses to offshore wind farms within the southern North Sea, with razorbill numbers increasing, decreasing, and continuing to be the same (Dierschke et al., 2016). Additionally, razorbill were found to show no avoidance in response to the Beatrice OWF (MacArthur Green, 2021). Furthermore, according to Woodward et al. (2019), tracking data has evidenced razorbill have a mean max foraging range (+1SD) of 164.6km, therefore any changes to the usage of foraging habitat as a result of the proposed development is expected to be minimal. As per the evidence presented here and that in the above it is unlikely that razorbill will be fully displaced from the arra area and could be attracted to the area as a result of the increased prey abundance and densities associated with offshore infrastructure (Stenberg et al., 2015).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of NWIS cSPA in relation to spatial distributional from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for impact on spatial distributional.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.21: Range-Based Increase in Density of Razorbill Within the Remainder of the NWIS cSPA During the Summer, Autumn, and Winter Following 50%, 30%, and 70% Displacement.

Season	Estimated number of individuals displaced from array area (plus 2km buffer)		Estimated increase in density in remainder of NWIS cSPA (%)	
	50% displacement	30-70% displacement	50% displacement	30-70% displacement
Summer	15.7	9.4 – 22.0	8.0	8.6 – 7.4
Autumn	393.1	235.9 – 550.3	2.3	5.1 - -0.6
Winter	12.6	7.5 – 17.6	8.3	8.7 – 7.8

5.4.2.3.5 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Razorbill typically feed on schooling fish such as sand eel and herring, as well as crustaceans and polychaetes (Lavers et al., 2020), as such razorbill exhibit a reasonably varied diet. Moreover, based on tracking data, razorbill have a large foraging range (mean max +1SD of 164.6km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above razorbill are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case razorbill can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.3.6 Barrier Effects (Operation)

The closest SPA to the proposed development (excluding the NWIS cSPA) is Lambay Island SPA, located 14.4km from the project. Tracking data from Lambay Island SPA presented by Baer and Newton (2012) indicates that razorbill foraging activity occurs within 31km of the Island, with a maximum distance of 40km, therefore partial overlap with the proposed development is a potential risk. However, the tracking data and Kernal analysis shows the foraging hotspot for razorbill is situated due east of Lambay island SPA up to 31km and therefore will not overlap with the array area or 2km buffer. There is, therefore, no evidence to suggest razorbill from the colony at Lambay Island SPA forage in the waters on the far side of the array area.) The vast majority of the tracking data was collected during the razorbill incubation period. Although birds are constrained during this time, they are less constrained than during the chick rearing period, where foraging intensifies (shorter, more frequent trips) in order to provision young. As such, overall interaction between this species and the proposed development during the breeding season is likely to be lower than demonstrated by these tracking data.

Razorbill densities during the breeding season (Jessop et al., 2018) were highest to the south and east of Lambay Island SPA. This suggests that the majority of birds from Lambay and other nearby colonies will have limited interaction with, and are very unlikely to forage beyond, the proposed development, thus eliminating the possibility of barrier effects occurring.

The high densities to the south and east of Lambay suggest that there is likely to be foraging suitable to sustain the relatively small number of birds that will potentially be displaced by the proposed development. Likewise, the relatively consistent densities to the north west of the highest density areas suggest that these areas can also support reasonable numbers of auks, and as such, accommodate the relatively small numbers displaced by the proposed development. Very high densities of auks were noted in this area during autumn surveys (in September) (Jessop et al., 2018). This suggests that this area is well used by birds in the post breeding dispersal period, which suggests that it supports foraging suitable to sustain much higher numbers of birds than use these areas during the breeding season. Again, this suggests that any displaced birds should be able to find alternative suitable foraging areas without expending excessive additional energy.

Tracking of guillemot during the breeding season (e.g. Carroll et al., 2019) shows that they can exploit a range of different foraging sites in a relatively short period of time. Thus, displacement from one particular area is unlikely to have sustained impact as a displaced bird will simply relocate to another suitable area, and barrier effects are unlikely to be encountered on numerous occasions (assuming that birds learn when a particular area is no longer available to them), thus reducing the energetic cost of having to fly around a perceived barrier.

Therefore, there is no evidence to suggest that a barrier effect would occur. Although it cannot be completely ruled out that, on occasion, razorbill from the colony at Lambay Island SPA might forage in the waters on the far side of the array area, the evidence suggests that this would be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.4 Kittiwake

Kittiwake has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from the proposed development alone.

According to the Site Synopsis, kittiwake are listed as a qualifying interest at three SPAs that abut the NWIS cSPA, namely Ireland’s Eye SPA, Lambay Island SPA and Howth Head SPA. Therefore, any impacts from collision risk kittiwake within the NWIS cSPA will be apportioned to the breeding populations at these SPAs. As such the ‘Population size’ CO has been measured against three defined populations: (1) the individual populations from abutting SPAs, (2) the NWIS cSPA Citation population (as stated in the COs), and (3) the biogeographic population for the relevant bio-season (as described in the Ornithology Technical Baseline).

Collision risk of kittiwake from Ireland’s Eye SPA, Lambay Island SPA and Howth Head SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January – February), this species does not have a migration-free winter season, as defined by Furness (2015).

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species.

These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the ‘Forage spatial distribution, extent, abundance and availability’ CO was assessed against species’ diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for kittiwake from the region has been undertaken.

5.4.2.4.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species.

5.4.2.4.2 Collision Risk (Operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons is 19.32 breeding adults per annum (CRM Appendix 18 and 19).

Collision risk impacts apportioned to the kittiwake populations of Ireland’s Eye, Lambay Island and Howth Head SPAs during the breeding and non-breeding bio-seasons can be found in Sections 5.4.11, 5.4.14 and 5.4.13, respectively. The assessments for these sites concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on kittiwake to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (1,632 individuals), the increase in baseline mortality relative to this citation count (1,632 individuals) and an associated background mortality of 238 (238.3) individuals would be 8.108% (Table 5.22).

However, the modelled collisions for the non-breeding season were derived from average monthly populations during this period. Summed, these come to 1,497 birds. As the impact is calculated from such a large proportion of the citation population (91.7%), yet the area sampled is only 8.6% of the area for which the citation count is produced, and the dataset informing the citation population shows no area of high density focussed on the array area, it is deemed that the citation count for kittiwake in the non-breeding season is not an appropriate population to assess against.

Likewise, this count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As described in the Apportioning Appendix 20 the appropriate regional population is 713,137 individuals, representing the number of birds considered to more realistically be present within the region.

When assessing the full unapportioned impacts on kittiwake to the regional population of 713,137 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 104,118 (104,118.1) individuals would be 0.019% (Table 5.22). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the kittiwake QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.22: Annual Collision Mortalities During the Operational Phase for Kittiwake at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Annual Total	19.32	1.74 – 45.74	8.108	0.729 – 19.194	0.019	0.002 – 0.044

5.4.2.4.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)

Kittiwake have considerably large foraging ranges (mean max +1SD 300.6km) (Woodward et al., 2019) over which alternative suitable foraging habitat are likely to be found in combination with their low habitat use specificity. Additionally, according to Bradbury et al. (2014) and Dierschke et al. (2016) kittiwake sensitivity to disturbance and displacement is ‘low’ therefore the presence of WTGs is unlikely to deter them from entering the array area.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.4.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Kittiwake are primarily piscivorous feeding on sand eel, herring and gadoids, but this species has been recorded feeding on invertebrates including euphausiids and amphipods (Hatch et al., 2020), as such kittiwake exhibit a fairly diverse diet. Moreover, based on tracking data, kittiwake have a large foraging range (mean max +1SD of 300.6km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above kittiwake are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case kittiwake can also be ruled out. Therefore, the CO’s target regarding ‘Forage spatial distribution, extent, abundance and availability’ will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.4.5 Barrier Effects (Operation)

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for kittiwake from the region.

Tracking data of 14 kittiwake from Lambay Island SPA was collected across 20 days between 2010 and 2011, with the maximum distance travelled 40km from the colony and a mean distance of 29.5km (Baer and Newton, 2012). There were no specific foraging hotspots identified during the survey, the feeding activity was widely dispersed with a broad concentration east south-easterly of the colony. Very few individuals were reported foraging beyond 100m depth otherwise there was no clear pattern to the foraging activity.

Breeding season distributions mapped in Jessop also indicate a strong preference for areas to the south and east of Lambay and other local colonies. As such, any locally breeding birds displaced by the proposed development should be able to find alternative suitable foraging areas, closer to colonies.

Despite the lack of clear foraging hotpots within the tracking data, it does indicate that the majority of foraging activity occurs south-east from the array area and would therefore not overlap with the site. It should be noted that the tracking data does suggest kittiwake may forage in the waters on the far side of array area, particularly to the south. However, as per tracking data presented by Woodward et al. (2019) kittiwake have considerable foraging ranges (MMF +1SD 300.6km) over which alternative suitable foraging habitat are likely to be found. This species also exhibits low habitat use specificity. Considering this and this species ‘low’ sensitivity to the presence of WTGs it is reasonable to conclude should this species experience a reduction in available foraging area as a result of the proposed development it is expected to cause minimal impact, as any displaced birds should be able to find suitable foraging elsewhere. Evidence suggests that this would be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Herring gull

Herring gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the Site Synopsis, herring gull are listed as a qualifying interest at three SPAs that abut the NWIS cSPA, namely Ireland's Eye SPA, Lambay Island SPA and Skerries Island SPA. Breeding herring gull from these SPAs are highly likely to utilise the habitat encompassed within the cSPA while foraging. Therefore, any impacts from collision risk herring gull within the NWIS cSPA will be apportioned to the breeding populations at these SPAs. As such the ‘Population size’ CO has been measured against three defined populations: (1) the individual populations from abutting SPAs, (2) the NWIS cSPA Citation population (as stated in the COs), and (3) the biogeographic population for the relevant bio-season (as described in the Ornithology Technical Baseline).

Collision risk of herring gull from Skerries Island SPA, Ireland's Eye SPA and Lambay Island SPA has been assessed for the full breeding bio-season (March – August), the non-breeding bio-season (September – February), as defined by Furness (2015).

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC.

Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, the Developer has taken a precautionary approach therefore a review of the available tracking data for herring gull from the region has been undertaken.

5.4.2.4.6 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.4.7 Collision Risk (Operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons is 57 (57.16) individuals per annum (CRM Appendix 18 and 19).

Collision risk impacts apportioned to the herring gull populations of Ireland's Eye, Lambay Island and Skerries Island SPAs during the breeding and non-breeding bio-seasons can be found in Sections 5.4.11, 5.4.14 and 5.4.10, respectively. The assessments for these sites concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on herring gull to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (6,893 individuals), the increase in baseline mortality relative to this citation count (6,893 individuals) and an associated background mortality of 1,144 (1,144.2) individuals would be 4.995% (Table 5.23).

This count is derived from a sample of birds that include both common and herring gulls, with final numbers from this sample being informed by ratios of the two species from a different survey area, at a different time, using a different survey method. As such, these counts should be treated with some caution. Also, the counts are of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix 20, the appropriate regional population is 187,094 individuals.

When assessing the full unapportioned impacts on herring gull to the regional population of 187,094 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 31,058 (31,057.5) individuals would be 0.184% (Table 5.23).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the Population size CO of the herring gull QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.23: Annual Collision Mortalities During the Operational Phase for Herring gull at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Annual Total	57.16	9.77 – 140.05	4.995	0.853 – 12.239	0.184	0.031 – 0.451

5.4.2.4.8 Spatial distribution (Construction, Operation and Decommissioning) and Barrier Effects (Operation)

Herring gull sensitivity to displacement effects is 'very low' according to sensitivity rankings presented in Bradbury et al. (2014) and Dierschke et al. (2016) therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn these birds are unlikely to experience barrier effects.

There is also evidence of herring gull roosting on OWTs (e.g., Leopold et al., 2013; Petersen et al., 2006; Vanermen et al., 2016), this species has even been observed feeding on the epi-fauna on WTG foundations during low tide (Vanerman et al., 2017). Furthermore, gulls often feed on fishery discards and therefore are often observed in association with fishing vessels (Leopold et al., 2013; Vanermen et al., 2017). OWFs are often closed to fishing vessels like trawlers therefore species like herring gull can exhibit 'pseudo-avoidance' despite not being vulnerable to distributional responses, as the birds are attracted to the vessels outside of the OWFs (Leopold et al., 2011; Nilsson and Green, 2011).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.4.9 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Herring gull are generalist and opportunistic feeders that forage across both the marine and terrestrial environment. Their diet includes fish, small crustaceans, fish offal, squid, other birds, eggs, earthworms, berries, carrion, and a wide variety of anthropogenic refuse (Weseloh et al., 2020). As such herring gull exhibit a highly diverse diet. Moreover, based on tracking data, herring gull have a relatively large foraging range (mean max +1SD of 85.6km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above herring gull are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case herring gull can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.5 Lesser Black-backed gull

Lesser black-backed gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA Site Synopsis, lesser black-backed gull are listed as a breeding qualifying interest at Lambay Island SPA, that abuts the NWIS cSPA. Therefore, any impacts from collision risk within the NWIS cSPA will be apportioned to the population of lesser black-backed gull at Lambay Island SPA. The impacts were therefore apportioned appropriately to this population as breeding lesser black-backed gull from Lambay Island SPA are highly likely to utilise the habitat encompassed within the NWIS cSPA; alongside individuals breeding at other colonies and non-breeding individuals. As such the 'Population size' CO has been measured against two defined populations: (1) the breeding population from Lambay Island SPA, and (2) the regional breeding season population as described and defined within the Ornithology Technical Baseline, as there is no specific citation population for this species for the NWIS cSPA.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for lesser black-backed gull from the region has been undertaken.

5.4.2.5.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.5.2 Collision Risk (Operation)

Collision risk impacts apportioned to the lesser black-backed gull population at Lambay Island SPA during the breeding bio-season can be found in Section 5.4.14. The assessments for this site concluded no AESI during the breeding bio-season.

The regional population of less black-backed gull is 171,500 individuals. When assessing the full unapportioned impacts on lesser black-backed gull to the regional population of 171,500 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 19,723 (19,722.5) individuals would be 0.002% (Table 5.24). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the lesser black-backed gull QI of NWIS cSPA, based on collision risk impacts from the proposed development alone, during the operational phase. Therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.24: Annual Collision Mortalities During the Operational Phase for Lesser Black-backed gull at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (Regional count)	
	Mean	**95% LCI - UCI**	**Mean**	**95% LCI - UCI**
Annual Total	0.45	0.02 – 1.42	0.002	0.000 – 0.007

5.4.2.5.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)

According to sensitivity rankings presented in Bradbury et al. (2014) and Dierschke et al. (2016) lesser black-backed gull vulnerability to disturbance and displacement is ‘very low’ therefore the presence of WTGs is unlikely to deter them from entering the array area.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1 the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.5.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Lesser black-backed gull are generalist and opportunistic feeders that forage across both the marine and terrestrial environment. Their diet includes small fish, fishery discards, bird’s eggs, berries and small mammals (Burger et al., 2020). As such lesser black-backed gull exhibit a highly diverse diet. Moreover, based on tracking data, lesser back-backed gull have a large foraging range (mean max +1SD of 233km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above lesser black-backed gull are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case lesser black-backed gull can also be ruled out. Therefore, the CO’s target regarding ‘Forage spatial distribution, extent, abundance and availability’ will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.5.5 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for lesser black-backed gull from the region.

Moss et al. (2016) tracked two lesser black-backed gulls from Lambay Island SPA and found these individuals primarily foraged within terrestrial environments with very little use of the marine area. The minimal tracks within the marine environment also do not overlap with the array area therefore there is no evidence to suggest that lesser black-backed gull forage on the far side of the array area. Consequently, there is no evidence to suggest that lesser black-backed gulls will experience barrier effects.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.6 Great Black-backed gull

Great black-backed gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA Site Synopsis, great black-backed gull are present within the NWIS cSPA during their non-breeding (autumn/winter) season in numbers that equalled or exceeded 1% of the total estimated size of the winter assemblage (2,096 individuals), but this species is not a qualifying interest within a proximity SPA. As such the ‘Population size’ CO has been measured against two defined populations: (1) the NWIS cSPA Citation population (as stated in the COs), and (2) the regional non-breeding season population as described and defined within the Ornithology Technical Baseline.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere.

As such the ‘Forage spatial distribution, extent, abundance and availability’ CO was assessed against species’ diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for great black-backed gull from the region has been undertaken.

5.4.2.6.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.6.2 Collision Risk (Operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality during the non-breeding bio-seasons is 18 (17.9) breeding adults per annum (

Table 5.25) (CRM Appendix 18 and 19).

When assessing the full unapportioned impacts on great black-backed gull to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (2,096 individuals), the increase in baseline mortality relative to this citation count (2,096 individuals) and an associated background mortality of 147 (146.7) individuals would be 11.069%

Table 5.25).

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix 20, the appropriate regional population is 53,406 individuals.

When assessing the full unapportioned impacts on great black-backed gull to the regional population of 53,406 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 3,738 (3,738.4) individuals would be 0.434% (

Table 5.25). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great black-backed gull QI of NWIS cSPA in relation to collision effects from the proposed development alone and therefore, subject to natural change, the great black-backed gull QI will be maintained in the long term with respect to potential adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.25: Annual Collision Mortalities During the Operational Phase for Great black-backed gull at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	**95% LCI - UCI**	**Mean**	**95% LCI - UCI**	**Mean**	**95% LCI - UCI**
Annual Total	16.24	1.24 – 42.34	11.069	0.847 – 28.860	0.434	0.033– 1.133

5.4.2.6.3 *Spatial Distribution and Disturbance (Construction, Operation and Decommissioning) and Barrier Effects (Operation)*

According to Bradbury et al. (2014) and Dierschke et al. (2016) great black-backed gull sensitivity to displacement effects and is 'low' therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn these birds are unlikely to experience barrier effects.

Furthermore, gulls often feed on fishery discards and therefore are often observed in association with fishing vessels (Leopold et al., 2013; Vanermen et al., 2017). OWFs are often closed to fishing vessels like trawlers therefore species like great black-backed gull can exhibit 'pseudo-avoidance' despite not being vulnerable to distributional responses, as the birds are attracted to the vessels outside of the OWFs (Leopold et al., 2011; Nilsson and Green, 2011).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great black-backed gull QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the great black-backed gull QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.6.4 *Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)*

Great black-backed gull are generalist feeders that forage across both the marine and terrestrial environment. Their diet includes small fish, fishery discards, bird's eggs, small mammals and a wide variety of anthropogenic refuse (Good, 2020). As such great black-backed gull exhibit a highly diverse diet. Moreover, based on tracking data, great back-backed gull have a moderate foraging range (mean max +1SD of 73km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above great black-backed gull are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case great black-backed gull can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great black-backed gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the great black-backed gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.7 *Common gull*

Common gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA site synopsis, common gull are present within the NWIS cSPA during their non-breeding (autumn/winter) season in numbers that equalled or exceeded 1% of the total estimated size of the winter assemblage (2,866 individuals), but this species is not a qualifying interest within a proximity SPA. As such the 'Population size' CO has been measured against two defined populations: (1) the NWIS cSPA Citation population (as stated in the COs), and (2) the regional non-breeding season population as described and defined within the Ornithology Technical Baseline.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for common gull from the region has been undertaken.

5.4.2.7.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.7.2 Collision Risk (operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality during the non-breeding bio-seasons is 6 (5.51) breeding adults per annum (CRM Appendix 18 and 19), provided 100% of the common gull within the array area are deemed to be breeding adults within NWIS cSPA during non-breeding bio-season (Apportioning Appendix 20).

When assessing the full unapportioned impacts on great black-backed gull to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (2,866 individuals), the increase in baseline mortality relative to this citation count (2,096 individuals) and an associated background mortality of 493 (493.0) individuals would be 1.118% (Table 5.26).

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix (20) the appropriate regional population is 67,500 individuals.

When assessing the full unapportioned impacts on common gull to the regional population of 67,500 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 6 11,610 (11,610.0) individuals would be 0.047% (Table 5.26). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common gull QI of NWIS cSPA in relation to collision effects from the proposed development alone and therefore, subject to natural change, the common gull QI will be maintained in the long term with respect to potential adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.26: Annual Collision Mortalities During the Operational Phase for Common gull at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Annual Total	5.51	0.40 – 14.45	1.118	0.080 – 2.932	0.047	0.003 – 0.124

5.4.2.7.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning) and Barrier Effects (Operation)

According to Bradbury et al. (2014) and Dierschke et al. (2016) common gull sensitivity to disturbance and displacement is ‘low’. therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn these birds are unlikely to experience barrier effects.

Furthermore, gulls often feed on fishery discards and therefore are often observed in association with fishing vessels (Leopold et al., 2013; Vanermen et al., 2017). OWFs are often closed to fishing vessels like trawlers therefore species like common gull can exhibit ‘pseudo-avoidance’ despite not being vulnerable to distributional responses, as the birds are attracted to the vessels outside of the OWFs (Leopold et al., 2011; Nilsson and Green, 2011).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common gull QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the common gull QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.7.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Common gull are opportunistic feeders, their diet consists of fish, fishery discards and marine invertebrates (Moskoff et al., 2021). As such common gull exhibit a highly diverse diet. Moreover, based on tracking data, common gull have a moderate foraging range (mean max +1SD of 50km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above common gull are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case common gull can also be ruled out. Therefore, the CO’s target regarding ‘Forage spatial distribution, extent, abundance and availability’ will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the common gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.8 Black-headed gull

Black-headed gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from proposed development alone.

According to the NWIS cSPA site synopsis, black-headed gull are present within the NWIS cSPA during their non-breeding (autumn/winter) season in numbers that equalled or exceeded 1% of the total estimated size of the winter assemblage (508 individuals), but this species is not a qualifying interest within a proximity SPA. As such the 'Population size' CO has been measured against two defined populations: (1) the NWIS cSPA Citation population (as stated in the COs), and (2) the regional non-breeding season population as described and defined within the Ornithology Technical Baseline.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for black-headed gull from the region has been undertaken.

5.4.2.8.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.8.2 Collision Risk (Operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality during the non-breeding bio-seasons is less than one (0.06) breeding adult per annum (CRM Appendix 18 and 19).

When assessing the full unapportioned impacts on black-headed gull to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (508 individuals), the increase in baseline mortality relative to this citation count (508 individuals) and an associated background mortality of 89 (88.9) individuals would be 0.225% (

Table 5.27). This level of impact would be indistinguishable from natural fluctuations in the population.

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix (20) the appropriate non-breeding regional population is 100,000 individuals.

When assessing the full unapportioned impacts on black-headed gull to the regional population of 100,000 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 17,500 (17,500.0) individuals would be 0.001% (

Table 5.27). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the black headed gull QI of NWIS cSPA in relation to collision effects from the proposed development alone and therefore, subject to natural change, the black headed gull QI will be maintained in the long term with respect to potential adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.27: Annual Collision Mortalities During the Operational Phase for Black-headed Gull at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	95% LCI – UCI	Mean	95% LCI – UCI	Mean	95% LCI – UCI
Annual Total	0.20	0.01 – 0.84	0.225	0.011 – 0.945	0.001	0.000 – 0.005

5.4.2.8.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning) and Barrier Effects (Operation)

According to Bradbury et al. (2014) and Dierschke et al. (2016) black-headed gull sensitivity to disturbance and displacement is ‘low’ therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn these birds are unlikely to experience barrier effects. Importantly, during the 29 months of DAS a small number of black-headed gull were recorded, a total of five individuals were observed within the array area with 12 individuals within the array area plus a 2km buffer.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the black-headed gull QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the black-headed gull QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.8.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Black-headed gull are opportunistic feeders, their diet consists of fish, fishery discards and marine invertebrates (Moskoff et al., 2021). As such black-headed gull exhibit a highly diverse diet. Moreover, based on tracking data, black-headed gull have a moderate foraging range (mean max +1SD of 50km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

In light of the available evidence above common gull are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case black-headed gull can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the black-headed gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the black-headed gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.9 Little gull

Little gull have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA site synopsis, little gull are present within the NWIS cSPA during their non-breeding (autumn/winter) season in numbers that equalled or exceeded 1% of the total estimated size of the winter assemblage (2,866 individuals), but this species is not a qualifying interest within a proximity SPA. During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects.

5.4.2.9.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.9.2 Collision Risk (Operation)

One little gull was recorded within the array area plus a 4km buffer, during the 29 months of DAS. It is therefore considered reasonable to scope this species out for this assessment on the basis there is, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to collision effects from proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential adverse effects from collision.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the little gull QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.9.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)

According to Bradbury et al. (2014) and Dierschke et al. (2016) little gull sensitivity to disturbance and displacement is 'very low' therefore the presence of WTGs is unlikely to deter them from entering the array area. Importantly only one little gull was recorded within the array area plus a 4km buffer therefore it was considered reasonable to scope this species out for these assessments given there is, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to disturbance and displacement effects from proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for disturbance and displacement.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.9.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptor to be indirectly impacted as a result of impacts on prey species and the habitats of prey species. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone).

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case little gull can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Importantly only one little gull was recorded within the array area plus a 4km buffer therefore it was considered reasonable to scope this species out for these assessments given there is, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.9.5 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects.

One little gull was recorded within the array area plus a 4km buffer, during the 29 months of DAS. The results of the DAS therefore suggest that little gull do not fly through the array area or forage in the waters on the far side of the array area. It was therefore considered reasonable to scope this species out for this assessment on the basis there is no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for barrier effects.

5.4.2.10 Little tern

Little tern have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from proposed development alone.

According to the NWIS cSPA site synopsis little tern are listed as a breeding qualifying interest at the Boyne Estuary SPA which abuts the NWIS cSPA. As such the 'Population size' CO has been measured against two defined populations: (1) the Boyne Estuary SPA Citation population, and (2) the regional non-breeding season population as described and defined within the Ornithology Technical Baseline.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for black-headed gull from the region has been undertaken.

5.4.2.10.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.10.2 Collision Risk (Operation)

Little tern were not recorded during the 29 months of DAS (May 2020 to October 2022). There is, therefore, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to collision effects from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential adverse effects from collision.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the little ternQI of NWIS cSPA in relation to collision effects from the proposed development alone and therefore, subject to natural change, the little tern QI will be maintained in the long term with respect to potential for displacement and barrier effects.

5.4.2.10.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning) and Barrier Effects (Operation)

Little tern were not recorded during the 29 months of DAS (May 2020 to October 2022). There is, therefore, no potential for an AEoI to the COs of the little tern QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the little tern QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the little tern QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the little tern QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.10.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

During the construction, operation and decommissioning phases of the proposed development, there is potential ornithological receptor to be indirectly impacted as a result of impacts on prey species and the habitats of prey species. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone).

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case little tern can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Importantly no little tern were recorded during the 29 months of DAS (May 2020 to October 2022) therefore it was considered reasonable to scope this species out for these assessments given there is, no potential for an AEoI to the COs of the little gull QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the little gull QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the little tern QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the little tern QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.11 Roseate tern

Roseate tern have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA Site Synopsis, roseate tern are listed as a breeding qualifying interest at Rockabill SPA, that abuts the NWIS cSPA. Therefore, any impacts from collision risk within the NWIS cSPA will be apportioned to the population of roseate tern at Rockabill SPA. The impacts were therefore apportioned appropriately to this population as breeding roseate tern from Rockabill SPA are highly likely to utilise the habitat encompassed within the NWIS cSPA; alongside individuals breeding at other colonies and non-breeding individuals. As such the 'Population size' CO has been measured against two defined populations: (1) the breeding population from Rockabill SPA, and (2) the regional breeding season population as described and defined within the Ornithology Technical Baseline. The citation population has not been assessed as it is unclear what the citation population is for this species at NWIS cSPA.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for roseate tern from the region has been undertaken.

5.4.2.11.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.11.2 Collision Risk (Operation)

Collision risk impacts apportioned to the roseate tern population at Rockabill SPA during the breeding bio-season can be found in Section 5.4.4. The assessments for this site concluded no AESI during the breeding bio-season.

The regional population of roseate tern is 6,735 individuals. When assessing the full unportioned impacts on roseate tern to the regional population of 6,735 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 746 (745.9) individuals would be 0.009%. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the roseate tern QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.11.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)

According to Bradbury et al. (2014) and Dierschke et al. (2016) roseate tern sensitivity to disturbance and displacement is 'low' therefore the presence of WTGs is unlikely to deter them from entering the array area. Furthermore, roseate tern were recorded in trivial numbers during the 29 months of DAS, a total of 16 roseate tern were recorded within the array area plus a 2km buffer.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the roseate tern QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.11.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

The standard approach is to scope species similar to roseate tern out.. For example, Rampion 2 screened common tern out based on the species ability to forage widely (and therefor adapt to any changes in food availability, and the temporary nature and low impact of effects on prey species. However, a precautionary approach has been taken and as such carried out an assessment to assess this species vulnerability to changes in prey species abundance and availability, due to the proposed development's proximity to Rockabill SPA.

Roseate tern are primarily piscivorous feeding on sand eels clupeids and, to a lesser extent, gadoids (Allbrook et al., 2022). As such roseate tern exhibit a moderately diverse diet. Moreover, based on tracking data, roseate tern have a relatively small foraging range (mean max +1SD of 23.2km). This suggests roseate tern are more limited in their ability to forage elsewhere and are perhaps less adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case roseate tern can also be ruled out.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the roseate tern QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.11.5 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken and reviewed the available tracking data for common tern to identify any foraging hotspots within the region.

Boat based, visual tracking of common tern from Rockabill SPA was conducted in 2021 by Power et al. (2022), following the methodology used within a similar studies namely Perrow et al (2011) and Perrow et al. (2019). A total of 7 roseate tern tracks were recorded during the survey. The majority of the roseate tern activity was concentrated within 8.6km of Rockabill therefore these birds would not overlap with the array area (located 11.9km from Rockabill) while foraging. The main foraging hotspots identified within the Power et al. (2022) surveys were within the waters around Rockabill and the Skerries (located adjacent to Rockabill) between 0.4km and 7km from the colony. Two roseate terns were also observed foraging within inshore waters (0-25m) up to 23.1km north of Rockabill off the coast of Clogerhead and Termonfeckin.

A similar study conducted by Perrow et al. (2019) found roseate tern foraged within similar inshore areas to Power et al. (2022), with much of the foraging activity during the incubation and intermediate chick development period concentrated within an area of water extending inshore from Rockabill (within 20m to 30m). Perrow et al. (2019) reported mean-max distances of <5km to 7km during these periods, this is broadly similar to an early study by Newton and Crowe (2000) that most of roseate tern foraging occurs within 3.5km of the colony and no further than 9.5km. The maximum distance from Rockabill recorded by Perrow et al. (2019) was 29.9km this would result in a partial overlap with the array area.

As such, it can be assumed that displacement and barrier effect impacts will be low for this species as the majority of birds will have no interaction with the array area. The foraging locations highlighted by tracking terns suggest that in the event of displacement, or behaviour being altered by a perceived barrier, the effected birds will be able to find suitable alternative foraging.

Although it cannot be completely ruled out that, on occasion, roseate tern from the colony at Rockabill might forage in the waters on the far side of the array area, the evidence suggests that this would be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the roseate tern QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.12 Common tern

Common tern have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA Site Synopsis, common tern are listed as a breeding qualifying interest at Rockabill SPA, that abuts the NWIS cSPA. Therefore, any impacts from collision risk within the NWIS cSPA will be apportioned to the population of common tern at Rockabill SPA. The impacts were therefore apportioned appropriately to this population as breeding common tern from Rockabill SPA are highly likely to utilise the habitat encompassed within the NWIS cSPA; alongside individuals breeding at other colonies and non-breeding individuals. As such the 'Population size' CO has been measured against two defined populations: (1) the breeding population from Rockabill SPA, and (2) the regional breeding season population as described and defined within the Ornithology Technical Baseline. The citation population has not been assessed as it is unclear what the citation population is for this species at NWIS cSPA

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken therefore a review of the available tracking data for common tern from the region has been undertaken.

5.4.2.12.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.12.2 Collision Risk (Operation)

Collision risk impacts apportioned to the common tern populations of Rockabill SPA during the breeding and non-breeding bio-seasons can be found in Section 5.4.4. The assessment for this site concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on common tern to the regional population of 74,000 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 8,658 (8,658.0) individuals would be 0.008%. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the common tern QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.12.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)

According to Bradbury et al. (2014) and Dierschke et al. (2016) common tern sensitivity to disturbance and displacement is 'low' therefore the presence of WTGs is unlikely to deter them from entering the array area.

There is, therefore, no potential for an AEoI to the COs of the common tern QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to disturbance and displacement.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.12.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

The standard approach across other projects is to scope this species out. For example, Rampion 2 screened common tern out based on the species ability to forage widely (and therefor adapt to any changes in food availability, and the temporary nature and low impact of effects on prey species. However, a precautionary approach has been taken and as such carried out an assessment to assess this species vulnerability to changes in prey species abundance and availability, due to the proposed development's proximity to Rockabill SPA.

Common tern are primarily piscivorous feeding on sand eels clupeids and gadoids (Allbrook et al., 2022). This species can also feed on a variety of crustaceans and insects and often has a more diverse diet compared to roseate terns from the same colony (Arnold et al., 2020).As such common tern exhibit a moderately diverse diet. This species tend to forage in coastal waters within 20km of their breeding sites, in coastal waters (Arnold et al., 2020).

In light of the available evidence above common tern are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case common tern can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common tern QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 1.

5.4.2.12.5 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. However, a precautionary approach has been taken and reviewed the available tracking data for common tern to identify any foraging hotspots within the region.

Boat based, visual tracking of common tern from Rockabill SPA was conducted in 2021 by Power et al. (2022), following methodology used during a similar study conducted by Perrow et al. (2019). A total of 22 common tern tracks were recorded during the survey. Most common tern activity is concentrated within 14.4km of the colony (68% of all tracks), this would result in a partial overlap with the array area (located 11.9km from Rockabill.

However, tracking data indicates the main foraging hotspots for common tern at this colony are inshore within the shallow water (0-25m) between Skerries and Dunnay point at the southern end of Dundalk Bay which would not overlap with the array area or 2km buffer. This species tends to forage in shallow waters, 53% of all prey caught during the Power et al. (2022) survey occurred within <20m, evidence also suggests individuals that nest on islands 5-15km offshore primarily forage inshore (Arnold et al., 2020).

Common tern were also recorded foraging and within the deeper waters (25-100m) south-east of Rockabill, with the maximum distance of 41.8km travelled by an individual (Power et al., 2022). This survey was conducted within mid-July (13th to 17th) within the fledging period, during a similar survey at Rockabill Island by Perrow et al. (2019) Roseate tern were observed foraging at greater ranges during the fledging period than the incubation period often within deeper waters, therefore the large foraging ranges observed by Power et al. (2022) may have been a result of provisioning prey items to chicks. This suggests a partial overlap with foraging common tern from Rockabill and the proposed boundary could occur, however only 27% of all prey items caught during the Power et al. (2022) were within deeper water >50m. Furthermore, according to Bradbury et al. (2014) and Dierschke et al. (2016) common tern sensitivity to disturbance and displacement is 'low' therefore the presence of WTGs is unlikely to deter them from entering the array area.

Although it cannot be completely ruled out that, on occasion, common tern from the colony at Rockabill might forage in the waters on the far side of the array area, the evidence suggests that this would be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

As such, it can be assumed that displacement and barrier effect impacts will be low for this species as the majority of birds will have no interaction with the array area. The foraging locations highlighted by tracking terns suggest that in the event of displacement, or behaviour being altered by a perceived barrier, the effected birds will be able to find suitable alternative foraging.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common tern QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to barrier effects.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 1.

5.4.2.13 Arctic tern

Arctic tern have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the NWIS cSPA Site Synopsis, Arctic tern are listed as a breeding qualifying interest at Rockabill SPA, that abuts the NWIS cSPA. Therefore, any impacts from collision risk within the NWIS cSPA will be apportioned to the population of Arctic tern at Rockabill SPA. The impacts were therefore apportioned appropriately to this population as breeding roseate tern from Rockabill SPA are highly likely to utilise the habitat encompassed within the NWIS cSPA; alongside individuals breeding at other colonies and non-breeding individuals. As such the 'Population size' CO has been measured against two defined populations: (1) the breeding population from Rockabill SPA, and (2) the regional breeding season population as described and defined within the Ornithology Technical Baseline. The citation population has not been assessed as it is unclear what the citation population is for this species at NWIS cSPA

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone).

The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability'

CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. Importantly, Arctic tern was recorded in low numbers, with only two birds recorded with the array area (15 within the array plus the 2km buffer) during 29 months of DAS.

5.4.2.13.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.13.2 Collision Risk (Operation)

Collision risk impacts apportioned to the Arctic tern populations of Rockabill SPA during the breeding and non-breeding bio-seasons can be found in Section 5.4.4. The assessment for this site concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on Arctic tern to the regional population of 72,231 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 8,451 (8,451.1) individuals would be 0.001%. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the Arctic tern QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the Arctic tern QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 2 the same conclusion of no AEoI is drawn for Project Option 1.

5.4.2.13.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning) and Barrier Effects (Operation)

According to Bradbury et al. (2014) and Dierschke et al. (2016) Arctic tern sensitivity to disturbance and displacement is 'low' therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn these birds are unlikely to experience barrier effects.

Importantly, Arctic tern was recorded in low numbers, with only two birds recorded with the array area (15 within the array plus the 2km buffer) during 29 months of DAS.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Arctic tern QI of NWIS cSPA in relation to distributional responses effects from the proposed development alone and therefore, subject to natural change, the Arctic tern QI will be maintained in the long term with respect to potential for displacement and barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.13.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

The standard approach is to scope species similar to Arctic tern out. Rampion 2 screened common tern out based on the species ability to forage widely (and therefor adapt to any changes in food availability, and the temporary nature and low impact of effects on prey species. However, a precautionary approach has been taken and as such carried out an assessment to assess this species vulnerability to changes in prey species abundance and availability, due to the proposed development's proximity to Rockabill SPA.

Arctic tern are primarily piscivorous feeding on sand eels herring, cod and pollock and, (Allbrook et al., 2022). As such Arctic tern exhibit a moderately diverse diet. Moreover, based on tracking data, Arctic tern have a moderate foraging range (mean max +1SD of 40.5km) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

In light of the available evidence above Arctic tern are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case arctic tern can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Arctic tern QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the Arctic tern QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.14 Fulmar

Fulmar have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from the proposed development alone.

According to the Site Synopsis, fulmar are listed as a QI at Lambay Island SPA, that abuts the NWIS cSPA. Breeding fulmar from Lambay SPA are highly likely to utilise the habitat encompassed within the cSPA while foraging Therefore, any impacts from collision risk within the NWIS cSPA will be apportioned to the breeding populations at Lambay Island SPA. As such the 'Population size' CO has been measured against three defined populations: (1) the individual populations from abutting SPAs, (2) the NWIS cSPA Citation population (as stated in the COs), and (3) the biogeographic population for the relevant bio-season (as described in the Ornithology Technical Baseline).

Collision risk of fulmar from Lambay Island SPA has been assessed for the full breeding bio-season (January – August), the post-breeding migration bio-season (September–October), the return migration bio-season (December–March), and the migration- free winter season (November) as defined by Furness (2015).

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats.

Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the NWIS cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. Importantly, fulmar are considered low risk of collision impacts due to a low proportion of birds flying at collision risk height.

5.4.2.14.1 Mitigation

Fulmar are not considered sensitive to collision impacts from windfarms. However, by increasing the air draft to 40m LAT predicted impacts on this species are reduced to almost zero.

In addition, array refinements and a total reduction in the project footprint have reduced the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.14.2 Collision Risk (Operation)

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons is less than one (0.02) breeding adults per annum.

Collision risk impacts apportioned to the fulmar populations of Lambay Island SPA during the breeding and non-breeding bio-seasons can be found in Section 5.4.14. The assessment for this site concluded no AESI during the breeding and non-breeding bio-seasons.

When assessing the full unapportioned impacts on fulmar to the non-breeding NWIS cSPA count informed by the ObSERVE surveys (11,260 individuals), the increase in baseline mortality relative to this citation count (11,260 individuals) and an associated background mortality of 721 (720.6) individuals would be 0.001% (

Table 5.28).

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix (20) the appropriate regional population is 843,783 individuals.

When assessing the full unapportioned impacts on fulmar to the regional population of 843,783 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 54,002 (54,002.1) individuals would be 0.000% (

Table 5.28). This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the fulmar QI of NWIS cSPA, based on collision risk from the proposed development alone, during the operational phase. Therefore, subject to natural change, the fulmar QI will be maintained in the long term with respect to potential for collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.28: Annual Collision Mortalities During the Operational Phase for Fulmar at NWIS cSPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (ObSERVE Autumn count)		% increase in baseline mortality (Regional count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Annual Total	0.02	0.00 – 0.16	0.001	0.000 – 0.008	0.000	0.000 – 0.010

5.4.2.14.3 Spatial Distribution and Disturbance (Construction, Operation and Decommissioning)
According to sensitivity rankings presented in Bradbury et al. (2014) and Dierschke et al. (2016) fulmar vulnerability to disturbance and displacement is 'very low' therefore the presence of WTGs is unlikely to deter them from entering the array area.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the fulmar QI of NWIS cSPA in relation to disturbance and displacement effects from the proposed development alone and therefore, subject to natural change, the fulmar QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.14.4 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)
Fulmar feed on sand eels, crustaceans, squid and fisheries discards (Philips et al., 1999). As such this species has a reasonably varied diet. Moreover, based on tracking data, fulmar have a large range (mean max +1SD of 1,200.2km) (Woodward et al., 2019). In light of the available evidence fulmar are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development. And therefore, the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case fulmar can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the fulmar QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the fulmar QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.14.5 Barrier Effects (Operation)
The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects.

A total of 26 fulmar were recorded throughout the 29 months of DAS, within the array area plus 2km buffer, this species has also been deemed to have 'very low' sensitivity to disturbance and displacement therefore the presence of WTGs is unlikely to deter them from entering the array area and in turn foraging within the NWIS cSPA.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the fulmar QI of NWIS cSPA in relation to barrier effects from the proposed development alone and therefore, subject to natural change, the fulmar QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.15 Manx shearwater

Manx shearwater have been screened in for the construction, operation and decommissioning phases to assess the potential of an AEoI from the array area.

Manx shearwater are present within the NWIS cSPA during their breeding (summer) season in numbers in numbers of international importance (13,010 individuals), but this species is not a qualifying interest within a proximity SPA. As such the 'Population size' CO has been measured against two defined populations: (1) the NWIS cSPA Citation population (as stated in the COs), and (2) the regional non-breeding season population as described and defined within the Ornithology Technical Baseline.

It should be noted Manx shearwater were also screened in to assess the potential for an AEoI from collision risk, during the operational phase from the proposed development alone, with regard to the population size within the NWIS cSPA, on a precautionary basis. However, following CRM no adverse impacts were found therefore this level of impact can be considered no material contribution and will, therefore, will not affect the achievement of the COs for the NWIS cSPA and as a result will not have an adverse effect on the integrity of the SPA.

Manx shearwater were screened in to assess for changes in distribution, during the construction, operation and decommissioning phases within the array area on a precautionary basis, despite the species' vast foraging ranges (mean max +1SD 2,365.5km) (Woodward et al., 2019), very low vulnerability to displacement by offshore wind farms (Bradbury et al., 2014; Furness et al., 2013). To assess potential changes in distribution of Manx shearwater and in turn changes in habitat availability and range within the NWIS cSPA, the increase in densities outside of the array area within the rest of the NWIS cSPA, following a displacement of 10% of birds, has been calculated.

During the construction, operation and decommissioning phases of the proposed development, there is potential for ornithological receptors to be indirectly affected as a result of impacts on prey species and their habitats. Impacts on prey species may arise due to increased underwater anthropogenic noise which has the potential to cause mobile prey species to avoid the area around the array area and/or the ECC. Additionally, suspended sediments due to maintenance activity may result in fish and mobile invertebrates avoiding the area and/or smothering and reducing the visibility of prey species. These impacts could therefore result in a reduction in prey available to foraging seabirds within the construction area (consisting of the array area, ECC and intertidal zone). The vulnerability of ornithological receptors to these potential effects varies across species, with some species being generalist foragers, able to feed on a wide variety of food sources (sometimes spanning across both marine and terrestrial environments like lesser black-backed gull), whereas some species rely more heavily on a narrower range of food sources such as sand eel and sprat. Additionally, vulnerability is linked to foraging range, with some species having very large foraging ranges and are able to easily forage across other areas, while other species (e.g., roseate tern) have a smaller foraging range and are more limited in their ability to forage elsewhere. As such the 'Forage spatial distribution, extent, abundance and availability' CO was assessed against species' diet variability, based on information presented in the North-West Irish Sea cSPA COs document, and sources within and species-specific foraging ranges presented in Woodward et al. (2019).

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s).

Including sitting birds within the displacement analysis accounts for those birds potentially displaced from an area of sea they reside, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for within the displacement assessment below (Section 5.4.2.15.2 and 5.4.2.15.3). This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). However, available tracking data of Manx shearwater from the region has also been reviewed to determine whether there are any site-specific foraging hotspots or distributional trends that should be considered in the assessment.

5.4.2.15.1 Mitigation

Manx shearwaters are not considered sensitive to displacement or collision impacts from windfarms. However, the mitigation employed reduces the predicted impacts on this species to almost zero. Displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on bird species. Although not a key consideration when undertaking array refinements, any reduction in array size benefits Manx shearwater by reducing the effects from any potential changes in species spatial distribution, barrier effects or changes to prey species.

The increase in the minimum draft height to 40m LAT decreased predicted collisions of this species to zero.

5.4.2.15.2 Disturbance and Displacement (Construction and Decommissioning)

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for Manx shearwater from construction and decommissioning activities.

The impacts of displacement during the construction and decommissioning phases of the proposed development on Manx shearwater are unlikely to equal those estimated during operational phase of the proposed development due to the localised nature of construction activities and the reduced size of the Project's footprint. During construction, on average roughly half the development will be built, therefore it is assumed the impacts during the construction and decommissioning phases are half of those during the operational phase. Consequently, it is reasonable to assume the potential disturbance and displacement impacts on the guillemot QI of the NWIS cSPA regarding population size, during the construction and decommissioning phases will be small and are likely to be limited temporally; with the extent of effects depending on the activities taking place. The effects are also likely reversible in nature, with birds returning to the area following the end of construction phase.

For the full assessment of the potential AEoI from displacement from the proposed development alone, during the operational phase, in relation to the Population size CO for the Manx shearwater QI of the NWIS cSPA see the section below.

The construction and decommissioning phase impacts are estimated to be half those presented in the following section for the operation phase. Given that no AEoI to the Population size CO of the Manx shearwater QI of NWIS cSPA was concluded during the operational phase, subject to natural change, the guillemot Manx shearwater will be maintained in the long term natural change, the guillemot QI will be maintained in the long term.

5.4.2.15.3 Disturbance and Displacement (Operation)

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for Manx shearwater from operation and maintenance activities.

The summed mean peak abundance of Manx shearwater in the array area plus a 2km buffer during the breeding bio-season is estimated at 3525 individuals. Based on 10% displacement and 1% mortality this equates to less than four (3.53) Manx shearwater mortality during the breeding bio-season (Table 5.29).

When assessing the full unapportioned impacts on Manx shearwater to the breeding NWIS cSPA count informed by the ObSERVE surveys (13,010 individuals), the increase in baseline mortality relative to this citation count (13,010 individuals) and an associated background mortality of 1,691 (1,691.3) individuals would be 0.208%. Table 5.29 presents the displacement consequent mortalities when 30% displacement, 1% mortality have been applied.

This count is derived from a sample of birds using the area during a single survey. However, these birds are likely to be from a much wider pool of the population that use the NWIS cSPA fluidly during the non-breeding season and therefore it is not considered to be appropriate to assess against this population size. As explained in the Apportioning Appendix (20) the appropriate breeding regional population is 2,727,371 individuals.

When assessing the full unapportioned impacts on Manx shearwater to the regional population of 2,727,371 individuals, the increase in baseline mortality relative to this regional count and a background mortality of 354,558 (354,558.2) individuals would be 0.001%. This level of impact would be indistinguishable from natural fluctuations in the population. Table 5.29 presents the displacement consequent mortalities when 30% displacement, 1% mortality have been applied.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the Population size CO of the Manx shearwater QI of NWIS cSPA, based on disturbance and displacement effects from the proposed development alone, during the operational phase. Therefore, subject to natural change, the Manx shearwater QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.29: Range-Based Displacement Mortalities During the Operational Phase for Manx Shearwater at NWIS cSPA Based on a Range of Displacement Impacts and the Latest ObSERVE Summer Population and the Regional Population.

SPA	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (ObSERVE Summer Population)		% increase in baseline mortality (Regional Population)	
		10% displacement, 1% mortality	30% displacement, 1% mortality	10% displacement, 1% mortality	30% displacement, 1% mortality	10% displacement, 1% mortality	30% displacement, 1% mortality
UCI							
NWIS	5,489.2	5.49	16.47	0.325	0.974	0.001	0.004
Mean							
NWIS	3,525.2	3.53	10.58	0.208	0.625	0.001	0.003
LCI							
NWIS	1,848.8	1.85	5.55	0.109	0.328	0.001	0.002

5.4.2.15.4 Spatial Distribution (Construction, Operation and Decommissioning)

The array area and the array plus 2km buffer occupy 3.8% and 8.6% of the NWIS cSPA, respectively. Therefore, under the worst-case scenario 8.6% of the NWIS cSPA may contain a reduced abundance of Manx shearwater due to displacement impacts. It should be noted, appropriate mitigation has already been taken, with the original array boundary occupying over double the 3.8% proportion (8.4% of the cSPA). The reduction in project boundary size almost halved the number of Manx shearwater within the array area (40.9% reduction in raw count based on data between May 2020 and August 2022). It is therefore considered that the proportion of foraging area lost as a result of the proposed development has already been significantly reduced through appropriate mitigation.

In order to calculate the number of Manx shearwater within the NWIS cSPA and, in turn, that would potentially be at risk of displacement from the array area during the construction, operation and decommissioning phases, the density of Manx shearwater within the NWIS cSPA were estimated using data presented in Jessop et al. (2018).

The overall density of Manx Shearwater within the NWIS cSPA was estimated to be 5.5 birds/km2 during the summer and 0.2 birds/km2 during the autumn (seasonal population of SPA divided by the total cSPA area of 2,333km2).

The ‘worst case’ area from which Manx shearwater could be displaced was the array area plus a 2km buffer which is 201.3km2. Assuming 10% of the Manx shearwater are displaced from the array area, 29 and two birds would be displaced from the array area (plus 2km buffer) into the remainder of the NWIS cSPA (2,132km2), during the summer and autumn. This would result in a maximum increase in density within the remainder of the NWIS cSPA of 9.2% and 9.0%, respectively. See Table 5.30 for the increase in density within the remainder of the NWIS cSPA when 30% displacement has been applied.

The area over which Manx shearwater could be displaced within the NWIS cSPA as a result of the construction, operation and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA. Furthermore, based on tracking data, it is clear that Manx shearwater have a large foraging range (mean max +1SD of 2,365.5km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is expected to cause minimal alteration to foraging habitat usage, given that individuals often travel beyond the NWIS cSPA boundaries to forage.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Manx shearwater QI of NWIS cSPA in relation to spatial distributional from the proposed development alone and therefore, subject to natural change, the Manx shearwater QI will be maintained in the long term with respect to potential for impacts on spatial distributional.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.30: Range-Based Increase in Density of Manx Shearwater Within the Remainder of the NWIS cSPA During the Summer and Autumn, Following 10% and 30% Displacement.

Season	Estimated number of individuals displaced array area (plus 2km buffer)		Estimated increase in density in remainder of NWIS cSPA (%)	
	10% displacement	30% displacement	10% displacement	30% displacement
Summer	29.0	87.1	9.2	8.7
Autumn	1.9	58.1	9.0	-4.6

5.4.2.15.5 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Manx shearwater primarily feed clupeiform fish during chick rearing, this species are also known to feed on squid and other marine invertebrates especially outside of the breeding bio-season (Brooke, 1990). As such Manx Shearwater exhibit a reasonably varied diet. Moreover, based on tracking data, Manx Shearwater have a large foraging range (mean max +1SD of 2,365.5km) (Woodward et al., 2019) and therefore the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage. In light of the available evidence above razorbill are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case Manx shearwater can also be ruled out. Therefore, the CO’s target regarding ‘Forage spatial distribution, extent, abundance and availability’ will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Manx Shearwater QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the Manx Shearwater QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.15.6 Barrier Effects (Operation)

The nearest breeding colony of Manx Shearwater to array area is on Lambay Island SPA (estimated 25 pairs in 2002) (NPWS, 2014a). There is no tracking data available for Manx shearwater from Lambay Island SPA, however this species has a significant large foraging range (MMF +SD) of 2,365.5km (Woodward et al., 2019). Other colonies that are within foraging range of the proposed development, include the Copeland Islands (Northern Ireland), Bardsey Island (Wales) and Skomer, Midland Island and Skokholm (Wales), from which Manx shearwater tracking data is available. Tracking data of Manx shearwater these colonies have been presented by Guilford et al. (2008) (Skomer), Dean et al. (2013) (Skomer and Copeland Islands) and Spivey et al. (2014) (Bardsey Island). Similar findings were found across these studies, Manx shearwater foraging activity is concentrated to the north and west of the Irish Sea front, off the north-east coast of Ireland, likely due to the high marine productivity associated with the QIs and the stratified waters west of the front.

The tracking data presented by Guilford et al. (2008), Dean et al. (2013) and Spivey et al. (2014) shows Manx shearwater foraging activity is likely to be concentrated north-west of the array area in waters on the far side of the proposed development.

Therefore, it cannot be completely ruled out that, on occasion, Manx shearwater might forage in the waters on the far side of the array area however as per Woodward et al. (2019) this species has a large foraging range over which suitable foraging habitat are likely to be found. Furthermore, this species was screened in for displacement assessment on a precautionary basis despite Manx Shearwater's 'very low' sensitivity to disturbance and displacement (Bradbury et al., 2014). In addition, with birds travelling such large distances between foraging areas and colonies, the relative additional energetic cost of avoiding the array area will be very small. Therefore, the evidence suggests this species foraging in waters on the far side of the Proposed Array is likely to be a very rare occurrence and of negligible consequence to the fitness of the individual involved or the colony.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Manx Shearwater QI of NWIS cSPA in relation to barrier effects from proposed development alone and therefore, subject to natural change, the Manx shearwater QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.16 Common scoter

Common scoter have been screened in for the construction operation and decommissioning phases to assess the potential of an AEoI from displacement from the ECC.

5.4.2.16.1 Disturbance and Displacement

Common scoter are considered to be highly sensitive to disturbance from boat and helicopter traffic (Garthe and Huppop, 2004 Schwemmer et al., 2011; Furness et al., 2013; Bradbury et al., 2014, Mendel et al. 2019), with individuals exhibiting disturbance responses at distances of over 1km from boats (Kaiser et al., 2006; Schwemmer et al., 2011). This species is highly sensitive to non-physical disturbance by noise and visual presence during the winter (Garthe and Hüppop 2004, Furness et al. 2013, Dierschke et al. 2017). There is limited evidence regarding displacement of this species in response to permanent infrastructure; Dierschke et al. (2016) reports this species shows a weak avoidance in response of OWFs (with most impacts resulting from boat and helicopter traffic). Additionally, minimal evidence of displacement impacts on common scoter was found during the post-consent monitoring at the Gwynt y Mor OWF (APEM, 2019).

No common scoter were recorded in the array area or the Array plus buffers (2km and 4km) during the 29 months of aerial surveys. However, it should be noted that relatively high numbers of common scoter were recorded during vantage-point surveys (see Appendix 12 Ornithology baseline). Therefore, this species has been screened out for disturbance and displacement within the array area during both the construction and decommissioning and operational phase of the proposed development. This species has been screened in for disturbance and displacement within the Proposed ECC during both the construction and decommissioning and operational phase of the proposed development on a precautionary basis.

In the absence of Irish-specific guidance regarding common scoter displacement and mortality rates a precautionary approach has been taken and a mortality rate of 1% and a displacement rate of 100% has been applied, to reflect this species high vulnerability to displacement A range of 90% to 100% has also been presented.

To assess displacement impacts in the ECC, data from Jessop et al., (2018) was used, which encompasses fine-scale aerial data on the distribution and abundance of seabirds in the western Irish Sea. Jessop aerial survey data had a 2.3% coverage of the ECC. To increase coverage, and therefore the representativeness of density estimates in the ECC, a 4km buffer was applied to the ECC. This increased aerial survey coverage to 10.5% of the ECC plus 4km buffer, with the resulting density used for the ECC assessment (noting that the ECC study area is the ECC only, with no surrounding buffer). Jessop et al. (2018) presented counts of common scoter, and of scoter species which were not identifiable to species level. As a precautionary approach, this assessment uses the combined count of common scoter and scoter species.

As per Section 2.4.2, there will be a maximum of one cable installation vessel operating within the Proposed ECC, with associated support vessels. For the assessment of displacement impacts within the ECC, the assessment considers the impacts of one vessel cluster, with a surrounding 3km buffer. It is noted that a 2km buffer round vessels is standard use, but a 3km buffer is used here as a precautionary approach, accounting for the fact that vessels may be up to a km apart from each other at a given point. Based on this, the area disturbed from the vessel cluster was calculated to be 28.3km^2, from which birds could be displaced.

5.4.2.16.2 Mitigation

The key mitigation employed to reduce impacts to divers is the Environmental Vessel Management Plan. This aims to minimise vessel disturbance to divers in the ECC by following strict vessel protocol which are outlined in the EVMP. By employing these mitigation measures any impacts to divers should reduce considerably. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.16.3 Disturbance and Displacement (Construction and Decommissioning)

Non-breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for common scoter from construction and decommissioning activities.

During the non-breeding bio-season, the density of common scoter present within the Proposed ECC is 3.0 birds/km2. Based on a total disturbance area of 28.3km^2, a total of 86 (86.2) common scoter are at risk of displacement. Of these, the total displacement consequent mortality is estimated to be one (0.86) individual, based on 100% displacement and 1% mortality.

Based on the 2016 citation count of 14,567 individuals, with an annual baseline mortality of 3,409 (3,408.7) individuals per annum (based on an average mortality rate of 0.234). The addition of one individual would represent a 0.026% increase in baseline mortality based on 100% displacement and 1% mortality. Potential effects based on a displacement range of 90% to 100% and a mortality range of 1% to 10% are presented in Table 5.31.

Displacement caused by vessels is temporary and reversible so the impacts presented here are likely to over-estimate mortality. Where established shipping lanes are used, displacement may be reduced as birds sensitive to disturbance from shipping may avoid such areas.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common scoter QI of NWIS cSPA in relation to disturbance and displacement effects as a result of vessel movement/ presence during the construction and decommissioning within the Proposed ECC and therefore, subject to natural change, the common scoter QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.31: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Common Scoter at NWIS cSPA Based on a Range of Displacement Impacts and the NPWS 2016 Citation Colony Count.

Bio-season	Density of birds within the ECC +4km buffer (km-^{2})	Estimated increase in mortality		% increase in baseline mortality (citation count)	
		100% displacement, 1% mortality	90-100% displacement, 1 - 10% mortality	100% displacement, 1% mortality	90-100% displacement, 1 - 100% mortality
Total Non-breeding	3.0	0.86	0.78 – 8.62	0.026	0.023 – 0.261

During the construction and decommissioning phases, there is potential for disturbance and displacement impacts due to vessel activity, and construction work in the intertidal area. The installation method used at landfall is HDD, a trenchless technique which minimises disruption to the structures and environment above, including birds in the intertidal zone. Considering the entrance pit will be landward of HWM and the HDD exit pits seaward of LWM, the whole intertidal zone will be bypassed. Consequently, the main disturbance impact at landfall will be from vessel disturbance at the exit pit and therefore it can be assessed in the same way as the remainder of the offshore ECC. See the section above regarding the displacement assessment for common scoter within the ECC.

A peak of 3,440 common scoter were recorded during landfall surveys (see Appendix 12 Ornithology baseline), with individuals consistently present across winter months. Despite their presence at the landfall site, risk to this species is considered to be low because any potential disturbance and displacement impacts will be spatially and temporally limited. As outlined above, works at the landfall site will be undertaken using HDD, which will limit any potential disturbance impacts in the intertidal zone, leaving vessel activity at the exit pit as the main disturbance in the intertidal zone. Works undertaken at the exit pit will be localised and carried out over a short time period with only 24 hours required to complete excavation of the exit pit and transition zone. Meanwhile any vessel disturbance is considered to be sufficiently covered within the ECC displacement assessment above, which accounts for vessel activity in the ECC during the full construction period.

5.4.2.16.4 Disturbance and Displacement (Operation)

Non-breeding Bio- season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for common scoter from operation and maintenance activities.

Common scoter are at risk of disturbance as a result of vessel movements from maintenance activities during the operational phase of the wind farm. It has been assumed within this assessment that 100% displacement of common scoter will occur within 2km of the operational vessels in the Proposed ECC. It should be noted no common scoter were recorded during the 29 months of aerial surveys therefore common scoter have not been assessed for disturbance within the array area during the operational phase. However, a precautionary approach has been taken by screening in common scoter for displacement within the Proposed ECC during the operational phase.

The absence of common scoter records throughout the aerial surveys is likely due to the large volumes of vessel traffic in and around the array area and ECC. According to data collected during seasonal site-specific surveys in December 2021 and July 2022, a total of 61 vessels (22 and 39 vessels, respectively) were observed intersecting with the array area and ECC per day.

Approximately 17% (4 vessels) of the vessels recorded during the December 2021 survey overlapped with the Proposed ECC while 14% of the vessels recorded in the summer survey (July 2022) crossed over into the Proposed ECC. The majority of the vessels recorded were cargo vessels, fishing vessels and recreational vessels. For further information regarding the vessel traffic around the proposed development and the site-specific surveys see the Environmental Vessel Management Plan (Appendix 11).

There are several important commercial ports within the region. Drogheda Port is the closest to the proposed development, with the port entrance located approximately 17km (9nm) from the array. The Dublin port is located 20nm south-west of the proposed development which handles approximately 50% of all trade in the

Republic of Ireland (Dublin Port Company, 2022). A number of smaller harbours used by emergency vessels and smaller crafts can also be found in the region. In addition, nine commercial shipping routes have been identified to intersect with the array area and/or the ECC (see the Environmental Vessel Management Plan (Appendix 11) for further information).

During the operational phase of the proposed development a maximum of 21 vessels could be in transit and/or operation within the offshore development area at one time, equating to a total of 1,018 round trips per year. It is proposed that operational vessels that will be utilised during the operational phase will transit from the proposed Greenore Port, located approximately 38km north of the array area. The Greenore Port currently handles a range of non-containerised cargo including rock, steel, fertiliser as well as general cargo like WTGs (Greenore Port, 2023). The operational vessels will likely utilise one or more of the identified commercial shipping routes that are already frequented by high volumes of vessels in transit across the NWIS cSPA. Therefore, common scoter within the cSPA are likely already affected by the shipping activity within the site and the Proposed ECC and the additional vessels associated with the operational phase of the proposed development will not adversely affect the common scoter population.

It should be noted appropriate mitigation has already been committed to regarding vessel impacts as per the Environmental (Appendix 11). During the operational phase the proposed development will reduce vessel activity in the ECC during the most sensitive months for coastal divers (November to March 1st inclusive), where practicable.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common scoter QI of NWIS cSPA in relation to disturbance and displacement as a result of vessel movement/ presence during the operational within the Proposed ECC and therefore, subject to natural change, the common scoter QI will be maintained in the long term with respect to potential for impacts on spatial distribution.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.16.5 Spatial Distribution (Construction, Operation and Decommissioning)

There will be a maximum of one cable laying vessels operating within the ECC during the construction phase (Section 2.4.2). Assuming common scoter flush 3km from approaching vessels, the maximum area within which the birds are at risk of disturbance is 28.3km2. The NWIS cSPA has a total area of 2,333km2, therefore common scoter are at risk of being displaced from 1% (1.2%) of the cSPA during the cable laying activities associated with the proposed development. As a result, the density within the remainder of the cSPA may increase by up to 1.2%.

The area over which common scoter could be displaced within the NWIS cSPA as a result of the construction and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA. Furthermore, changes to common scoter distribution within the cSPA are likely to have occurred already due to the large volume of vessel movement.

This is reflected in the low numbers of common scoter recorded within the array area plus 4km during aerial surveys. Considering the small number of common scoter potentially affected by vessel disturbance and the minimal area within which disturbance could occur, therefore the potential for any adverse impact is unlikely.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common scoter QI of NWIS cSPA in relation to spatial distribution as a result of vessel movement/ presence during the construction and decommissioning within the Proposed ECC and therefore, subject to natural change, the common scoter QI will be maintained in the long term with respect to potential for impacts on spatial distribution.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.16.6 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Common scoter primarily feed on bivalve molluscs and occasionally on crustaceans, gastropods and small fish (Kaiser et al., 2006). As such this species has a reasonably varied diet.

According to Jessop et al (2018) common scoter tend to aggregate in waters close to the shore often with a preference for water depths around 10m, although individuals were observed further offshore. During these surveys this species was concentrated in the northernmost section of the survey area around Dundalk Bay, similarly to the divers (red-throated diver and great northern diver) (Jessop et al., 2018).

In light of the available evidence above common scoter are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development. And therefore, the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case common scooter can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common scoter QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the common scoter QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.16.7 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for common scoter at North-West Irish Sea SPA is provided in Section 5.4.30.2, concluding no AEoI for this species.

5.4.2.16.8 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds.

During the 29 months of aerial surveys no common scoter were recorded in the array area or the Array plus buffers (2km and 4km), therefore suggesting this species does not fly through the proposed development or forage on the far side of the array area. This is supported by the distribution of birds observed by Jessop et al (2018), where the majority of scoter aggregated (presumably over suitable feeding areas) inshore.

There is, therefore, no potential for an AEoI to the COs of the common scoter QI of NWIS cSPA in relation to barrier effects from the array area and therefore, subject to natural change, the common scoter QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.17 Red-throated Diver

Red-throated diver have been screened in for construction, operational and decommissioning phases to assess the potential of an AEoI from displacement from vessel movement within the ECC.

5.4.2.17.1 Disturbance and displacement

Non-breeding red-throated divers are highly sensitive to non-physical disturbance as a result of noise and visual presence (Garthe and Hüppop 2004, Furness et al. 2013), therefore this species is at risk of disturbance and displacement as a result of offshore cable laying vessel activity throughout the NWIS cSPA. Minimal noise is emitted during offshore cable installation activity especially in comparison to activities like pilling, therefore red-throated diver are likely to be disturbed by the presence of the vessels rather than any associated noise (Schwemmer et al., 2011). There is evidence to suggest red-throated diver avoid approaching vessels at a distance of up to 2km, however the majority are expected to flush at 1km or less (Bellebaum et al., 2006; Schwemmer et al., 2011; Jarrett et al., 2018; Topping and Petersen, 2011).

The Dublin port is located 20nm south-west of the proposed development, approximately 50% of all trade in the Republic of Ireland is handled at this port (Dublin Port Company, 2022). Therefore, there is extensive existing vessel traffic around the array area and ECC. A total of 22 and 39 unique vessels were observed overlapping with the array area and the ECC per day, during 14-day site-specific shore-based vantage point surveys during December 2021 and July 2022, respectively. During the winter survey (December 2021) four unique vessels were recorded within the Proposed ECC per day (17% of vessels observed) while six vessels crossed the Proposed ECC per day during the summer survey. The majority of recorded vessels recorded were cargo vessels, fishing vessels and recreational vessels; for further information regarding the vessel traffic around the proposed development and the site-specific surveys see the Environmental Vessel Management Plan (Appendix 11).

A total of two red-throated diver were recorded in the 4km buffer, during 29 months of aerial surveys; one in August 2020 and another in December 2020. Low densities were also recorded by Jessop et al. (2016). Considering the species' high sensitivity to vessel disturbance it is likely that the large amounts of vessel traffic intersecting with the array area and ECC is a key contributing factor in the low abundances of red-throated divers observed during the aerial surveys. Red-throated diver have been screened out for displacement within the array area during all phases due to the low abundances of birds. However, a precautionary approach has been taken, therefore this species has been assessed for disturbance within the Proposed ECC for the construction, operation and decommissioning phases, despite their low abundance in the array area plus 4km buffer.

As per Table 6.22, there will be a maximum of one cable installation vessel operating within the Proposed ECC, with associated support vessels. For the assessment of displacement impacts within the ECC, the assessment considers the impacts of one vessel cluster, with a surrounding 3km buffer. It is noted that a 2km buffer around vessels may be considered the standard approach, but a 3km buffer is used here as a precautionary approach, accounting for the fact that vessels may be up to one km apart from each other at any given point. Based on this, the area disturbed from the vessel cluster was calculated to be 28.3km^2, from which birds could be displaced.

5.4.2.17.2 Mitigation

The key mitigation employed to reduce impacts to divers is the Environmental Vessel Management Plan (Appendix 11). This aims to minimise vessel disturbance to divers in the ECC by following strict vessel protocol which are outlined in the EVMP. This mitigation was not considered in the assessment and therefore by employing these measures any impacts to divers should reduce considerably. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.17.3 Disturbance and Displacement (Construction and Decommissioning)

Non-breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for red-throated diver from construction and decommissioning activities.

During the post- breeding migration bio-season and the return migration bio-season, the density of red-throated diver present within the ECC is 0.9 birds/km^2.

Based on a total disturbance area of 28.3km^2, a total of 25 (24.9) red-throated diver are at risk of displacement. Of these, the total displacement consequent mortality is estimated at less than one (0.25) individual, based on 100% displacement and 1% mortality.

Based on the 2016 citation count of 538 individuals, with an annual baseline mortality of 126 (126.4) individuals per annum (based on an average mortality rate of 0.235). The addition of less than one individual would represent a 0.201% increase in baseline mortality based on 100% displacement and 1% mortality. Potential impacts based on a displacement range of 90% to 100% and a mortality range of 1% to 10% are presented in Table 5.32.

During the migration- free winter bio-season, the density of birds present within the ECC is 0.4 birds/km2. Based on a total disturbance area of 28.3km^2, a total of 10 (10.3) red-throated divers are at risk of displacement. Of these, the total displacement consequent mortality is estimated at less than one (0.04) individual, based on 100% displacement and 1% mortality.

Based on the 2016 citation count of 538 individuals, with an annual baseline mortality of 126 (126.4) individuals per annum (based on an average mortality rate of 0.235). The addition of less than one individual would represent a 0.083% increase in baseline mortality based on 100% displacement and 1% mortality. Potential effects based on a displacement range of 90% to 100% and a mortality range of 1% to 10% are presented in Table 5.32.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.6) individual per annum. This represents an increase of 0.484% in baseline mortality of the 2016 citation population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the red-throated diver QI of NWIS cSPA in relation to disturbance and displacement effects as a result of vessel movement/ presence during the construction and decommissioning phases within the Proposed ECC and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.32: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Red-Throated Diver at NWIS cSPA Based on a Range of Displacement Impacts and the NWIS 2016 Citation Colony Count.

Bio-season	Density of birds within the ECC +4km buffer (km-2)	Total disturbed birds	Estimated increase in mortality		% increase in baseline mortality (citation count)	
			100% displacement, 1% mortality	90-100% displacement, 1 - 10% mortality	100% displacement, 1% mortality	90-100% displacement, 1 - 100% mortality
Post-breeding migration	0.88	24.93	0.25	0.22 – 2.49	0.201	0.181 – 2.006
Return-breeding migration	0.88	24.93	0.25	0.22 – 2.49	0.201	0.181 – 2.006
Migration -free winter	0.36	10.26	0.10	0.0.9 – 1.03	0.083	0.074 – 0.826
Total non-breeding	2.12	60.1	0.24	0.27 – 2.67	0.484	0.435 – 4.837

During the construction and decommissioning phases, there is potential for disturbance and displacement impacts due to vessel activity, and construction work in the intertidal area. The installation method used at landfall is HDD, a trenchless technique which minimises disruption to the structures and environment above, including birds in the intertidal zone. Considering the entrance pit will landward of the HWM and the HDD exit pit seaward of LWM, the whole intertidal zone will be bypassed. Consequently, the main disturbance impact at landfall will be from vessel disturbance at the exit pit and therefore it can be assessed in the same way as the remainder of the offshore ECC. See the section above regarding the displacement assessment for common scoter within the ECC.

A total of 220 red-throated diver were recorded during landfall surveys (see Appendix 12 Ornithology baseline), with individuals consistently present across winter months. Despite their presence at the landfall site, risk to this species is considered to be low because any potential disturbance and displacement impacts will be spatially and temporally limited. As outlined above, works at the landfall site will be undertaken using HDD, which will limit any potential disturbance impacts in the intertidal zone, leaving vessel activity at the exit pit as the main disturbance in the intertidal zone. Works undertaken at the exit pit will be localised and carried out over a short time period with only 24 hours required to complete excavation of the exit pit and transition zone. Meanwhile any vessel disturbance is considered to be sufficiently covered within the ECC displacement assessment above, which accounts for vessel activity in the ECC during the full construction period.

5.4.2.17.4 Disturbance and Displacement (Operation)

Non-breeding Bio- season

As determined in Table 5.11, Project Option 1 has a greater potential for adverse effects on disturbance and displacement than Project Option 2 for red-throated diver from operation and maintenance activities.

It should be noted that red-throated divers have not been assessed for disturbance within the array area during the operational phase due to the trivial numbers recorded during the 29 months of aerial surveys; a total of two red-throated divers were observed within the 4km buffer (during August and December 2020). However, a precautionary approach has been taken by screening in red-throated diver for displacement within the ECC during the operational phase.

The low number of red-throated divers recorded throughout the aerial surveys is likely due to the large volumes of vessel traffic in and around the array area and ECC. According to data collected during seasonal site-specific surveys in December 2021 and July 2022, a total of 61 vessels (22 and 39 vessels, respectively) were observed intersecting with the array area and ECC per day. Approximately 17% (4 vessels) of the vessels recorded during the December 2021 survey overlapped with the Proposed ECC while 14% of the vessels recorded in the summer survey (July 2022) crossed over into the Proposed ECC. The majority of the vessels recorded were cargo vessels, fishing vessels and recreational vessels. For further information regarding the vessel traffic around the proposed development and the site-specific surveys see the Environmental Vessel Management Plan (Appendix 11).

There are several important commercial ports within the region. Drogheda Port is the closest to the proposed development, with the port entrance is located approximately 17km (9nm) from the array area. Dublin port is located 20nm south-west of the proposed development which handles approximately 50% of all trade in the Republic of Ireland (Dublin Port Company, 2022). A number of smaller harbours used by emergency vessels and smaller crafts can also be found in the region. In addition, nine commercial shipping routes have been identified to intersect with the array area and/or the ECC (see the Environmental Vessel Management Plan (Appendix 11) for further information).

During the operational phase of the project a maximum of 21 vessels could be in transit and/or operation within the array area at one time, equating to a total of 1,018 round trips per year. It is proposed that the operational vessels that will be utilised during the operational will transit from the Greenore Port, located approximately 38km north of the array area. The Greenore Port currently handles a range of non-containerised cargo including rock, steel, fertiliser as well as general cargo like WTGs (Greenore Port, 2023). The operational vessels will likely utilise one or more of the identified commercial shipping routes that are already frequented by high volumes of vessels in transit across the NWIS cSPA.

Therefore, red-throated diver within the cSPA are likely already affected by the shipping activity within the site and the Proposed ECC and the additional vessels associated with the operational phase of the proposed development are unlikely to adversely affect the red-throated diver population.

It should be noted the Applicant has referred to NE best practice for appropriate mitigation regarding vessel impacts as per the Environmental Vessel Management Plan (Appendix 11). During the operational phase the proposed development will reduce vessel activity in the ECC during the most sensitive months for coastal divers (November to March 1st inclusive), where practicable. Furthernore, the operational port is located outside of the NWIS cSPA therefore vessel movement can be diverted around the inshore areas within the cSPA where the divers and sea ducks like red-throated diver are likely to forage and reside and in turn reduce potential disturbance and displacement of such species, should this be required. The current assessment has been made based on the assumption that this mitigation has not been introduced.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the red-throated diver QI of NWIS cSPA in relation to disturbance and displacement effects as a result of vessel movement/ presence during the operational phase within the Proposed ECC and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.17.5 Spatial Distribution (Construction, Operation and Decommissioning)

There will be a maximum of one cable laying vessel operating within the ECC during the construction phase (Section 2.4.2). Assuming red-throated diver flush 2km from approaching vessels, the maximum area within which the birds are at risk of disturbance is 28.3km^2. The NWIS cSPA has a total area of 2,333km^2, therefore red-throated divers are at risk of being displaced from 1% (1.2%) of the cSPA during the cable laying activities associated with the proposed development. Provided 100% of red-throated diver are displaced from around the cable laying vessel and that displacement was local (remain within the NWIS cSPA) the density within the remainder of the cSPA will increase by 1% (1.2%).

The area over which red-throated diver could be displaced within the NWIS cSPA as a result of the construction and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA (1.2%). Furthermore, changes to red-throated diver distribution within the cSPA are likely to have occurred already due to the large existing volume of vessel movements. This is further reflected in the low numbers of red-throated divers recorded within the array area plus 4km during aerial surveys. Considering the small number of red-throated divers potentially affected by vessel disturbance and the minimal area within which disturbance could occur the potential for any adverse impact is unlikely.

There is, therefore, no potential for an AEoI to the COs of the red-throated diver QI of NWIS cSPA in relation to spatial distribution as a result of vessel movement/ presence during the construction and decommissioning phases within the Proposed ECC and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for impacts on spatial distribution.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.17.6 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for red-throated diver at North-West Irish Sea SPA is provided in Section 5.4.30.2, concluding no AEoI for this species.

5.4.2.17.7 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

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 has a reasonably varied diet.

This species tend to forage close to the coast especially during adverse weather, however red-throated diver can travel further offshore during call conditions (Furness, 1983).

Based on tracking data, red-throated diver have a small foraging range (mean max +1SD of 9km) (Woodward et al., 2019). This suggests red-throated diver are more limited in their ability to forage elsewhere and are perhaps less adaptable to potential changes to prey species abundance and availability as a result of the proposed development.

However, as per the Jessop et al (2018) surveys divers (red-throated diver and/or great northern diver) were concentrated in the northern coastal areas with a notable preference for shallow waters between 5 to 20m depth. The highest density of divers was in the northwest of the survey area around Dundalk Bay (Jessop et al., 2018). During the autumn and winter these birds remained largely concentrated along the north coast, with a slight southwardly distribution down to the north of Wexford harbour (Jessop et al., 2018).

In light of the available evidence above red-throated diver are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development. And therefore, the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

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 are addressed within the Approach to Assessment (Section 5.4.1.3.1). 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 ornithological receptors in this case red-throated diver can also be ruled out. Therefore, the CO's target regarding 'Forage spatial distribution, extent, abundance and availability' will be preserved.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the CO of the red-throated diver QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.17.8 Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds.

The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for. By including sitting birds within the analysis those potentially displaced from an area of sea they reside are assessed, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects).

A total of two red-throated diver were recorded in the array area plus a 4km buffer during the 29 months of DAS, one in August 2020 and another in December 2020, this suggests that this species do not fly through the array area or forage within the water on the seaward side of the array area.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the red-throated diver QI of NWIS cSPA in relation to barrier effects from the array area and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.18 Great northern diver

Great northern diver have been screened in for the construction, operational and decommissioning phases to assess the potential of an AEoI from displacement from vessel movement within the ECC.

5.4.2.18.1 Disturbance and distribution

There is limited evidence regarding the sensitivity of great northern divers, compared to red-throated divers. According to Bradbury et al. (2014) this species are highly vulnerable to disturbance and displacement, while results from study in Ireland by Gittings et al. (2015) indicated that great northern diver did not exhibit a flush response to boat traffic, despite the boat passing within 10 to 20m of individuals. Jarrett et al (2022) also describe minimal meaningful impact on great northern diver from the presence of vessels, with the majority opting to dive or swim away, and virtually no flight response to vessels at any proximity. A precautionary approach has been taken within this assessment and great northern diver has been assumed to show high sensitivity to vessel disturbance.

A total of 7 great northern diver were recorded within the array area plus a 4km buffer during the 29 months of DAS. The majority (six) were observed in February 2021, with one in May 2021. This species has been screened out for displacement and disturbance within the array area during all phases of the proposed development. However, since great norther diver are assumed to be highly sensitive to vessel disturbance they have been assessed for disturbance within the Proposed ECC, despite their low abundance in the array area.

As per Table 6.22, there will be a maximum of one cable installation vessel operating within the Proposed ECC, with associated support vessels. For the assessment of displacement impacts within the ECC, the assessment considers the impacts of one vessel cluster, with a surrounding 3km buffer. It is noted that a 2km buffer round vessels is standard use, but a 3km buffer is used here as a precautionary approach, accounting for the fact that vessels may be up to a km apart from each other at a given point. Based on this, the area disturbed from the vessel cluster was calculated to be 28.3km2, from which birds could be displaced.

5.4.2.18.2 Mitigation

The key mitigation employed to reduce impacts to divers is the Environmental Vessel Management Plan (Appendix 11). This aims to minimise vessel disturbance to divers in the ECC by following strict vessel protocol which are outlined in the Environmental Vessel Management Plan. This mitigation was not considered in the assessment and therefore by employing these measures any impacts to divers should reduce considerably. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.2.18.3 Disturbance and displacement (Construction and Decommissioning)

Non-breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for great northern diver from construction and decommissioning activities.

During the non-breeding bio-season, the density of great northern divers present within the ECC is 0.06 birds/km2. Based on a total disturbance area of 28.3km2, a total of two (1.7) great northern divers are at risk of displacement. Of these, the total displacement consequent mortality is estimated at less than one (0.02) individual, based on 100% displacement and 1% mortality.

Based on the 2016 citation colony count of 478 individuals, with an annual baseline mortality of 53 (53.1) individuals per annum (based on an average mortality rate of 0.111). The addition of less than one individual would represent a 0.022% increase in baseline mortality based on 100% displacement and 1% mortality. Potential effects based on a displacement range of 90% to 100% and a mortality range of 1% to 10% are presented in Table 5.33.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great northern diver QI of NWIS cSPA in relation to disturbance and displacement effects as a result of vessel movement/ presence during the construction and decommissioning phases within the Proposed ECC and therefore, subject to natural change, the great northern diver QI will be maintained in the long term with respect to potential for disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.33: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Great Northern Diver at NWIS cSPA Based on a Range of Displacement Impacts and the NPWS 2016 Citation Colony Count.

Bio-season	Density of birds within the ECC +4km buffer (km-2)	Estimated increase in mortality		% increase in baseline mortality (citation count)	
		100% displacement, 1% mortality	90-100% displacement, 1 – 10% mortality	100% displacement, 1% mortality	90-100% displacement, 1 – 100% mortality
Total non-breeding	0.06	0.02	0.02 – 0.17	0.022	0.020 – 0.219

During the construction and decommissioning phases, there is potential for disturbance and displacement impacts due to vessel activity, and construction work in the intertidal area. The installation method used at landfall is HDD, a trenchless technique which minimises disruption to the structures and environment above, including birds in the intertidal zone. Considering the input pit will be behind the beach, the whole intertidal zone will be bypassed. Consequently, the main disturbance impact at landfall will be from vessel disturbance at the exit pit and therefore it can be assessed in the same way as the remainder of the offshore ECC. See the section above regarding the displacement assessment for common scoter within the ECC.

A total of 20 great northern diver were recorded during landfall surveys (see Appendix 12 Ornithology baseline), with individuals consistently present across winter months. Despite their presence at the landfall site, risk to this species is considered to be low because any potential disturbance and displacement impacts will be spatially and temporally limited. As outlined above, works at the landfall site will be undertaken using HDD, which will limit any potential disturbance impacts in the intertidal zone, leaving vessel activity at the exit pit as the main disturbance in the intertidal zone. Works undertaken at the exit pit will be localised and carried out over a short time period with only 24 hours required to complete excavation of the exit pit and transition zone. Meanwhile any vessel disturbance is considered to be sufficiently covered within the ECC displacement assessment above, which accounts for vessel activity in the ECC during the full construction period.

5.4.2.18.4 Disturbance and Displacement (Operation)

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for great northern diver from operation and maintenance activities.

Great northern diver are at risk of disturbance as a result of vessel movements from maintenance activities during the operational phase of the wind farm. It has been assumed within this assessment that 100% displacement of great northern diver will occur within 3km of the operational vessels in the Proposed ECC, although recent analyses suggest this may be highly precautionary. It should be noted that great northern diver have not been assessed for disturbance within the array area during the operational phase due to the trivial numbers recorded during the 29 months of aerial surveys; a total of seven great northern divers were observed within the array area plus a 4km buffer (during February and May 2021). However, a precautionary approach has been taken by screening in great northern diver for displacement within the Proposed ECC during the operational phase.

The low numbers of great northern divers recorded throughout the aerial surveys are likely due to the large volumes of vessel traffic in and around the array area and ECC. According to data collected during seasonal site-specific surveys in December 2021 and July 2022, a total of 61 vessels (22 and 39 vessels, respectively) were observed intersecting with the array area and/or ECC per day. Approximately 17% (four vessels) of the vessels recorded during the December 2021 survey overlapped with the Proposed ECC while 14% of the vessels recorded in the summer survey (July 2022) crossed over into the Proposed ECC. The majority of the vessels recorded were cargo vessels, fishing vessels and recreational vessels. For further information regarding the vessel traffic around the proposed development and the site-specific surveys see the Environmental Vessel Management Plan (Appendix 11).

There are several important commercial ports within the region. Drogheda Port is the closest to the proposed development, with the port entrance is located approximately 17km (9nm) from the array area. The Dublin port which handles approximately 50% of all trade in the Republic of Ireland (Dublin Port Company, 2022) is located 20nm south-west of the proposed boundary. A number of smaller harbours used by emergency vessels and smaller crafts can also be found in the region. In addition, nine commercial shipping routes have been identified to intersect with the array area and/or the ECC (see the Environmental Vessel Management Plan (Appendix 11) for further information).

During the operational phase of the project a maximum of 21 vessels could be in transit and/or operation within the proposed development at one time, equating to a total of 1,018 round trips per year. It is proposed that the operation and maintenance vessels that will be utilised during the operational phase will transit from the Greenore Port, located approximately 38km north of the array area. The Greenore Port currently handles a range of non-containerised cargo including rock, steel, fertiliser as well as general cargo like WTGs (Greenore Port, 2023). The operational vessels will likely utilise one or more of the identified commercial shipping routes that are already frequented by high volumes of vessels in transit across the NWIS cSPA. Therefore, great northern diver within the cSPA are likely already affected by the shipping activity within the site and the Proposed ECC and the additional vessels associated with the operational phase of the proposed development are unlikely to adversely affect the great northern diver population.

It should be noted appropriate mitigation has already been taken regarding vessel impacts as per the Environmental Vessel Management Plan (Appendix 11).

During the operational phase the proposed development will reduce vessel activity in the ECC during the most sensitive months for coastal divers (November to March 1st inclusive), where practicable.

Furthermore, the operational port is located outside of the NWIS cSPA therefore vessel movement can easily be directed away from the inshore areas within the cSPA where the divers and sea ducks like great northern diver are likely to forage and reside and in turn reduce potential disturbance and displacement of such species.

5.4.2.18.5 Spatial Distribution (Construction and Decommissioning)

There will be a maximum of one cable laying vessels operating within the Proposed ECC during the construction phase (Section 2.4.2). Assuming great northern diver flush 3km from approaching vessels, the maximum area within which the birds are at risk of disturbance is 28.3km^2. The NWIS cSPA has a total area of 2,333km^2, therefore great northern diver are at risk of being displaced from 1% (1.2%) of the cSPA during the cable laying activities associated with the proposed development. Provided 100% of great northern diver are displaced from around the cable laying vessel and that displacement was local (remain within the NWIS cSPA) the density within the remainder of the cSPA will increase by 1% (1.2%).

The area over which great northern diver could be displaced within the NWIS cSPA as a result of the construction and decommissioning phases is relatively small compared to the total area of habitat available in the cSPA. Furthermore, changes to great northern diver distribution within the cSPA are likely to have occurred already due to the large volume of vessel movement. This is reflected in the low numbers of great northern divers recorded within the array area plus a 4km during DAS. Considering the small number of great northern potentially affected by vessel disturbance and the minimal area within which disturbance could occur the potential for any adverse impact is unlikely.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great northern diver QI of NWIS cSPA in relation to spatial distribution as a result of vessel movement/ presence during the construction and decommissioning phases within the Proposed ECC and therefore, subject to natural change, the great northern diver QI will be maintained in the long term with respect to potential for impacts on spatial distribution.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.18.6 Indirect Effects via Impacts on Prey (Construction, Operation and Decommissioning)

Great northern diver piscivorous although their diet frequently includes marine invertebrates (Paruk et al., 2021). As such this species has a reasonably varied diet. This species tend to forage to forage close to the shore within 50-150m of the shoreline, in shallow waters of less than 5m depth, during the breeding season (Strong et al., 1989; Ruggles, 1994).

Moreover, as per the Jessop et al (2018) surveys divers (red-throated diver and/or great northern diver) were concentrated in the northern coastal areas with a notable preference for shallow waters between 5 to 20m depth. The highest density of divers was in the northwest of the survey area around Dundalk Bay (Jessop et al., 2018). During the autumn and winter these birds remained largely concentrated along the north coast, with a slight southwardly distribution down to the north of Wexford harbour (Jessop et al., 2018).

In light of the available evidence above great northern diver are considered to be adaptable to potential changes to prey species abundance and availability as a result of the proposed development. And therefore, the reduction in available foraging area as a result of the proposed development is likely to cause minimal alteration to foraging habitat usage.

Furthermore, potential effects on prey species namely, sand eels, herring and sprat, that are key prey species for various seabirds, and the habitats that support these species have been covered within the Fish and Shellfish Ecology Baseline (Appendix 21). 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 ornithological receptors in this case great northern diver is extremely low.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great northern diver QI of NWIS cSPA in relation to prey species abundance and availability from the proposed development alone and therefore, subject to natural change, the great northern diver QI will be maintained in the long term with respect to potential for impacts on prey species abundance and availability.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.18.7 Barrier Effects (Operation)

The presence of WTGs (both operational and during construction and decommissioning phases) has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds.

The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for. By including sitting birds within the analysis those potentially displaced from an area of sea they reside are assessed, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot guidance (NatureScot 2023c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects).

A total of ten great northern diver were recorded in the array area plus a 4km buffer during the 29 months of DAS, the majority were observed in February 2021, six individuals were recorded during this month, the remaining great northern diver was observed in May 2021. This suggests that this species do not fly through the array area or forage within the water on the seaward side of the array area.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the great northern diver QI of NWIS cSPA in relation to barrier effects from the array area and therefore, subject to natural change, the great northern diver QI will be maintained in the long term with respect to potential for barrier effects.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.2.19 Impacts Arising from the Onshore Elements of the Proposed Development

This section addresses the assessment of effects that arise from works associated with the onshore elements of the proposed development. While these impacts will not occur above the HWM, as the effect arises from works occurring above the HWM, they have been considered in this section.

North-West Irish Sea cSPA lies immediately adjacent to the onshore elements of the proposed development at the landfall site. All watercourse crossings along the onshore cable route of the proposed development drain to the cSPA, either directly or via Rogerstown Estuary, Malahide Estuary or Baldoyle Bay. At the landfall site, direct hydrological connectivity is through surface water.

A total of twelve QIs of North-West Irish Sea cSPA have been screened in for the assessment of impacts arising from the onshore elements of the proposed development due to their presence within the ZoI during baseline surveys at the landfall site. These are common scoter, red-throated diver, great northern diver, kittiwake, lesser black-backed gull, black-headed gull, common gull, herring gull, guillemot, razorbill, shag and cormorant. At the landfall site, direct hydrological connectivity is through surface water.

5.4.2.19.1 Surface Water Run-off of Suspended Sediment/Deposition (Construction and Decommissioning)

Suspended material from onshore construction and decommissioning works may enter the marine environment through surface water run-off arising from the nearest onshore works at the landfall site or indirectly via hydrological connectivity at watercourse crossings. With HDD activities at watercourse crossings there is a risk of frac-out in the watercourse bed which results in the return of drilling fluids to the surface during HDD and release of these fluids into the watercourse. Increased suspended sediment arising from onshore works and reaching North-West Irish Sea cSPA via surface water will be localised to the immediate downstream area of the works.

Temporary increased suspended sediment arising from onshore elements of the proposed development and reaching North-West Irish Sea cSPA via surface water will be localised to the immediate downstream area of the works. An increase in suspended sediment and deposition has the potential to affect QIs and the habitats on which they rely for feeding and roosting. Considering the dilution factor within the marine cSPA, it is expected that any suspended sediment reaching the cSPA at the landfall site will be imperceptible. However, water quality mitigation measures are proposed nevertheless to minimise any such impact.

Mitigation

There is potential for material produced by onshore construction activities to enter the marine environment within surface runoff. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills that may reach the downstream environment via surface water run-off. At the landfall site, the nearest works will occur a minimum of 50m from the coastline which will further reduce the risk of surface water run-off reaching the marine environment of the cSPA.

Conclusion of AEoI

With the implementation of best practice construction methods and additional specific water quality mitigation measures outlined in the CEMP (Appendix 8), the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the marine habitats utilised by designated QIs of the North-West Irish Sea cSPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

5.4.2.19.2 Accidental Pollution (Construction and Decommissioning)

An accidental pollution event of hydrocarbons or other contaminants reaching the hydrologically connected cSPA has the potential to impact QI species that utilise the adjacent marine habitat. Direct contact of QIs with such pollutants, of a sufficient magnitude, can result in mortality of birds. Indirectly an accidental pollution event can impact the habitats and food supply on which these birds rely for feeding and roosting.

Considering the dilution factor within the marine cSPA, it is expected that any pollutants reaching the cSPA at the landfall site will be imperceptible. However, water quality mitigation measures are proposed nevertheless to minimise any such impact.

Mitigation

There is potential for materials arising from an accidental pollution spill produced by onshore construction activities to enter the marine environment within surface runoff. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials and refuelling restrictions. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills. At the landfall site, the nearest works will occur a minimum of 50m from the coastline which will further reduce the risk of an accidental pollution spill reaching the marine environment of the cSPA.

Conclusion of AEoI

With the implementation of the mitigation measures set out in the CEMP (Appendix 8) for accidental pollution spill during construction and decommissioning of the onshore elements of the proposed development, the conclusion can be reached that the construction of onshore elements of the proposed development (alone) will not have AEoI on the marine habitats utilised by designated QIs of the North-West Irish Sea cSPA in relation to accidental pollution arising from the onshore elements of the proposed development.

5.4.2.19.3 Dust Deposition (Construction and Decommissioning)

Dust deposition arising during construction and decommissioning of the onshore development area has the potential to reach the cSPA at adjacent works at the landfall site. Typically, dust impacts are localised and dust deposition does not extend further than 100m from the source, however under dry and windy weather conditions dust can travel a significant distance and deposit on habitats a distance greater than 100m from the source. Indirectly dust deposition can impact the habitats and food supply on which QI birds rely for feeding and roosting. Considering the dilution factor within the marine cSPA, localised extent of any dust deposition, i.e. not much greater than c. 100m from the source, it is expected that any dust reaching the cSPA at the landfall site will be imperceptible. However, dust mitigation measures are proposed nevertheless to minimise any such impact.

Mitigation

Standard best practice construction methods will be adopted to minimise dust impacts including preparation and management of site and works areas to minimise soil and dust exposure; maintenance of construction plant and equipment; coverage and revegetation of exposed earthworks. At the landfall site, the nearest works will occur a minimum of 50m from the coastline which will further reduce the risk of dust reaching the marine environment of the cSPA.

Conclusion of AEoI

With the implementation of the mitigation measures set out in the CEMP (Appendix 8) for dust during construction and decommissioning of the onshore elements of the proposed development, the conclusion can be reached that the construction of onshore elements of the proposed development (alone) will not have AEoI on the marine habitats utilised by designated QIs of the North-West Irish Sea cSPA in relation to dust arising from the onshore elements of the proposed development.

5.4.2.19.4 Disturbance and Displacement (Construction and Decommissioning)

The North-West Irish Sea cSPA is immediately adjacent to the onshore elements of the proposed development at the landfall site. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009).

In addition to the onshore works at the landfall site that occur above the HWM, near-shore works, which comprise the HDD exit location, will occur in the sub-tidal area several hundred meters offshore from the HWM. QIs recorded during surveys in the near-shore area of the landfall site, including common scoter, great northern diver, red-throated diver, kittiwake, razorbill and guillemot. Of these, common scoter, great northern diver, red-throated diver were recorded in numbers greater than 1% of the national population, while kittiwake, razorbill and guillemot were recorded in numbers significantly lower than 1% of the national population.

It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m to the SPA boundary as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). However, it is possible that QIs associated with the cSPA, as detailed above, are likely to be exposed to localised disturbance and displacement effects at the onshore landfall site.

Construction works at the landfall site will take approximately 13-14 months to complete. Once commenced, the HDD drilling activities are expected to operate continuously over a 24 hour period. The construction activities proposed near the shoreline at the landfall site are those associated with the HDD compounds. Construction noise levels potentially producing a moderate effect (that is, above 50dBLAeq) could occur within a distance of c. 100m of the works at ground level surrounding the compounds. Birds within this distance may be disturbed and be displaced to a location further from the works. For birds located on the shoreline, that is, locations where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels, using noise barriers, would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts would occur at the shoreline or further offshore.

QIs of the North-West Irish Sea cSPA recorded at the shoreline of the landfall site included black-headed gull, common gull, herring gull, cormorant, shag and lesser black-backed gull. Of these, cormorant was the only species that was recorded in numbers close to 1% of the national population. Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will be implemented along this coastal stretch which will further minimise the disturbance and displacement effect, however given the volume of works at the landfall QIs occurring along the shoreline are likely to be disturbed and displaced temporarily during onshore works. QIs recorded in the arable fields at the landfall site included black-headed gull, common gull and herring gull, and would be exposed to localised construction noise levels and visual disturbance and displacement from the onshore works. All three species were recorded in numbers significantly lower than 1% of the national population.

It is expected that with mitigation in place, i.e. noise barriers which also act as visual screens, local and temporary disturbance and displacement of QIs utilising the arable fields at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QIs located at the landfall. The coastline stretching south and north from the landfall site is used by QIs and will remain available to displaced QIs within the cSPA boundary.

Additionally, wintering waterbirds and seabirds occurring at the landfall site have potential to interact with near-shore works at the HDD exit pit in the sub-tidal area which would extend to a point at a suitable distance offshore, usually several hundred metres considering geological features, water depths, mechanical properties of cables and ducts. At HDD exit pit, 24-hour working could result in a disturbance and displacement effect as a result of artificial lighting, noise impacts and the presence of construction vessels and machinery. Given the knowledge that it is not expected that disturbance impacts affecting wintering waterbirds will extend beyond a distance of c. 300m (Cutts et al., 2009), and that the HDD exit pit will be located several hundred metres offshore, it is therefore only seabirds occurring offshore that could be impacted by the near-shore works. While birds have been recorded at nationally important numbers in the vicinity of the HDD exit pit, the localised nature of the works and scale of the exit pit footprint relative to the marine environment, in the absence of mitigation, localised disturbance impacts could arise from unmitigated noise impacts, visual disturbance or lighting impacts associated with the near-shore works of the offshore development.

Mitigation
The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

Conclusion of AEoI
It can be concluded that the implementation of mitigation measures including noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore and nearshore elements of the proposed development (alone) will not have AEoI on the North-West Irish Sea cSPA.

5.4.2.19.5 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for great northern diver at North-West Irish Sea SPA is provided in Section 5.4.30.2, concluding no AEoI for this species.

5.4.3 Malahide Estuary SPA

Malahide Estuary SPA lies 0.0005km (0.5m) east of the onshore infrastructure, 16.2km from the offshore ECC and 21.7km from the array area. The SPA encompasses the estuary, saltmarsh habitats and shallow subtidal areas at the mouth of the estuary. A railway viaduct crosses the estuary and has led to the inner estuary becoming lagoonal in character and only partly tidal. Much of the outer part of the estuary is well-sheltered from the sea by a large sand spit and empties almost completely at low tide when there are extensive intertidal flats exposed. Salt marshes, which provide important roosts during high tide, occur in parts of the outer estuary and in the extreme inner part of the inner estuary. A frequently used recreational path, the Broadmeadow Estuary walk, is adjacent to the southern coast of the estuary. The Malahide Estuary SPA CO supporting document highlights the levels of existing pressure from disturbance, mainly from walking, with or without dogs and experienced by QI wintering waterbirds (NPWS, 2013i).

The nearest works of the onshore infrastructure to Malahide Estuary SPA are located along the Estuary Road which is immediately adjacent to the SPA for c. 2.3km. The works at this location will include road breaking out, cable trenching and backfilling, installation of a joint bay, road resurfacing, HDDing, a HDD compound and two watercourse crossings at Seapoint Stream and Greenfields Stream. This section addresses the assessment of effects that arise from construction and decommissioning works associated with the onshore elements of the proposed development for which this site has been screened in. Malahide Estuary SPA was not screened in for potential effects associated with the offshore elements of the proposed development.

All QIs have been screened in for the assessment of Malahide Estuary SPA due to their presence within the ZoI of the onshore elements of the proposed development due to the adjacent nature of the onshore works to the SPA, and the hydrological and hydrogeological connectivity. Malahide Estuary SPA overlaps with the Malahide Estuary SAC designation which is assessed for impacts on QI habitats in Section 5.1.2.

5.4.3.1 Qualifying Interests and Conservation Objectives

The following QIs are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.34:Qualifying Interests and Conservation Objectives of Malahide Estuary SPA

Qualifying Interests Screened In	Conservation Objectives
Great Crested Grebe (Podiceps cristatus) [A005] Light-bellied Brent Goose (Branta bernicla hrota) [A046] Shelduck (Tadorna tadorna) [A048]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets:

Qualifying Interests Screened In	Conservation Objectives
Pintail (Anas acuta) [A054] Goldeneye (Bucephala clangula) [A067] Red-breasted Merganser (Mergus serrator) [A069] Oystercatcher (Haematopus ostralegus) [A130] Golden Plover (Pluvialis apricaria) [A140] Grey Plover (Pluvialis squatarola) [A141] Knot (Calidris canutus) [A143] Dunlin (Calidris alpina) [A149] Black-tailed Godwit (Limosa limosa) [A156] Bar-tailed Godwit (Limosa lapponica) [A157] Redshank (Tringa totanus) [A162]	Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation
Wetland and Waterbirds [A999]	To maintain the favourable conservation condition of the wetland habitat in this SPA as a resource for the regularly-occurring migratory waterbirds that utilize it, which is defined by the following attribute and target: Habitat area (ha):The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 765 hectares, other than that occurring from natural patterns of variation

5.4.3.2 Impacts Arising from the Onshore Elements of the Proposed Development

All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.3.2.1 Dust Deposition (Construction and Decommissioning)

Dust deposition arising during construction of the onshore elements of the proposed development has the potential to cause degradation to wetland habitats utilised by QIs of Malahide Estuary SPA, at adjacent works along the Estuary Road. Typically, dust impacts are localised and dust deposition does not extend further than 100m from the source, however under dry and windy weather conditions dust can travel a significant distance and deposit on habitats a distance greater than 100m from the source. As such, dust can impact habitats for which QIs rely on.

Dust impacts are expected to be minimal and temporary during the nearest construction works, while the magnitude of the impact is not expected to significantly affect the COs of the SPA, mitigation measures have been proposed to reduce any dust impacts on Malahide Estuary SPA. As such, with the implementation of dust control mitigation in the CEMP (Appendix 8) for dust deposition, the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Malahide Estuary SPA in relation to dust deposition arising from the onshore elements of the proposed development.

Mitigation

Standard best practice construction methods will be adopted to minimise dust impacts including preparation and management of site and works areas to minimise soil and dust exposure; maintenance of construction plant and equipment; coverage and revegetation of exposed earthworks.

Conclusion of AEoI

The predicted impacts are expected to be minimal and temporary during the nearest construction works of the onshore infrastructure. Therefore, the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Malahide Estuary SPA in relation to dust deposition arising from the onshore elements of the proposed development.

5.4.3.2.2 Surface Water Run-off of Suspended Sediment/Deposition (Construction and Decommissioning)

Temporary increased suspended sediment arising from onshore elements of the proposed development and reaching Malahide Estuary SPA via surface water will be localised to the immediate downstream area of the works, and at watercourse crossing Seapoint Stream and Greenfields Stream where near stream works adjacent to the SPA will occur. An increase in suspended sediment and deposition has the potential to affect QIs which rely on such intertidal and wetland habitats for feeding and roosting. The four nearest connected watercourse crossings upstream of the site do not involve in-stream works as the cable route will HDD under the watercourse which will reduce the magnitude of any potential effect. With HDD activities at watercourse crossings there is a risk of frac-out in the watercourse bed which results in the return of drilling fluids to the surface during HDD and release of these fluids into the watercourse. An assessment made on intertidal habitats and the associated community types, for which QIs feed on and roost on in Malahide Estuary, was undertaken in Section 5.1.2. The assessment concluded that suspended sediment and deposition arising from the proposed development would not adversely affect the integrity of the QI habitats for which Malahide Estuary SAC is designated. As such, with the implementation of the standard best practice construction methods and additional specific water quality mitigation measures outlined in the CEMP (Appendix 8), the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Malahide Estuary SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

Mitigation

There is potential for material produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills that may reach the downstream environment via surface water run-off.

Conclusion of AEoI

The conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Malahide Estuary SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

5.4.3.2.3 Accidental Pollution (Construction and Decommissioning)

An accidental pollution event of hydrocarbons or other contaminants reaching the hydrologically connected SPA has the potential to impact QI species that roost and feed in the adjacent wetland habitats. Direct contact of QIs with such pollutants, of a sufficient magnitude, can result in mortality of birds. Indirectly an accidental pollution event can impact the habitats and food supply on which these birds rely. Watercourse crossing methods that will be used at Seapoint Stream and Greenfield stream, both which are adjacent to and discharge into Malahide Estuary, will not involve in-stream works. While near-stream works, and near estuary works, remain a risk to an accidental spill reaching Malahide Estuary SPA, removing this direct connection reduces the likelihood of such an event.

An assessment made on intertidal habitats and the associated community types, for which QIs feed and roost within Malahide Estuary, was undertaken in Section 5.1.2. The assessment concluded that an accidental pollution event arising from the proposed development would not adversely affect the integrity of the QI habitats for which Malahide Estuary is designated. With this information, and the implementation of best practice construction methods and pollution control mitigation measures set out in the CEMP (Appendix 8), enables the conclusion that the construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs which utilise Malahide Estuary SPA in relation to accidental pollution during construction and decommissioning.

Mitigation
There is potential for materials arising from an accidental pollution spill produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials and refuelling restrictions. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

Conclusion of AEoI
The assessment concluded that an accidental pollution event arising from the proposed development would not adversely affect the integrity of the QI habitats for which Malahide Estuary is designated. This information, and the implementation of the mitigation measures set out in the CEMP (Appendix 8), enables the conclusion that the construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs which utilise Malahide Estuary SPA in relation to accidental pollution during construction and decommissioning.

5.4.3.2.4 Disturbance and Displacement (Construction and Decommissioning)
Construction and decommissioning works occurring adjacent to the Malahide Estuary SPA have the potential to cause disturbance and displacement to QIs arising from an increased presence of machinery, construction personnel, noise impacts, lighting impacts and the overall construction works. The proposed onshore cable route runs adjacent to the SPA for c. 2.3km. Wintering waterbirds that occurred in numbers of up to national importance at the landfall site and/or Malahide Estuary (i.e. in numbers greater than 1% of the national population) were golden plover, light-bellied brent goose and great crested grebe. While it is not expected that disturbance impacts affecting QIs will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009), QIs occurring within the 300m ZoI would potentially be displaced form this area during works. At a distance of greater than 300m visual disturbance from the works area is not expected to persist.

Noise impacts are expected to be periodic and irregular over the construction period. A study investigating the effects of piling noise on estuary birds found that irregular piling noise (above 70dB) had a high to moderate affect, regular noise (50-70dB) moderate to low affect, and noise below 50dB low affect. The study also suggested that birds were seen to accept a wide range of steady state noise levels from between 55dB(A) to 85dB(A) in some cases (Cutts et al., 2009). The construction activities proposed alongside the Malahide Estuary are those associated with the installation of the onshore cable route under Estuary Road. The cables will be trenched beneath the Estuary Road, with the cable roadworks gradually working their way along the road in a linear fashion, lasting approximately 2 months.

For all construction works along Estuary Road visual and noise impacts associated with the onshore elements of the proposed development will be short-term and temporary during the construction phase. The works along the Estuary Road are proposed to occur at more than one location at a time to minimise the duration of works, in part for traffic management reasons, and to minimise any prolonged duration of disturbance to QIs if these works are to occur during the period September to March.

After mitigation through the implementation of noise barriers, which also act as visual screens, considering the localised extent of the potential effect i.e. within 60 to 100m of the works, and the separation distance of c. 20-50m, in most parts, between the works area in the road corridor to the edge of the estuary, it is apparent that only the estuary fringe adjacent to the works would be subject to construction noise. With the mitigation in place, construction noise levels of above 70dBLAeq, and those associated with potentially moderate to high impacts on birds, are avoided.

Inland feeding sites for light-bellied brent geese associated with County Dublin SPAs, including Malahide Estuary SPA, and occurring away from the SPA boundary, are located c. 160m southwest of the proposed onshore works area at playing pitches in Belcamp Park. At this location light-bellied brent geese are screened from the works within the road corridor by existing mature vegetation.

Light-bellied brent geese are considered sensitive to noise levels of 120-125bB decibels (dB) emanating from a distance of up to 300m (Cutts et al., 2013). No such level of noise will emanate from the works area as demonstrated from the noise levels provided in the above paragraphs.

Mitigation

At the Malahide Estuary, which is separated from the works area by, in most parts, 20-50m, the first measure of avoidance will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not possible, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats. An ECoW will be present for works along the Estuary Road, and toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the Malahide Estuary.

Conclusion of AEoI

The first measure will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, the implementation of the noise barriers along the works area on Estuary Road, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the QIs of Malahide Estuary SPA in relation to disturbance and displacement arising from the onshore elements of the proposed development.

5.4.3.3 Migratory Collision Risk (Operation)

An assessment of the project option with the greatest potential for AEoI (as presented in Table 5.11) for migratory collision risk for QIs screened in for that impact at Malahide Estuary SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

Given the extremely low level of impact predicted from both onshore and offshore activities there is no indication that the combined effects from these impacts will alter the conclusions of the assessment. Therefore, no AEoI can be concluded for all assessed species alone from any combined impacts presented above.

5.4.4 Rockabill SPA

Rockabill SPA is located 0.2km from the array area, 0.1km from the ECC and c.7km off the coast of Co. Dublin. The nearest onshore works at the landfall site are located 8.3km from the SPA. The SPA encompasses two small, low-lying islets known as Lighthouse Island and Bill, in addition to a distance of 3.5km of the marine area surrounding the islands. The SPA is of ornithological importance as the most important roseate tern population in Europe is supported along with nationally important breeding populations of common tern and Arctic tern and a non-breeding population of purple sandpiper. All three tern species and purple sandpiper have been considered within the ornithological assessments presented here.

5.4.4.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Rockabill SPA are considered within this section:

Table 5.35: qualifying interests and Conservation Objectives of Rockabill SPA

Qualifying Interests Screened In	Conservation Objectives
Common tern [A193]; Roseate tern [A192]; and Arctic tern [A194].	To maintain the favourable conservation condition of listed species in Rockabill SPA, which is defined by the following list of attributes and targets: No significant decline; Breeding population abundance: apparently occupied nests (AONs); Productivity rate: fledged young per breeding pair; Distribution: breeding colonies; Prey biomass available; No significant increase;

	Barriers to connectivity; Human activities should occur at levels that do not adversely affect the breeding (species) population; and Disturbance at breeding site.
Purple sandpiper (*Calidris maritima*) [A148]	To maintain the favourable conservation condition of Purple Sandpiper in Rockabill SPA, which is defined by the following list of attributes and targets: Population trend- Long term population trend stable or increasing; and Distribution- No significant decrease in the range, timing or intensity of use of areas by purple sandpiper other than that occurring from natural patterns of variation

5.4.4.2 Common tern

For collision risks, common tern has been screened in for the operational phase, to assess the potential for an AEoI from the proposed development alone. Common tern is also screened in for barrier effects and effects via impacts on prey sources during operation.

In terms of collision risks, the array area is situated 0.2km from Rockabill SPA, which is within the MMF+1SD for common tern (18.0+8.9km) (Woodward et al., 2019) and has therefore been screened in for the breeding season only. While common tern will disperse throughout the bio-geographic region, during the breeding season, during the non-breeding bio-season terns migrate south and therefore birds from this SPA may pass through the array area in very small numbers which will be insufficient to result in LSE. They are therefore screened out I as outlined in the SISAA for collision risks (operation) during the non-breeding season.

5.4.4.2.1 Mitigation

The array area refinement process has increased the distance between the WTG and Rockabill SPA, a key colony for tern species. Although the benefits are not quantified in the assessment this refinement will reduce any potential barrier and displacement effects on terns from this colony.

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.4.2.2 Collision Risk (Operation)

Migration-free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season for common tern and common tern combined is one (1.22) individual (CRM Appendix 18 and 19). Assuming 59% of individuals are breeding adults (Apportioning Appendix 20), the total number of breeding adults in the array impacted by collision is less than one (0.67) per annum during the migration-free breeding bio-season.

Provided 100% of these collisions are breeding birds from Rockabill SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.67) breeding adults (Table 5.36).

The population of common tern at Rockabill has not changed considerably since the citation colony count in 2010, with the latest colony count undertaken in 2016 - 2018 being 198 individuals greater (4,078 birds). The potential impact on the population has been assessed against both the 2010 citation colony count and the latest colony count undertaken in 2016 – 2018.

Based on a citation colony count of 3,880 breeding adults and annual adult background mortality of 454 (454.0) individuals, the addition of less than one breeding adult mortality would represent a 0.147% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 4,078 individuals and an annual background mortality of 477 (477.1) adults, this would represent a 0.140% increase in baseline mortality during the breeding bio-season (Table 5.36)

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common tern QI of Rockabill SPA in relation to collision risk effects during the operational phase from the proposed development alone, during common tern breeding season, and therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 1.

Table 5.36: Seasonal Collision Mortalities During the Operational Phase for Common Tern at Rockabill SPA[14].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Migration- free breeding	0.67	0.04 – 1.78	0.147	0.010 – 0.392	0.140	0.009 – 0.373

Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of terns from Rockabill SPA, increasing energy expenditure by causing them to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, like common tern, the evidence suggests that the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. According to Bradbury et al. (2014) and Dierschke et al. (2016) common tern sensitivity to disturbance and displacement is 'low'.

Indirect Effects via Impacts on Prey (Operation)

The Rockabill SPA is located within the North West Irish Sea cSPA. Therefore prey impacts assessed within the North West Irish Sea cSPA assessment should be seen for impacts on common tern at the Rockabill SPA.

As detailed in the North West Irish Sea cSPA assessment, common tern have a diverse diet, are adaptable to change in prey species abundance and availability, and potential effects on key prey species are all found to be not significant, and therefore there is no potential for AEoI as a result of this impact.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the common tern QI of Rockabill SPA in relation to displacement, barrier effects or indirect effects due to impacts on prey species from the proposed development alone and therefore, subject to natural change, the common tern QI will be maintained in the long term with respect to displacement and barrier effect impacts.

Based on the increased risk of effects of Project Option 2, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.4.3 Roseate tern

Roseate tern has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 0.2km from Rockabill SPA, which is within the MMF+1SD for roseate tern (12.6+10.6km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Roseate tern will disperse throughout the bio-geographic region, during the non-breeding season. However, However, during the non-breeding bio-season terns migrate south and therefore birds from this SPA may pass through the array area in very small numbers which will be insufficient to result in LSE. They are therefore screened out during the non-breeding season.

---

[14] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.4.3.1 Mitigation

The array area refinement process has increased the distance between the WTG and Rockabill SPA, a key colony for tern species, a key colony for tern species. Although the benefits are not quantified in the assessment this refinement will reduce any potential barrier and displacement effects on terns from this colony.

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.4.3.2 Collision Risk (Operation)

Migration-free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is less than one (0.1) individual (CRM Appendix 18 and 19). Assuming 59% of individuals are breeding adults (Apportioning Appendix 20), the total number of breeding adults in the array impacted by collision is less than one (0.07) per annum during the migration-free breeding bio-season.

Provided 100% of these collisions are breeding birds from Rockabill SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.07) breeding adults (Table 5.37).

The population of roseate tern at Rockabill has changed considerably since the citation colony count in 2010, with the latest colony count undertaken in 2021 being 1,222 individuals greater (3,408 birds). The potential impact on the population has been assessed against both the 2010 citation count and the latest colony count undertaken in 2021.

Based on a citation colony count of 2,186 breeding adults and annual adult background mortality of 317 (317.0) individuals, the addition of less than one breeding adult mortality would represent a 0.028% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 3,408 individuals and an annual background mortality of 494 (494.2) adults, this would represent a 0.018% increase in baseline mortality during the breeding bio-season (Table 5.37).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the roseate tern QI of Rockabill SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.37: Seasonal Collision Mortalities During the Operational Phase for Roseate Tern at Rockabill SPA[15].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Migration- free breeding	0.07	0.00 – 0.21	0.028	0.001 – 0.080	0.018	0.001 – 0.054

Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s).

---

[15] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, like roseate tern, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. According to Bradbury et al. (2014) and Dierschke et al. (2016) roseate tern sensitivity to disturbance and displacement is ‘low’. The array area is also located beyond the Rockabill SPA boundary. As such, it can be assumed that displacement and barrier effect impacts will be low for this species.

Indirect Effects via Impacts on Prey (Operation)

The Rockabill SPA is located within the North West Irish Sea cSPA. Therefore prey impacts assessed within the North West Irish Sea cSPA assessment should be seen for impacts on Roseate tern at the Rockabill SPA.

As detailed in the North West Irish Sea cSPA assessment, Roseate tern have a diverse diet, are adaptable to change in prey species abundance and availability, and potential effects on key prey species are all found to be not significant, and therefore there is no potential for AEoI as a result of this impact.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Roseate tern QI of Rockabill SPA in relation to displacement, barrier effects and indirect effects due to impacts on prey species from the proposed development alone and therefore, subject to natural change, the roseate tern QI will be maintained in the long term with respect to displacement and barrier effect impacts.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.4.4 Arctic tern

Arctic tern has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development assessment alone.

The array area is situated 0.2km from Rockabill SPA, which is within the MMF+1SD for Artic tern (25.7+14.8km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Arctic tern will disperse throughout the bio-geographic region, during the non-breeding season. However, during the non-breeding bio-season terns migrate south and therefore birds from this SPA may pass through the array area in very small numbers which will be insufficient to result in LSE. They are therefore screened out during the non-breeding season.

5.4.4.4.1 Mitigation

The array area refinement process has increased the distance between the WTG and Rockabill SPA, a key colony for tern species. a key colony for tern species. Although the benefits are not quantified in the assessment this refinement will reduce any potential barrier and displacement effects on terns from this colony.

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. Due to the low flight height distribution of terns, the increase in the minimum draft height has decreased predicted collisions of this species to zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.4.4.2 Collision Risk (Operation)

Migration-free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is less than one (0.1) individual (CRM Appendix 18 and 16).9Assuming 66% of Arctic tern are breeding adults (Apportioning Appendix 20), the total number of breeding adults in the array impacted by collision is less than one (0.05) per annum during the migration-free breeding bio-season.

Provided 100% of these collisions are breeding birds from Rockabill SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.05) breeding adults (Table 5.38).

The population of Arctic tern at Rockabill has changed considerably since the citation colony count in 2010, with the latest colony count undertaken in 2018 being 382 individuals fewer (118 birds). The potential impact on the population has been assessed against both the 2010 citation colony count and the latest colony count.

Based on a citation colony count of 500 breeding adults and annual adult background mortality of 59 (58.5) individuals, the addition of less than one breeding adult mortality would represent a 0.091% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 118 individuals and an annual background mortality of 14 (13.8) adults, this would represent a 0.384% increase in baseline mortality during the breeding bio-season (Table 5.38).

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Arctic tern QI of Rockabill SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the Arctic tern QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.38: Seasonal collision mortalities during the operational phase for Arctic tern at Rockabill SPA[16].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Migration- free breeding	0.05	-	0.091	-	0.384	-

Barrier Effects (Operation)

The presence of WTGs has the potential to create a barrier to the movement of flying seabirds, increasing energy expenditure by causing some species to detour around the OWF(s). There is potential for barrier effects to impact both migratory and resident birds. For most collision risk species, like common tern, the presence of WTGs does not deter them from entering the array area therefore these birds are unlikely to experience barrier effects. According to Bradbury et al. (2014) and Dierschke et al. (2016) common tern sensitivity to disturbance and displacement is ‘low’. The array area is also located beyond the Rockabill SPA boundary. As such, it can be assumed that displacement and barrier effect impacts will be low for this species.

Importantly, Arctic tern was recorded in low numbers, with only 2 birds recorded with the array area (15 within the array plus the 2km buffer) during 29 months of DAS.

Indirect Effects via Impacts on Prey (Operation)

The Rockabill SPA is located within the North West Irish Sea cSPA. Therefore prey impacts assessed within the North West Irish Sea cSPA assessment should be seen for impacts on Arctic tern at the Rockabill SPA.

As detailed in the North West Irish Sea cSPA assessment, Arctic tern have a diverse diet, are adaptable to change in prey species abundance and availability, and potential effects on key prey species are all found to be not significant, and therefore there is no potential for AEoI as a result of this impact.

---

[16] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the Arctic tern QI of Rockabill SPA in relation to displacement, barrier effects and indirect effects due to impacts on prey species from the proposed development alone and therefore, subject to natural change, the Arctic tern QI will be maintained in the long term with respect to displacement and barrier effect impacts.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.4.5 Purple sandpiper

Purple sandpiper has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from the proposed development.

5.4.4.5.1 Mitigation

The array area refinement process has increased the distance between the WTG and Rockabill SPAwhich will reduce any potential displacement effects on the purple sandpiper.

The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

5.4.4.5.2 Impacts Arising from the Offshore Elements of the Proposed Development

During the offshore construction and decommissioning phases, there is potential for disturbance and displacement impacts due to vessel activity, and construction work in the intertidal area. Rockabill SPA is 0.2km from the array area and 0.1km from the ECC and therefore potentially within the disturbance ranges for intertidal birds of 0.5km. However, the SPA boundary, from which these distances are measured, includes the surrounding seas out to a distance of 3.5km from the islands. Therefore, as tidal zone feeders rather than seabirds, purple sandpiper on the islands will be far beyond the disturbance ranges for intertidal birds and unaffected from displacement and disturbance impacts during offshore construction and decommissioning (Goodship and Furness, 2022). Consequently, there is no pathway for disturbance of purple sandpiper from Rockabill SPA from the offshore construction activities.

5.4.4.5.3 Impacts Arising from the Onshore Elements of the Proposed Development

While these impacts will not occur above the HWM, as the effect arises from works occurring above the HWM, they have been considered in this section. The onshore elements of the proposed development are not hydrologically connected to Rockabill SPA, however considering their proximity there is potential for mobile QIs to occur outside of the SPA boundary and within the disturbance and displacement ZoI of the proposed onshore works.

Wintering purple sandpiper has been screened in for the assessment of Rockabill SPA due to their presence within the ZoI during baseline surveys at the landfall site.

Disturbance and Displacement (Construction and Decommissioning)

It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m to the SPA boundary as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). However, it is possible that QIs associated with the Rockabill SPA utilise coastline habitats at the landfall site and are exposed to disturbance and displacement effects at this location outside of the SPA boundary.

Purple sandpiper occurring at the landfall site were located on the shoreline, that is, at a location where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts, as per Cutts et al. (2009), would occur at the shoreline. In this case, purple sandpiper utilise coastal habitats at the landfall site and would not be exposed to construction noise levels.

Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will implemented along this coastal stretch which will further minimise the disturbance and displacement effect, however given the volume of works at the landfall purple sandpiper occurring in this area are likely to be disturbed and displaced temporarily during onshore works. Numbers of purple sandpiper recorded at the coastline were significantly lower than 1% of the national population.

It is expected that with mitigation in place, local and temporary disturbance and displacement of purple sandpiper utilising the coastline at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QI located at the landfall c. 8.3km from the Rockabill SPA. The coastline stretching south and north from the landfall site will remain available to displaced QIs that occur outside the SPA boundary. It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the Rockabill SPA.

Mitigation

At the landfall site, the HDD compounds near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels at the shoreline and minimise disturbance and displacement. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the purple sandpiper QI of Rockabill SPA in relation to disturbance and displacement effects as a result of both onshore and offshore elements of the proposed development during construction and decommissioning. Therefore, subject to natural change, the purple sandpiper QI will be maintained in the long term with respect to potential for disturbance and displacement arising from offshore activities.

5.4.4.6 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Rockabill SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.5 Rogerstown Estuary SPA

Rogerstown Estuary SPA lies 0.8km east of the onshore infrastructure, 15.6km inshore of the array area and 12.5km from the ECC. The nearest works of the onshore infrastructure of the proposed development to Rogerstown Estuary SPA are located along the R132 at Blakes Cross South. Rogerstown Estuary is a relatively small, funnel shaped estuary separated from the sea by a sand and shingle peninsula; the SPA extends eastwards to include an area of shallow marine water. The estuary is divided by a causeway, railway line, and narrow bridge. At low tide extensive intertidal sand and mud flats are exposed and these provide the main food resource for the wintering waterbirds that use the site.

The nearest onshore works at this location will include road breaking out, cable trenching and backfilling, road resurfacing, and two watercourse crossings at Deanestown Stream and Ballyboghil Stream. An additional four watercourse crossings discharge to Rogerstown Estuary SPA.

All QIs have been screened in for the assessment of Rogerstown Estuary SPA due to their presence within the ZoI of the onshore development area, and the sites proximity and connectivity to the onshore development area. Rogerstown Estuary SPA overlaps with the Rogerstown Estuary SAC designation which is assessed for impacts on habitats in Section 5.1.3.

5.4.5.1 Qualifying Interests and Conservation Objectives

All of the following QIs have been screened in and are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.39: qualifying interests and Conservation Objectives of Rogerstown Estuary SPA

Qualifying Interests Screened In	Conservation Objectives
Light-bellied Brent Goose [A046] Shelduck [A048] Greylag Goose [A053] Shoveler [A056] Oystercatcher [A130] Ringed Plover (*Charadrius hiaticula*) [A137] Grey Plover [A141] Knot [A143] Dunlin [A149] Black-tailed Godwit [A156] Redshank [A162]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation
Wetland and Waterbirds [A999]	To maintain the favourable conservation condition of the wetland habitat in this SPA as a resource for the regularly-occurring migratory waterbirds that utilize it, which is defined by the following attribute and target: Habitat area (ha): The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 646ha, other than that occurring from natural patterns of variation

5.4.5.2 Impacts Arising from the Onshore Elements of the Proposed Development

All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.5.2.1 Dust Deposition (Construction and Decommissioning)

Rogerstown Estuary SPA is located c. 0.8km east of the nearest point of the proposed development. At this distance dust impacts are expected to be imperceptible. As such, the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Rogerstown Estuary SPA in relation to dust deposition arising from the onshore elements of the proposed development. Rogerstown Estuary SPA also overlaps with the Rogerstown Estuary SAC designation which is assessed for dust in Section 5.1.3.

Mitigation

No specific mitigation measures are required at this location for dust deposition, however standard best practice construction methods will minimise any dust impacts regardless.

Conclusion of AEoI

The direct dust impacts are expected to be imperceptible at this site. As such, the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Rogerstown Estuary SPA in relation to dust deposition arising from the onshore elements of the proposed development.

5.4.5.2.2 Surface Water Run-off of Suspended Sediment/Deposition (Construction and Decommissioning)

Temporary increased suspended sediment arising from onshore elements of the proposed development and reaching Rogerstown Estuary SPA via surface water will be localised to the immediate downstream area of the works. An increase in suspended sediment and deposition has the potential to affect QIs which rely on intertidal and wetland habitats within the SPA for feeding and roosting. Nearest watercourse crossings are at Deanestown Stream and Ballyboghil Stream. Where these are proposed to be crossed via HDD there is a risk of frac-out in the watercourse bed which results in the return of drilling fluids to the surface during HDD and release of these fluids into the watercourse.

An assessment made on intertidal habitats and the associated community types, for which QIs feed on and roost on in Rogerstown Estuary, was undertaken in under Section 5.1.3.

The assessment concluded that suspended sediment and deposition arising from the proposed development would not adversely affect the integrity of the QI habitats for which Rogerstown Estuary SAC is designated. As such, with the implementation of standard best practice construction methods and additional specific water quality mitigation measures outlined in the CEMP (Appendix 8), the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Rogerstown Estuary SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

Mitigation

There is potential for material produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills that may reach the downstream environment via surface water run-off.

Conclusion of AEoI

Considering mitigation measures, the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Rogerstown Estuary SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

5.4.5.2.3 Accidental Pollution (Construction and Decommissioning)

An accidental pollution event of hydrocarbons or other contaminants reaching the hydrologically connected SPA has the potential to impact QI species that roost and feed in the downstream wetland habitats. Direct contact of QIs with such pollutants, of a sufficient magnitude, can result in mortality of birds. Indirectly an accidental pollution event can impact the habitats and food supply on which these birds rely. Watercourse crossings at Deanestown Stream and Ballyboghil Stream are directly hydrologically connected to the downstream SPA.

An assessment made on intertidal habitats and the associated community types, for which QIs feed on within Rogerstown Estuary, was undertaken in Section 5.1.3 and 6.4. The assessment concluded that an accidental pollution event arising from the proposed development would not adversely affect the integrity of the QI habitats for which Rogerstown Estuary is designated. With this information, and the implementation of best practice construction methods and pollution control mitigation measures set out in the CEMP (Appendix 8), it enables the conclusion that the construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs which utilise Rogerstown Estuary SPA in relation to accidental pollution during construction and decommissioning.

Mitigation

There is potential for materials arising from an accidental pollution spill produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials and refuelling restrictions. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

Conclusion of AEoI

Accidental pollution event arising from the proposed development would not adversely affect the integrity of the QI habitats at Rogerstown Estuary SPA.

The construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs of the Rogerstown Estuary SPA in relation to accidental pollution during construction and decommissioning.

5.4.5.2.4 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the Rogerstown Estuary SPA to the proposed development is 0.8km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). Given the distance between the works area and site, and existing vegetation between the two, visual disturbance is not expected at this location. With the exception of agricultural fields at the landfall site, no QIs were recorded at inland works areas, with notable absence at Blakes Cross North and Blakes Cross South which are c. 0.9km and 1.2km inland from the SPA. It is possible, however, that QIs associated with the Rogerstown Estuary SPA utilise intertidal and estuarine habitat at Malahide Estuary, or coastal habitats at the landfall site, and are exposed to disturbance and displacement effects at these locations outside of the Rogerstown Estuary SPA.

Considering the disturbance and displacement assessment undertaken for Malahide Estuary SPA and for North-west Irish Sea cSPA, which concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of Rogerstown Estuary SPA occurring outside of the SPA and utilising Malahide Estuary or the landfall site, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the Rogerstown Estuary SPA.

Mitigation

For QIs occurring outside the SPA boundary at the landfall site or Malahide Estuary, the HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. At Malahide Estuary, the first measure will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, for works at Malahide Estuary during the period September to March, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats. An ECoW will be present for works along the Estuary Road, and toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

Conclusion of AEoI

Visual disturbance and noise level from construction activity in relation to the distance between the works and site is not to be expected at this site. For QIs of Rogerstown Estuary SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the Rogerstown Estuary SPA.

5.4.5.3 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Rogerstown Estuary SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.6 Baldoyle Bay SPA

Baldoyle Bay SPA lies 0.9km east of the onshore infrastructure, 26.4km inshore of the array area and 22.6km from the ECC. Baldoyle Bay is a relatively small, narrow estuary separated from the open sea by a large sand dune system. Large areas of intertidal flats are exposed at low tide.

The nearest works of the onshore infrastructure of the proposed development to Baldoyle Bay SAC are located along the R124 east of Kinsealy.

The works at this location will include road breaking out, cable trenching and backfilling, road resurfacing, and further south of the nearest location, two watercourse crossings at Cuckoo Stream and Mayne Stream.

All QIs have been screened in for the assessment of Baldoyle Bay SPA due to their presence within the ZoI of the onshore elements of the proposed development. All QIs of this SPA were recorded during baseline surveys at Malahide Estuary and/or the landfall site. Inland feeding sites for light-bellied brent geese associated with Baldoyle Bay SPA include playing pitches at Red Arches, Seagrange Park and Donaghmeade Park, which is c. 400m east of the nearest proposed onshore works. Baldoyle Bay SPA overlaps with the Baldoyle Bay SAC designation which is assessed for impacts on QI habitats in Section 5.1.4.

5.4.6.1 Qualifying Interests and Conservation Objectives

The following QIs are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.40: qualifying interests and Conservation Objectives of Baldoyle Bay SPA

Qualifying Interests Screened In	Conservation Objectives
Light-bellied Brent Goose [A046] Shelduck [A048] Ringed Plover [A137] Golden Plover [A140] Grey Plover [A141] Bar-tailed Godwit [A157]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation
Wetland and Waterbirds [A999]	To maintain the favourable conservation condition of the wetland habitat in this SPA as a resource for the regularly-occurring migratory waterbirds that utilize it, which is defined by the following attribute and target: Habitat area (ha):The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 263ha, other than that occurring from natural patterns of variation

5.4.6.2 Impacts Arising from the Onshore Elements of the Proposed Development

All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.6.2.1 Surface Water Run-off of Suspended Sediment/Deposition (Construction and Decommissioning)

Temporary increased suspended sediment arising from onshore elements of the proposed development and reaching Baldoyle Bay SPA via surface water will be localised to the immediate downstream area of the works. An increase in suspended sediment and deposition has the potential to affect QIs which rely on intertidal and wetland habitats within the SPA for feeding and roosting. The two nearest connected watercourse crossings at the Cuckoo Stream and Mayne River upstream of the site do not involve in-stream works, and will be crossed via HDD, which will reduce the magnitude of any potential effect. With HDD activities at watercourse crossings there is a risk of frac-out in the watercourse bed which results in the return of drilling fluids to the surface during HDD and release of these fluids into the watercourse.

An assessment made on intertidal habitats and the associated community types, for which QIs feed on and roost on in Rogerstown Estuary, was undertaken in Section 5.1.4. The assessment concluded that suspended sediment and deposition arising from the proposed development would not adversely affect the integrity of the QI habitats for which Baldoyle Bay SAC is designated.

As such, with the implementation standard best practice construction methods and additional specific water quality mitigation measures outlined in the CEMP (Appendix 8), the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Baldoyle Bay SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

Mitigation

There is potential for material produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials, refuelling restrictions and protocols for HDD operations and frac-out. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills that may reach the downstream environment via surface water run-off.

Conclusion of AEoI

The two nearest connected watercourse crossings upstream of the site do not involve in-stream works which will reduce the magnitude of any potential effect. With the implementation of the mitigation in the CEMP (Appendix 8) for suspended sediment, the conclusion can be reached that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the wetland habitats utilised by designated QIs of the Baldoyle Bay SPA in relation to surface water run-off of suspended sediment/deposition arising from the onshore elements of the proposed development.

5.4.6.2.2 Accidental Pollution (Construction and Decommissioning)

An accidental pollution event of hydrocarbons or other contaminants reaching the hydrologically connected SPA has the potential to impact QI species that roost and feed in the downstream intertidal and wetland habitats. Direct contact of QIs with such pollutants, of a sufficient magnitude, can result in mortality of birds. Indirectly an accidental pollution event can impact the habitats and food supply on which these birds rely. Watercourse crossing methods at the Cuckoo Stream and Mayne River will not involve in-stream works. While near-stream works, and near estuary works c. 0.9km, remain a risk to an accidental spill reaching Baldoyle Bay SPA, removing this direct connection reduces the likelihood of such an event.

An assessment made on intertidal habitats and the associated community types, for which QIs feed on and roost on within Baldoyle Bay, was undertaken in Section 5.1.4. The assessment concluded that an accidental pollution event arising from the proposed development would not adversely affect the integrity of the QI habitats for which Baldoyle Bay is designated. With this information, and the implementation of best practice construction methods and pollution control mitigation measures set out in the CEMP (Appendix 8), it enables the conclusion that the construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs which utilise Baldoyle Bay SPA in relation to accidental pollution during construction and decommissioning.

Mitigation

There is potential for materials arising from an accidental pollution spill produced by onshore construction activities to enter the estuary and marine environment within surface run-off. However, as outlined in the CEMP (Appendix 8) standard best practice methods will be adopted to protect downstream water quality, these include control of surface water run-off, control of release of hydrocarbons and contaminates, protocols for storage of materials and refuelling restrictions. The adoption of pollution management controls as outlined in the CEMP (Appendix 8) will minimise and manage accidental spills. For works in high risk areas such as refuelling or the use of chemicals restrictions will be in place and a Risk Assessment and Method Statement (RAMS) will be carried out detailing specific methods to reduce any pollution incidents and protocols to deal with accidental spills.

Conclusion of AEoI

Watercourse crossing methods at the Cuckoo Stream and Mayne River will not involve in-stream works. Furthermore, removing the direct connection between stream works and the estuary works reduces the likelihood of such an event. With this information, and the implementation of the mitigation measures set out in the CEMP (Appendix 8), it enables the conclusion that the construction of onshore elements of the proposed development will not adversely affect the integrity of the QIs which utilise Baldoyle Bay SPA in relation to accidental pollution during construction and decommissioning.

5.4.6.2.3 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the Baldoyle Bay SPA to the onshore elements of the proposed development is 0.8km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). Given the distance and landscape between the works area and SPA site, including inland feeding site at Donaghmeade Park, visual disturbance is not expected at this location. With the exception of agricultural fields at the landfall site, no QIs were recorded at inland works areas, with notable absence at Sluice Stream which is c. 2.5km inland from the SPA. It is possible, however, that QIs associated with the Baldoyle Bay SPA utilise intertidal and estuarine habitat at Malahide Estuary and are exposed to disturbance and displacement effects at this location outside of the Baldoyle Bay SPA.

Considering the disturbance and displacement assessment, and including assessment of the inland feeding site at Belcamp Park, undertaken in in the assessment for Malahide Estuary SPA, which concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of Baldoyle Bay SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the Baldoyle Bay SPA.

Mitigation

For QIs occurring outside the SPA boundary at Malahide Estuary, the first measure to avoid disturbance and displacement to QIs at this location will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, for works at Malahide Estuary during the period September to March, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats. An ECoW will be present for works along the Estuary Road, and toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at Malahide Estuary.

Conclusion of AEoI

Visual disturbance and noise level from construction activity in relation to the distance between the works and site is not to be expected at this site. For QIs of Baldoyle Bay SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the Baldoyle Bay SPA.

5.4.6.3 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Baldoyle Bay SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.7 North Bull Island SPA

North Bull Island SPA lies 2.0km south of the onshore infrastructure, 29.0km inshore of the array area and 26.2km from the ECC. The SPA covers all of the inner part of north Dublin Bay. The North Bull Island sand spit is a depositional feature and is almost 5 km long and 1 km wide and runs parallel to the coast between Clontarf and Sutton.

Saltmarsh extends along the length of the landward side of the island and provides the main roost site for wintering waterbirds. The island shelters two intertidal lagoons which are divided by a solid causeway. These lagoons provide the main feeding grounds for the wintering waterbirds.

The onshore development area of the proposed development are not hydrologically connected to North Bull Island SPA, however considering the proximity of the SPA to the onshore development area there is potential for mobile QIs to occur outside the SPA boundary and within the disturbance and displacement ZoI of the proposed onshore works at Malahide Estuary. For this reason, all QIs have been screened in for the assessment of North Bull Island SPA.

North Bull Island SPA was screened out for likely significant effect arising from the offshore elements of the proposed development.

5.4.7.1 Qualifying Interests and Conservation Objectives

The following QIs are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.41: qualifying interests and Conservation Objectives of North Bull Island SPA

Qualifying Interests Screened In	Conservation Objectives
Light-bellied Brent Goose [A046] Shelduck [A048] Teal [A052] Pintail [A054] Shoveler [A056] Oystercatcher [A130] Golden Plover [A140] Grey Plover [A141] Knot [A143] Sanderling [A144] Dunlin [A149] Black-tailed Godwit [A156] Bar-tailed Godwit [A157] Curlew [A156] Redshank [A162] Turnstone [A169] Black-headed Gull [A179]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation

5.4.7.2 Impacts Arising from the Onshore Elements of the Proposed Development

All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.7.2.1 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the North Bull Island SPA to the onshore elements of the proposed development is 2.0km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). It is possible, however, that QIs associated with the North Bull Island SPA utilise intertidal and estuarine habitat at Malahide Estuary and are exposed to disturbance and displacement effects at this location outside of the North Bull Island SPA.

Considering the disturbance and displacement assessment, undertaken in the assessment for Malahide Estuary SPA, assessed that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of North Bull Island SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the North Bull Island SPA.

Mitigation
For QIs occurring outside the SPA boundary at Malahide Estuary, the first measure to avoid disturbance and displacement to QIs at this location will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, for works at Malahide Estuary during the period September to March, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats. An ECoW will be present for works along the Estuary Road, and toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at Malahide Estuary.

Conclusion of AEoI
The implementation of the noise barriers, which also act as visual mitigation, in the CEMP for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of North Bull Island SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the North Bull Island SPA.

5.4.8 River Nanny Estuary and Shore SPA
River Nanny Estuary and Shore SPA lies 3.0km north of the onshore infrastructure with nearest onshore works occurring at the landfall site, 16.9km inshore of the array area and 3.1km from the ECC. The SPA comprises the estuary of the River Nanny and sections of the shoreline to the north and south of the estuary (c. 3 km in length), in Co. Meath. The estuarine channel, which extends inland for almost 2 km, is narrow and well sheltered. Sediments are muddy in character and edged by saltmarsh and freshwater marsh/wet grassland. The shoreline comprises beach and intertidal habitats which provide high tide roosts for birds, and are backed in places by clay cliffs.

The onshore infrastructure of the proposed development are not hydrologically connected to River Nanny Estuary and Shore SPA, however considering their proximity there is potential for mobile QIs to occur outside of the SPA boundary and within the disturbance and displacement ZoI of the proposed onshore works at the landfall site.

All QIs have been screened in for the assessment for River Nanny Estuary and Shore SPA due to their presence within the ZoI during baseline surveys at the landfall site.

5.4.8.1 Qualifying Interests and Conservation Objectives
All of the following QIs have been screened in and are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.42: qualifying interests and Conservation Objectives of River Nanny Estuary and Shore SPA

Qualifying Interests Screened In	Conservation Objectives
Oystercatcher [A130] Ringed Plover [A137] Golden Plover [A140] Knot [A143] Sanderling [A144] Herring Gull [A184]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation

5.4.8.2 Impacts Arising from the Onshore Elements of the Proposed Development
All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.8.2.1 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the River Nanny Estuary and Shore SPA to the onshore elements of the proposed development is 3.0km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). It is possible, however, that QIs associated with the River Nanny Estuary and Shore SPA utilise inland and intertidal habitats at the landfall site and are exposed to disturbance and displacement effects at this location outside of the River Nanny Estuary and Shore SPA. There is no risk of QIs associated with this SPA occurring at Malahide Estuary and being exposed to disturbance and displacement effects at that location due to the distance between them, i.e. c. 19.9km.

Construction works at the landfall site will take approximately 13-14 months to complete. Once commenced, the HDD drilling activities are expected to operate continuously over a 24 hour period. The construction activities proposed near the shoreline at the landfall site are those associated with the HDD compounds. Construction noise levels potentially producing a moderate effect (that is, above 50dBLAeq) could occur within a distance of c. 100m of the works at ground level surrounding the compounds. Birds within this distance may be disturbed and be displaced to a location further from the works. For birds located on the shoreline, that is, locations where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels, using noise barriers, would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts would occur at the shoreline or further offshore.

QIs of the River Nanny Estuary and Shore SPA recorded at the shoreline of the landfall site included golden plover, herring gull, knot, oystercatcher and ringed plover, and were all recorded in numbers significantly less than 1% of the national population. Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will be implemented along this coastal stretch which will further minimise the disturbance and displacement effect, however given the volume of works at the landfall QIs occurring along the shoreline are likely to be locally disturbed and displaced temporarily during onshore works. QIs recorded in the arable fields at the landfall site including golden plover, herring gull and oystercatcher would be exposed to localised construction noise levels and visual disturbance and displacement from the onshore works. Numbers of QI birds recorded in agricultural fields at the landfall site for these QIs did not reach 1% of the national population.

It is expected that with mitigation in place, i.e. noise barriers which also act as visual screens, local and temporary disturbance and displacement of QIs utilising the arable fields at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QIs located at the landfall c. 3km from the south of the River Nanny Estuary and Shore SPA. The coastline stretching south from the SPA to the landfall site is used by QIs and will remain available to displaced QIs that occur outside the SPA boundary. It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the River Nanny Estuary and Shore SPA.

Mitigation

The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

Conclusion of AEoI

It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the River Nanny Estuary and Shore SPA.

5.4.8.3 *Migratory Collision Risk (Operation)*

An assessment of migratory collision risk for QIs screened in for that impact at River Nanny Estuary and Shore SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.9 South Dublin and River Tolka Estuary SPA

South Dublin and River Tolka Estuary SPA lies 4.4km south of the onshore infrastructure, 33.8km to the array and 28.8km to the ECC. The SPA comprises a substantial part of Dublin Bay. It includes the intertidal area between the River Liffey and Dun Laoghaire, and the estuary of the River Tolka to the north of the River Liffey, as well as Booterstown Marsh. A portion of the shallow marine waters of the bay is also included.

The onshore elements of the proposed development are not hydrologically connected to South Dublin and River Tolka Estuary SPA, however considering their proximity there is potential for mobile QIs to occur outside of the SPA boundary and within the disturbance and displacement ZoI of the proposed onshore works.

All QIs, with the exception of roseate tern, common tern and Arctic tern, have been screened in for the assessment of South Dublin and River Tolka Estuary SPA due to their presence within the ZoI of the onshore development area during baseline surveys at Malahide Estuary.

South Dublin and River Tolka Estuary SPA was screened out for likely significant effect arising from the offshore elements of the proposed development due to their presence out with the ZoI of the offshore development area.

5.4.9.1 *Qualifying Interests and Conservation Objectives*

The following QIs are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.43: qualifying interests and Conservation Objectives of South Dublin and River Tolka Estuary

Qualifying Interests Screened In	Conservation Objectives
Light-bellied Brent Goose [A046] Oystercatcher [A130] Ringed Plover [A137] Knot [A143] Sanderling [A144] Dunlin [A149] Bar-tailed Godwit [A157] Redshank [A162] Black-headed Gull [A179]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation
Grey Plover [A141]	Grey plover is proposed for removal from the list of QIs for South Dublin Bay and River Tolka Estuary SPA. As a result, a site-specific conservation objective has not been set for this species. However, until it is removed the conservation objective set out above for other wintering QIs is assumed.

5.4.9.2 *Impacts Arising from the Onshore Elements of the Proposed Development*

All potential impacts arising through operation of the proposed development were screened out in the SISAA, therefore only potential construction and decommissioning impacts are assessed here.

5.4.9.2.1 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the South Dublin and River Tolka Estuary SPA to the onshore elements of the proposed development is 4.4km south. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). It is possible, however, that QIs associated with the South Dublin and River Tolka Estuary SPA utilise intertidal and estuarine habitat at Malahide Estuary and are exposed to disturbance and displacement effects at this location outside of the South Dublin and River Tolka Estuary SPA. In additional QIs associated with the South Dublin and River Tolka Estuary SPA may occur at Belcamp Park, a known inland feeding site of light-bellied brent geese.

Considering the disturbance and displacement assessment, and including assessment of the inland feeding site at Belcamp Park, undertaken in the assessment for Malahide Estuary SPA, which concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of South Dublin and River Tolka Estuary SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the South Dublin and River Tolka Estuary SPA.

Mitigation

For QIs occurring outside the SPA boundary at Malahide Estuary, the first measure to avoid disturbance and displacement to QIs at this location will be to avoid works along the Estuary Road during the period September to March when wintering birds are present. Where this is not practicable, for works at Malahide Estuary during the period September to March, noise barriers will line the works area within the Estuary Road on the estuary side to protect wintering waterbirds utilising the nearest estuarine habitats. An ECoW will be present for works along the Estuary Road, and toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at Malahide Estuary.

Conclusion of AEoI

The implementation of the noise barriers, which also act as visual mitigation, in the CEMP for disturbance and displacement at the site during construction and decommissioning, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the site. It can similarly be concluded for QIs of South Dublin and River Tolka Estuary SPA occurring outside of the SPA and utilising Malahide Estuary, that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI of the South Dublin and River Tolka Estuary SPA.

5.4.10 Skerries Islands SPA

The Skerries Islands SPA is comprised of Shenick's Island; St. Patrick's Island, Colt Island and an additional 200m seaward marine area surrounding the islands. The SPA is situated 9.3km from the array area and between 0.5km to 1.5km off the north coast of Co. Dublin. The SPA is located 6km from the nearest onshore development area at the landfall site. This SPA is of high ornithological importance for both breeding seabirds and wintering waterfowl. This site supports an internationally important population of breeding cormorant and nationally important populations of shag and herring gull, in addition to an internationally important wintering population of Light- bellied Brent goose and four other nationally important wintering species (cormorant, herring gull, turnstone and purple sandpiper). Herring gull is the only species to have been considered within the offshore ornithological assessment presented here, as cormorant and shag are not considered to be vulnerable to OWF impacts. Light-bellied brent goose, purple sandpiper and turnstone have been assessed for migratory collision risk (See Section 5.4.26). This section also addresses the assessment of effects that arise from works associated with the onshore elements of the proposed development on all QIs.

5.4.10.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Skerries Islands SPA are considered within this section:

Table 5.44:Qualifying Interests and Conservation Objectives of Skerries Islands SPA

Qualifying Interests Screened In	Conservation Objectives
Herring gull [A184]; Light-bellied brent goose [A046]; Purple sandpiper [A148]; Turnstone [A169]; Cormorant [A017]; and Shag [A018].	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.10.2 Herring gull

When considering impacts from the offshore elements of the proposed development, Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 9.3km from Skerries Islands SPA, which is within the MMF+1SD for herring gull (58.8+26.8km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Herring gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of herring gull from Skerries Islands SPA has been assessed for the full breeding bio-season (March – August) and the non-breeding bio-season (September – February), as defined by Furness (2015).

5.4.10.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions for gulls by up to 65% for some species from the proposed development, compared to a 22m air draft, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.10.2.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 17 (17.45) individuals (CRM Appendix 18 and 19). Assuming 48% of these 17 individuals, are breeding adults and adult herring gull exhibit a sabbatical rate of 35% (Apportioning Appendix 20), the total number of breeding adults in the array impacted by collision is 7 (6.98) per annum during the breeding bio-season.

Provided 0.3% of these collisions are breeding birds from Skerries Islands SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.02) breeding adult per annum (Table 5.45).

The population of herring gull at the Skerries Islands has not changed considerably since the citation colony count in 1999 with the latest colony count undertaken in 2010 being 20 individuals. The potential impact on the population has been assessed against both the 1999 citation colony count and the latest colony count undertaken in 2010.

Based on a citation population of 600 breeding adults and annual adult background mortality of 91 (90.6) individuals, the addition of less than one (0.02) breeding adult mortality would represent a 0.022% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest count of 20 individuals and an annual background mortality of three (3.3) adults, this would represent a 0.655% increase in baseline mortality during the breeding bio-season (Table 5.45).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 39 (39.71) individuals. Provided 0.0% of the herring gulls within the array area are deemed to be breeding adults from the Skerries Islands SPA during non-breeding bio-season (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.00) during the non-breeding bio- season (Table 5.45).

Based on the 1999 citation colony count the addition of less than one (0.00) predicted breeding adult mortality would indicate an increase in baseline mortality of 0.002% during the non-breeding season. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.052% increase in baseline mortality in the non-breeding bio-season (Table 5.45).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Skerries Islands SPA is less than one (0.03) breeding adult per annum.

The annual predicted mortality of less than one breeding adult from the Skerries Island SPA across all bio-seasons indicates an increase in baseline mortality of 0.024% and 0.707% when considering the 1999 citation colony count and the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.45).

An annual predicted impact of less than one (0.03) breeding adult per annum can be considered a non-material contribution to the baseline mortality of this qualifying interest QI of Skerries Island SPA.

There is considerable uncertainty around the status of herring gulls at Skerries Island SPA and latest count of 20 breeding adults. An updated count for Herring Gull will be collected during the 2024 breeding season, which will provide further insight into the predicted impact on this qualifying interest.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Skerries Islands SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.45: Seasonal Collision Mortalities During the Operational Phase for Herring Gull at Skerries Islands SPA[17].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.02	0.00 – 0.06	0.022	0.001 – 0.060	0.655	0.037 – 1.796
Non-breeding	0.00	0.00 – 0.01	0.002	0.000 – 0.004	0.052	0.011 – 0.120
Annual Total	0.03	0.00 – 0.07	0.024	0.002 – 0.064	0.707	0.049 – 1.916

5.4.10.3 Impacts Arising from the Onshore Elements of the Proposed Development

The SPA is located 6km from the nearest onshore development area at the landfall site. All QIs have been screened in for the assessment of impacts arising from the onshore elements of the proposed development.

5.4.10.3.1 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the Skerries Islands SPA to the onshore elements of the proposed development is 6.0km.

[17] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). It is possible, however, that QIs associated with the Skerries Islands SPA utilise inland and intertidal habitats at the landfall site and are exposed to disturbance and displacement effects at this location outside of the SPA boundary.

Of the wintering QIs occurring at the landfall site, as set out in of the assessment of North-west Irish Sea cSPA, for birds located on the shoreline, that is, locations where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts would occur at the shoreline. Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will be implemented along this coastal stretch which will further minimise the disturbance and displacement effect, however given the volume of works at the landfall QIs occurring along the shoreline are likely to be disturbed and displaced temporarily during onshore works. QIs recorded in the arable fields at the landfall site include light-bellied brent goose and herring gull and would be exposed to localised construction noise levels and visual disturbance and displacement from the onshore works. Numbers of light-bellied brent goose and herring gull recorded in agricultural fields at the landfall site did not reach 1% of the national population.

It is expected that with mitigation in place, local and temporary disturbance and displacement of QIs utilising the arable fields at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QIs located at the landfall c. 6km from the Skerries Islands SPA. The coastline stretching south and north from the landfall site is used by QIs and will remain available to displaced QIs that occur outside the SPA boundary.

Mitigation

The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

Conclusion of AEoI

It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the Skerries Islands SPA.

5.4.10.4 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Skerries Islands SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.11 Ireland’s Eye SPA

Ireland’s Eye is a relatively small (c. 24ha) uninhabited island, located 25.1km from the array area and 1.5km north of Howth in Co. Dublin. The SPA boundary encompasses near vertical cliffs along the northern and eastern sides of the Island, stacks, a grassy islet (Thulla) to the south and a sandy beach on the western shore. The SPA boundary extends seaward by 200m to the west of the island and by 500m in the north and east. Ireland’s Eye is of high ornithological importance with five designated (nationally important) populations, namely herring gull, kittiwake, guillemot, razorbill, and cormorant, which has been screened out. All of these designated species (except for cormorant) have been considered in the ornithology assessments for offshore elements of the proposed development presented here.

5.4.11.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Ireland's Eye SPA are considered within this section:

Table 5.46: qualifying interests and Conservation Objectives of the Ireland's Eye SPA

Qualifying Interests Screened In	Conservation Objectives
• Guillemot [A199]; • Razorbill [A200]; • Kittiwake [A188]; and • Herring gull [A184].	"To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.11.2 Guillemot

Guillemot has been screened in for the construction, operational and decommissioning phases to assess the potential for an AEoI from disturbance and displacement from the proposed development alone.

The array area is located 25.1km from the Ireland's Eye SPA which is within Mean Max Foraging range (MMF) plus one standard deviation (+1SD) for guillemot (73.2+80.5km) (Woodward et al, 2019) and therefore has been assessed for the breeding bio-season. Guillemot will also disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Ireland's Eye SPA are likely to be present within the array area; therefore, guillemot have also been assessed for the non-breeding bio-season.

Mitigation

Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.11.2.1 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

Site Specific Approach

During the breeding bio-season, 1,813 guillemot are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array area is 49% (Apportioning Appendix 20), the total number of breeding adults in the array area at risk of displacement is 888 (888.4) during the full breeding bio-season.

Of these 888 breeding adults, 3.3% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20). Therefore, 29 (28.9) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 5.47). Applying a displacement rate of 25% and a mortality rate of 1%, the estimated consequent mortality is less than one (0.07) breeding adult. See Table 5.47 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of guillemot at Ireland's Eye SPA has not changed considerably since the citation colony count in 2001 with the latest colony count, undertaken in 2015, being 460 individuals greater (4,410 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count (Table 5.47).

Based on the 2001 citation colony count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.030% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.027% increase in baseline mortality during the breeding bio-season.

Generic Approach

During the breeding bio-season, 13,703 guillemot are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array area plus 2km buffer is 49%, the total number of breeding adults in the array at risk of displacement is 6,715 (6,714.5) during the full breeding bio-season.

Of these 6,714 breeding adults, 3.3% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20). Therefore, 218 (218.2) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 5.48). Provided a displacement rate of 25% and a mortality rate of 1% have been applied the consequent mortality is less than one (0.55) breeding adults. See Table 5.48 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

Based on the 2001 citation colony count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.226% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.203 % increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

During the non-breeding bio-season 29,765 guillemot are estimated to occur in the array area and 2km buffer. Assuming that 0.3% of these guillemot within the array area plus 2km buffer are deemed to be breeding adults from Ireland's Eye SPA during the non-breeding bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 99 (98.5) individuals (Table 5.47).

Provided, 25% displacement and 1% mortality have been applied, the total predicted consequent mortality from displacement is estimated to be less than one (0.25) individual during the non-breeding bio-season. See Table 7.29 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

As a result, the estimated increase in the baseline mortality during the non-breeding bio-season relative to the citation colony count of 3,950 individuals and background mortality of 241 (241.0) individuals would be 0.102%. Whereas when considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.092%, increase in baseline mortality during the non-breeding bio-season.

Annual Total

Site Specific Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 31,578 individuals, with 127 (127.4) of these being breeding adults from the Ireland's Eye SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is less than one (0.32) breeding adult per annum across all bio-seasons. Table 7.29 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The predicted mortality of less than one breeding adult from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.132% when considering the citation colony count and an increase in baseline mortality of 0.118% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Generic Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 43,468 individuals, with 317 (316.7) of these being breeding adults from the Ireland's Eye SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is one (0.79) breeding adult per annum across all bio-seasons. Table 7.30 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The predicted mortality of less than one breeding adult from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.329% when considering the citation colony count and an increase in baseline mortality of 0.294% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

Site Specific Approach

The predicted impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs regarding the guillemot QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to the potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Generic Approach

The predicted impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs regarding the guillemot QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to the potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.47: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Guillemot at Ireland's Eye SPA for the Site Specific Approach, where 1,813 Guillemot are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the latest NPWS Colony Count and the 2001 Citation Colony Count[18].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
Upper Confidence Intervals (UCI)							
Breeding	38.0	0.09	0.06 - 0.66	0.039	0.024 - 0.276	0.035	0.021 - 0.247
Non-breeding	126.9	0.32	0.19 - 2.22	0.132	0.079 - 0.921	0.118	0.071 - 0.825
Annual Total	164.8	0.41	0.25 - 2.88	0.171	0.103 - 1.197	0.153	0.092 - 1.072
Mean							
Breeding	28.9	0.07	0.04 - 0.51	0.030	0.018 - 0.210	0.027	0.016 - 0.188
Non-breeding	98.5	0.25	0.15 - 1.72	0.102	0.061 - 0.715	0.092	0.055 - 0.641
Annual Total	238.8	0.32	0.19 - 2.23	0.132	0.079 - 0.925	0.118	0.071 - 0.829
Lower Confidence Intervals (LCI)							
Breeding	20.0	0.05	0.03 - 0.35	0.021	0.012 - 0.145	0.019	0.011 - 0.130
Non-breeding	69.8	0.17	0.1 - 1.22	0.072	0.043 - 0.507	0.065	0.039 - 0.454
Annual Total	89.8	0.22	0.13 - 1.57	0.093	0.056 - 0.652	0.083	0.050 - 0.584

[18] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.48: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Guillemot at Ireland's Eye SPA for the Generic Approach, where 13,703 Guillemot are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the latest NPWS Colony Count and the 2001 Citation Colony Count[19].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Breeding	293.2	0.73	0.44 - 5.13	0.304	0.183 - 2.129	0.272	0.163 - 1.907
Non-breeding	126.9	0.32	0.19 - 2.22	0.132	0.079 - 0.921	0.118	0.071 - 0.825
Annual Total	420.1	1.05	0.63 - 7.35	0.436	0.262 - 3.051	0.390	0.234 - 2.733
Mean							
Breeding	218.2	0.55	0.33 - 3.82	0.226	0.136 - 1.585	0.203	0.122 - 1.419
Non-breeding	98.5	0.25	0.15 - 1.72	0.102	0.061 - 0.715	0.092	0.055 - 0.641
Annual Total	316.7	0.79	0.48 - 5.54	0.329	0.197 - 2.300	0.294	0.177 - 2.060
LCI							
Breeding	142.3	0.36	0.21 - 2.49	0.148	0.089 - 1.034	0.132	0.079 - 0.926
Non-breeding	69.8	0.17	0.10 - 1.22	0.072	0.043 - 0.507	0.065	0.039 - 0.454
Annual Total	212.1	0.53	0.32 - 3.71	0.220	0.132 - 1.541	0.197	0.118 - 1.380

[19] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.11.2.2 Disturbance and Displacement (Operation)

Breeding Bio-season

Site Specific Approach

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from operation and maintenance activities.

During the breeding bio-season, 1,813 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array area is 49% (Apportioning Appendix 20), the total number of breeding adults in the array area at risk of displacement is 888 (888.4) during the full breeding bio-season.

Of these 888 breeding adults, 3.3% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20. Therefore, 29 (28.9) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 7.31). Provided a displacement rate of 50% and a mortality rate of 1% have been applied the consequent mortality is estimated is less than one (0.14) breeding adult. See Table 7.31 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The population of guillemot at Ireland's Eye SPA has changed since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 460 individuals greater (4,410 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count, undertaken in 2015.

Based on the 2001 citation colony count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.060% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.054% increase in baseline mortality during the breeding bio-season.

Generic Approach

During the breeding bio-season, 13,703 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 49% (Apportioning Appendix 20) the total number of breeding adults in the array at risk of displacement is 6,715 (6,714.5) during the full breeding bio-season.

Of these 6,715 breeding adults, 3.3% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20. Therefore, 218 (218.2) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 7.32). Provided a displacement rate of 50% and a mortality rate of 1% have been applied the consequent mortality is estimated is 1 (1.09) breeding adults. See Table 7.31 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The population of guillemot at Ireland's Eye SPA has not changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 460 individuals greater (4,410 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count, undertaken in 2015.

Based on the 2001 citation colony count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals, the addition of less than two predicted breeding adult mortalities would represent a 0.453% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.406% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

During the non-breeding bio-season 29,765 guillemot are estimated to occur in the array area and 2km buffer. Assuming that 0.3% of these guillemot within the array area plus 2km buffer are deemed to be breeding adults from Ireland's Eye SPA during the non-breeding bio-season (Apportioning Appendix 20, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 99 (98.5) (Table 7.31).

Provided, 50% displacement and 1% mortality have been applied, the total predicted consequent mortality from being displaced is estimated as less then one (0.49) individual during the non-breeding bio-season. Table 7.27 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (30% displacement to 70% displacement, 1 to 5% mortality).

As a result the estimated increase in the baseline mortality during the non-breeding bio-season relative to the citation count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals would be 0.204%. Whereas, considering the latest colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adults, this would represent a 0.183% during the non-breeding bio-season.

Annual Total

Site Specific Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 31,578 individuals, with 127 (127.4) of these being breeding adults from the Ireland's Eye SPA. The total predicted displacement consequent mortality throughout the operation of the proposed development is less than one (0.64) breeding adults per annum across all bio-seasons. Table 7.30 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the guillemot QI of Ireland's Eye SPA is presented within Table 7.33.

The predicted mortality of two breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.264% when considering the citation colony count (3,950 individuals) and a background mortality of 241 (241.0) individuals and an increase in baseline mortality of 0.237% when considering the latest colony count (4,410 individuals) and an annual background mortality of 269 (269.0) adults. This level of impact would be indistinguishable from natural fluctuations in the population.

Generic Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 43,468 individuals, with 317 (316.7) of these being breeding adults from the Ireland's Eye SPA. The total predicted displacement consequent mortality throughout the operation of the proposed development is less than two (1.58) breeding adults per annum across all bio-seasons. Table 7.31 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The predicted mortality of two breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.657% when considering the citation colony count (3,950 individuals) and a background mortality of 241 (241.0) individuals and an increase in baseline mortality of 0.589% when considering the latest colony count (4,410 individuals) and an annual background mortality of 269 (269.0) adults. This level of impact would be indistinguishable from natural fluctuations in the population. In terms of the integrity of the population, these minimal impacts should be viewed in the context of a growing population. An additional 1.58 mortalities per year will only slightly slow growth (the colony grew by approximately 33 birds per year between 2001 and 2015) and so no reduction in colony size can be expected.

Conclusion of AEoI

Site Specific Approach

The predicted impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs regarding the guillemot QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to the potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Generic Approach

The predicted impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs regarding the guillemot QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to the potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.49: Range-Based Displacement Mortalities During the Operational Phase for Guillemot at Ireland's Eye SPA, where 1,813 Guillemot (site-specific approach) are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impact and the Latest NPWS Colony Count and the 2001 Citation Colony Count[20].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Breeding	38.0	0.19	0.11 - 1.33	0.079	0.047 - 0.552	0.071	0.042 - 0.494
Non-breeding	126.9	0.63	0.38 - 4.44	0.263	0.158 - 1.843	0.236	0.141 - 1.651
Annual Total	164.8	0.82	0.49 - 5.77	0.342	0.205 - 2.394	0.306	0.184 - 2.145
Mean							
Breeding	28.9	0.14	0.09 - 1.01	0.060	0.036 - 0.419	0.054	0.032 - 0.376
Non-breeding	98.5	0.49	0.30 - 3.45	0.204	0.123 - 1.431	0.183	0.110 - 1.282
Annual Total	127.4	0.64	0.38 - 4.46	0.264	0.159 - 1.850	0.237	0.142 - 1.657
LCI							
Breeding	20.0	0.10	0.06 - 0.70	0.042	0.025 - 0.291	0.037	0.022 - 0.261
Non-breeding	69.8	0.35	0.21 - 2.44	0.145	0.087 - 1.014	0.130	0.078 - 0.908
Annual Total	89.8	0.45	0.27 - 3.14	0.186	0.112 - 1.305	0.167	0.100 - 1.169

[20] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.50: Range-Based Displacement Mortalities During the Operational Phase for Guillemot at Ireland's Eye SPA, where 13,703 Guillemot (Furness approach) are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count.

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Breeding	293.2	0.73	0.44 - 5.13	0.304	0.183 - 2.129	0.272	0.163 - 1.907
Non-breeding	126.9	0.32	0.19 - 2.22	0.132	0.079 - 0.921	0.118	0.071 - 0.825
Annual Total	420.1	1.05	0.63 - 7.35	0.436	0.262 - 3.051	0.390	0.234 - 2.733
Mean							
Breeding	218.2	1.09	0.65 - 7.64	0.453	0.272 - 3.169	0.406	0.243 - 2.839
Non-breeding	98.5	0.49	0.30 - 3.45	0.204	0.123 - 1.431	0.183	0.110 - 1.282
Annual Total	316.7	1.58	0.95 - 11.08	0.657	0.394 - 4.600	0.589	0.353 - 4.120
LCI							
Breeding	142.3	0.71	0.43 - 4.98	0.295	0.177 - 2.068	0.265	0.159 - 1.852
Non-breeding	69.8	0.35	0.21 - 2.44	0.145	0.087 - 1.014	0.130	0.078 - 0.908
Annual Total	212.1	1.06	0.64 - 7.43	0.440	0.264 - 3.082	0.394	0.237 - 2.760

Table 5.51: Mean Annual Abundance of Guillemot Apportioned to Ireland's Eye SPA During Operational Phase Displacement Matrix (Array Area Plus 2km Buffer) where 1,813 Guillemot are Estimated to Occur in the Array Area (+2km buffer) During the Breeding Bio-Season.

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	0	1	1	3	4	5	6	8	9	10	11	13
20	0	1	1	3	5	8	10	13	15	18	20	23	25
30	0	1	2	4	8	11	15	19	23	27	31	34	38
40	1	1	3	5	10	15	20	25	31	36	41	46	51

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
50	1	1	3	6	13	19	25	32	38	45	51	57	64
60	1	2	4	8	15	23	31	38	46	54	61	69	76
70	1	2	4	9	18	27	36	45	54	62	71	80	89
80	1	2	5	10	20	31	41	51	61	71	82	92	102
90	1	2	6	11	23	34	46	57	69	80	92	103	115
100	1	3	6	13	25	38	51	64	76	89	102	115	127

5.4.11.3 Razorbill

Razorbill has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from disturbance and displacement from the proposed development alone

The array area is located 25.1km from the Ireland's Eye SPA which is within MMF+1SD for razorbill (88.7+75.9km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Razorbill will also disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Ireland's Eye SPA are likely to be present within the array area.

Therefore, razorbill have been screened for the post-breeding migration bio-season (August to October), the return migration bio-season (January to March), and the migration-free winter bio-season (November to December) as defined by Furness (2015).

Mitigation

Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.11.3.1 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from construction and decommissioning activities.

During the breeding bio-season, 168 razorbill are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 50% (Apportioning Appendix 20), the total number of breeding adults in the array at risk of displacement is 84 (84.0) during the full breeding bio-season.

Of these 84 breeding adults, 8.6% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20). Therefore, seven (7.1) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 7.34). Provided a displacement rate of 25% and a mortality rate of 1% has been applied the consequent mortality is estimated is less than one (0.02) breeding adults. See Table 7.34 for the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of razorbill at Ireland's Eye SPA has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 680 individuals greater (1,600 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count undertaken in 2015 (See Table 7.34).

Based on the 2001 citation colony count of 920 breeding adults and annual background mortality of 97 (96.6) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.018% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 1,600 individuals and an annual background mortality of 168 (168.0) adults, this would represent a 0.011% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-seasons

The mean-peak number of razorbills estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration- free winter bio-season.

Assuming that 0.3% of these razorbill within the array area plus 2km buffer are deemed to be breeding adults from Ireland's Eye SPA during the migration bio-seasons and 0.4% during the migration-free winter bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer eight (8.5) during the post- breeding migration bio-season, one (1.2) during the return migration and nine (9.1) during the migration free winter bio-season (Table 7.34).

Provided, 25% displacement and 1% mortality have been applied, the total predicted consequent mortality from displacement is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.02; 0.00 and 0.02 individuals, respectively). Table 7.34 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The consequent estimated mortality equates to an increase in baseline mortality of 0.022% during the post-breeding migration bio-season, 0.003% during the return migration and 0.023% during the migration-free winter bio-season based on the 2001 citation colony count of 1,600 individuals and an annual background mortality of 168 (168.0) adults. And 0.013%, 0.002% and 0.013%, respectively relative to the latest colony count of 920 breeding adults and annual background mortality of 97 (96.6) individuals.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.05) breeding adult per annum. This represents an increase of 0.049% in baseline mortality of the 2001 citation colony count and 0.028% increase using the latest colony count.

Annual Total

Throughout all bio-seasons, the number of razorbill estimated to occur in the array area plus a 2km buffer is 6,101 individuals, with 26 (25.5) of these being breeding adults from the Ireland's Eye SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phase of the proposed development is less than one (0.06) breeding adult per annum across all bio-seasons. Table 7.34 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1% to 5% mortality).

The predicted mortality of less than one breeding adult from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.067% when considering the citation colony count and an increase in baseline mortality of 0.039% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

The predicted impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Ireland's Eye SPA in relation to disturbance and displacement effects from construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.52: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Razorbill at Ireland's Eye SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[21].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Breeding	11.2	0.03	0.02 - 0.20	0.029	0.017 - 0.202	0.017	0.010 - 0.116
Post-breeding migration	13.6	0.03	0.02 - 0.24	0.035	0.021 - 0.247	0.020	0.012 - 0.142
Return-breeding migration	2.0	0.01	0.00 - 0.04	0.005	0.003 - 0.036	0.003	0.002 - 0.021
Migration-free winter	12.8	0.03	0.02 - 0.22	0.033	0.020 - 0.231	0.019	0.011 - 0.133
Total Non-breeding	28.4	0.07	0.04 - 0.50	0.074	0.044 - 0.515	0.042	0.025 - 0.296
Annual Total	39.6	0.10	0.06 - 0.69	0.102	0.061 - 0.717	0.059	0.035 - 0.412
Mean							
Breeding	7.1	0.02	0.01 - 0.12	0.018	0.011 - 0.129	0.011	0.006 - 0.074
Post-breeding migration	8.5	0.02	0.01 - 0.15	0.022	0.013 - 0.154	0.013	0.008 - 0.089
Return-breeding migration	1.2	0.00	0.00 - 0.02	0.003	0.002 - 0.022	0.002	0.001 - 0.013
Migration-free winter	9.1	0.02	0.01 - 0.16	0.023	0.014 - 0.164	0.013	0.008 - 0.094
Total Non-breeding	18.8	0.05	0.03 - 0.33	0.049	0.029 - 0.341	0.028	0.017 - 0.196
Annual Total	25.9	0.06	0.04 - 0.45	0.067	0.04 - 0.470	0.039	0.023 - 0.270

[21] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	**15-35% displacement, 1 - 5% mortality**	**25% displacement, 1% mortality**	**15-35% displacement, 1 - 5% mortality**	**25% displacement, 1% mortality**	**15-35% displacement, 1 - 5% mortality**
LCI							
Breeding	3.5	0.01	0.01 - 0.06	0.009	0.005 - 0.063	0.005	0.003 - 0.036
Post-breeding migration	3.8	0.01	0.01 - 0.07	0.010	0.006 - 0.068	0.006	0.003 - 0.039
Return-breeding migration	0.6	0.00	0.00 - 0.01	0.002	0.001 - 0.011	0.001	0.001 - 0.006
Migration-free winter	5.4	0.01	0.01 - 0.09	0.014	0.008 - 0.097	0.008	0.005 - 0.056
Total Non-breeding	9.7	0.02	0.01 - 0.17	0.025	0.015 - 0.176	0.014	0.009 - 0.101
Annual Total	13.2	0.03	0.02 - 0.23	0.034	0.021 - 0.239	0.020	0.012 - 0.138

5.4.11.3.2 Displacement and Disturbance (Operation)

Breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from operation and maintenance activities.

During the breeding bio-season, 168 razorbills are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 50% (Apportioning Appendix 20) the total number of breeding adults in the array at risk of displacement is 84 (84.0) during the full breeding bio-season.

Of these 84 breeding adults, 8.6% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20). Therefore, seven (7.1) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 7.35). The consequent mortality is estimated is less than one (0.04) breeding adult, provided a displacement rate of 50% and a mortality rate of 1% has been applied. Table 7.35 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The population of razorbill at Ireland's Eye SPA has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 680 individuals greater (1,600 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count (Table 7.35).

Based on the 2001 citation colony count of 920 breeding adults and annual background mortality of 97 (96.6) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.037% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 1,600 individuals and an annual background mortality of 168 (168.0) adults, the baseline mortality would increase by 0.021% during the breeding bio-season.

Non-breeding Bio-season

The mean-peak number of razorbill estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration- free winter bio-season.

Assuming that 0.3% of these razorbill within the array area are deemed to be breeding adults from Ireland's Eye SPA during the migration bio-seasons and 0.5% during the migration-free winter bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is eight (8.5) during the post- breeding migration bio-season, one (1.2) during the return migration and nine (9.1) during the migration free winter bio-season (Table 7.35).

Provided, 50% displacement and 1% mortality have been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.04; 0.01 and 0.05 individuals, respectively). Table 7.35 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The consequent estimated mortality of less than one individual equates to an increase in baseline mortality of 0.044% during the post-breeding migration bio-season, 0.006% during the return migration and 0.047% during the migration-free winter bio-season based on the 2001 citation colony count of 1,600 individuals and an annual background mortality of 168 (168.0) adults and 0.025%, 0.004% and 0.027%, respectively relative to the latest colony count of 920 breeding adults and annual background mortality of 97 (96.6) individuals.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.09) breeding adult per annum. This represents an increase of 0.097% in baseline mortality respective to the 2001 citation colony count and 0.056% increase when considering the latest colony count.

Annual Total

Throughout all bio-seasons, the number of razorbill estimated to occur in the array area plus a 2km buffer is 6,101 individuals, with 26 (25.9) of these being breeding adults from the Ireland's Eye SPA.

The total predicted displacement consequent mortality throughout the operational phase of the proposed development is less than one (0.13) breeding adult per annum across all bio-seasons. Table 7.35 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the razorbill QI of Ireland's Eye SPA is presented within Table 7.35.

The predicted mortality of less than one breeding adult from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.134% when considering the citation colony count and an increase in baseline mortality of 0.077% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs regarding the razorbill QI of Ireland's Eye SPA in relation to disturbance and displacement effects from operational phase from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.53: Range-Based Displacement Mortalities During the Operational Phase for Razorbill at Ireland's Eye SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[22].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	**30-70% displacement, 1 - 5% mortality**	**50% displacement, 1% mortality**	**30-70% displacement, 1 - 5% mortality**	**50% displacement, 1% mortality**	**30-70% displacement, 1 - 5% mortality**
UCI							
Breeding	11.2	0.06	0.03 - 0.39	0.058	0.035 - 0.404	0.033	0.020 - 0.232
Post-breeding migration	13.6	0.07	0.04 - 0.48	0.071	0.042 - 0.494	0.041	0.024 - 0.284
Return-breeding migration	2.0	0.01	0.01 - 0.07	0.010	0.006 - 0.073	0.006	0.004 - 0.042
Migration-free winter	12.8	0.06	0.04 - 0.45	0.066	0.040 - 0.463	0.038	0.023 - 0.266
Total Non-breeding	28.4	0.14	0.09 - 0.99	0.147	0.088 - 1.029	0.085	0.051 - 0.592
Annual Total	39.6	0.20	0.12 - 1.38	0.205	0.123 - 1.433	0.118	0.071 - 0.824
Mean							
Breeding	7.1	0.04	0.02 - 0.25	0.037	0.022 - 0.258	0.021	0.013 - 0.148
Post-breeding migration	8.5	0.04	0.03 - 0.30	0.044	0.026 - 0.309	0.025	0.015 - 0.178
Return-breeding migration	1.2	0.01	0.00 - 0.04	0.006	0.004 - 0.044	0.004	0.002 - 0.025
Migration-free winter	9.1	0.05	0.03 - 0.32	0.047	0.028 - 0.328	0.027	0.016 - 0.189
Total Non-breeding	18.8	0.09	0.06 - 0.66	0.097	0.058 - 0.682	0.056	0.034 - 0.392
Annual Total	25.9	0.13	0.08 - 0.91	0.134	0.081 - 0.940	0.077	0.046 - 0.540
LCI							

[22] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	3.5	0.02	0.01 - 0.12	0.018	0.011 - 0.127	0.010	0.006 - 0.073
Post-breeding migration	3.8	0.02	0.01 - 0.13	0.019	0.012 - 0.136	0.011	0.007 - 0.078
Return-breeding migration	0.6	0.00	0.00 - 0.02	0.003	0.002 - 0.022	0.002	0.001 - 0.012
Migration-free winter	5.4	0.03	0.02 - 0.19	0.028	0.017 - 0.194	0.016	0.010 - 0.112
Total Non-breeding	9.7	0.05	0.03 - 0.34	0.050	0.030 - 0.352	0.029	0.017 - 0.202
Annual Total	13.2	0.07	0.04 - 0.46	0.068	0.041 - 0.479	0.039	0.024 - 0.275

Table 5.54: Mean Annual Abundance of Razorbill Apportioned to Ireland's Eye SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	0	0	0	1	1	1	1	2	2	2	2	3
20	0	0	0	1	1	2	2	3	3	4	4	5	5
30	0	0	0	1	2	2	3	4	5	5	6	7	8
40	0	0	1	1	2	3	4	5	6	7	8	9	10
50	0	0	1	1	3	4	5	6	8	9	10	11	13
60	0	0	1	2	3	5	6	8	9	11	12	14	15
70	0	0	1	2	4	5	7	9	11	13	14	16	18
80	0	0	1	2	4	6	8	10	12	14	16	18	20
90	0	0	1	2	5	7	9	11	14	16	18	21	23

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
100	0	1	1	3	5	8	10	13	15	18	20	23	26

5.4.11.4 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 25.1km from Ireland's Eye SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Ireland's Eye SPA has been assessed for the breeding bio-season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January – February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.11.4.1 Mitigation

The proposed development has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, compared to a 22m air draft, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.11.4.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals (CRM Appendix 18 and 19). Assuming 47% of these 5 individuals are adult (Apportioning Appendix 20) the total number of breeding adults in the array area impacted by collision is less than three (2.5) per annum during the breeding bio-season.

Provided 3.4% of these collisions are breeding birds from Ireland's Eye SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.09) breeding adult (Table 7.37).

The population of kittiwake at Ireland's Eye SPA has changed considerably since the 2001 citation colony count, with the latest colony count undertaken in 2015 being 1,172 individuals greater (3,220 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count.

Based on the 2001 citation colony count of 2,048 breeding adults and annual background mortality of 299 (299.0) individuals, the addition of less than one (0.09) predicted breeding adult mortalities would represent a 0.029% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 3,220 individuals and an annual background mortality of 470 (470.1) adults, this would represent a 0.074% increase in baseline mortality during the breeding bio-season (Table 7.37).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase are seven (6.54) and seven (7.42) individuals during the post-breeding migration bio-season and the return migration, respectively (Table 7.37). Provided 0.1% of the kittiwake within the array area are deemed to be breeding adults from the Ireland's Eye SPA during the post-breeding migration bio- season and 0.1% during the return migration (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.01) during the migration bio- seasons.

Based on the 2001 citation colony count of 2,048 breeding adults and annual background mortality of 299 (299.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.002% and a 0.005% increase in baseline mortality during the post-breeding migration bio-season and the return migration, respectively. Whereas, when considering the latest colony count of 3,220 individuals and an annual background mortality of 470 (470.1) adults, this would represent a 0.005% and a 0.010% increase in baseline mortality during the post-breeding migration bio-season and the return migration, respectively.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.02) breeding adult per annum. This represents an increase of 0.006% in baseline mortality when assessed against the citation colony count and an 0.014% increase when assessed against the latest colony count.

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Ireland's Eye SPA is less than one (0.10) breeding adult per annum (Table 7.37).

The annual predicted mortality of less than one breeding adults from the Ireland's Eye SPA across all bio-seasons indicates an increase in baseline mortality of 0.035% and 0.088% when considering the citation colony count and the latest colony count, respectively.

Table 5.55: Seasonal Collision Mortalities during the Operational Phase for kittiwake at Ireland's Eye SPA[23].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.09	0.01 – 0.21	0.029	0.003 – 0.070	0.074	0.007 – 0.180
Post-breeding migration	0.01	0.00 – 0.01	0.002	0.000 – 0.004	0.005	0.001 – 0.011
Return migration	0.01	0.00 – 0.02	0.005	0.000 – 0.008	0.010	0.000 – 0.020
Non-breeding Total	0.02	0.00 – 0.04	0.006	0.000 – 0.012	0.014	0.001 – 0.032
Annual Total	0.10	0.01 – 0.25	0.035	0.003 – 0.083	0.088	0.007 – 0.211

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Ireland's Eye SPA in relation to collision risk effects from operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.11.5 Herring gull

Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 25.1km from Ireland's Eye SPA, which is within the MMF+1SD for herring gull (58.8+26.8km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Herring gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area plus 2km buffer and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of herring gull from Ireland's Eye SPA has been assessed for the full breeding bio-season (March – August) and the non- breeding bio-season (September – February) as defined by Furness (2015).

[23] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.11.5.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 65% for gull species from the proposed development, compared with a project with an air draft of 22m. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.11.5.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 17 (17.45) individuals (CRM Appendix 18 and 19). Assuming 48% of these 17 individuals are breeding adults (Apportioning Appendix 20) and adult herring gull exhibit a sabbatical rate of 35% (meaning 35% of adults will not be breeding in any given year), the total number of breeding adults in the array impacted by collision is 7 (6.98) per annum during the full breeding bio-season.

Provided 2.9% of these collisions are breeding birds from Ireland’s Eye SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.20) breeding adults (Table 7.38).

The population of herring gull at Ireland’s Eye SPA has changed considerably since the citation colony count in 1999 with the latest colony count undertaken in 2015 being 144 individuals greater (636 birds). The potential impact on the population has been assessed against both the 1999 citation count and the latest colony count undertaken in 2015.

Based on a citation colony count of 492 breeding adults and annual adult background mortality of 82 (81.7) individuals, the addition of less than one breeding adult mortality would represent a 0.250% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest count of 636 individuals and an annual background mortality of 106 (105.6) adults, this would represent a 0.193% increase in baseline mortality during the breeding bio-season (Table 7.38).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 40 (39.7) individuals, provided 0.3% of the herring gulls within the array area are deemed to be breeding adults from Ireland’s Eye SPA during non-breeding bio-season (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.13) during the non-breeding bio- season (Table 7.38).

Based on the 1999 citation colony of breeding adults the addition of less than one (0.13) predicted breeding adult mortality would indicate an increase in baseline mortality of 0.157% during the non-breeding season. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.122% increase in baseline mortality in the non-breeding bio-season (Table 7.38).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Ireland’s Eye SPA is less than one (0.34) breeding adults per annum (Table 7.38).

The annual predicted mortality of less than one breeding adults from Ireland’s Eye SPA across all bio-seasons indicates an increase in baseline mortality of 0.415% and 0.321% when considering the 1999 citation population and the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population (Table 7.38).

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Ireland’s Eye SPA in relation to collision risk effects from operational phase from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.56: Seasonal Collision Mortalities During the Operational Phase for Herring gull at Ireland's Eye SPA[24].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.20	0.01 – 0.56	0.250	0.014 – 0.686	0.193	0.011 – 0.531
Non-breeding	0.13	0.03 – 0.31	0.165	0.037 – 0.384	0.128	0.028 – 0.297
Annual Total	0.34	0.04 – 0.87	0.415	0.051 – 1.070	0.321	0.039 – 0.827

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Ireland's Eye SPA in relation to collision risk effects from operational phase from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.12 Howth Head Coast SPA

Howth Head is a rocky headland situated 27.1km from the array area, on the northern side of Dublin Bay. The SPA covers cliffs ranging from 60m to 90m hight that extend east from the nose of Howth to the tip of the Bailey Lighthouse peninsula. The SPA is of high ornithological importance as it supports a nationally important population of kittiwake, alongside an assemblage population comprised of a further seven seabird species including herring gull. The kittiwake population at Howth Head Coast SPA has been considered in the ornithology assessment presented here for impacts arising from the offshore elements of the proposed development.

5.4.12.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Howth Head Coast SPA are considered within this section:

Table 5.57: qualifying interests and Conservation Objectives of Howth Head Coast SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.12.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 27.1km from the Howth Head Coast SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season.

---

[24] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Howth Head Coast SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January – February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.12.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.12.2.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season five 5 (5.36) individuals (CRM Appendix 18 and 19). Assuming 47% of these 5 individuals are breeding adults (Apportioning Appendix 20) the total number of breeding adults in the array impacted by collision is less than three (2.52) per annum during the breeding bio-season.

Provided 11.7% of these collisions are breeding birds from Howth Head Coast SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.30) breeding adult.

Based on a 1999 citation population of 4,538 individuals and a background mortality of 663 (662.5), this would represent a 0.045% increase in baseline morality during the breeding bio-season. Based on the latest colony count undertaken in 2015 of 3,586 individuals and an annual background mortality of 524 (523.6) adults, this would represent a 0.057% increase in baseline mortality during the breeding bio-season (Table 5.58).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is seven (6.54) individuals, and seven (7.42) individuals during the return migration, provided 0.4% of the kittiwake within the array area are deemed to be breeding adults from the Howth Head Coast SPA during the post-breeding migration bio- season and 0.5% during the return migration (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.02) individual during the post-breeding migration bio-season and less than one (0.05) individual during the return migration bio-season.

Based on the citation population from 1999, the potential impact on the population would represent a 0.004% and 0.008% increase in baseline mortality in the post-breeding migration bio-season and return migration, respectively. Based on the latest population count, undertaken in 2015, the potential impact on the population would represent a 0.005% and 0.010% increase in baseline mortality in the post-breeding migration bio-season and return migration, respectively.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.08) breeding adult per annum. This represents an increase of 0.015% in baseline mortality when assessed against the latest colony count (Table 5.58).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Howth Head Coast SPA is less than one (0.37) breeding adult per annum.

The annual predicted mortality of less than one breeding adults from the Howth Head Coast SPA across all bio-seasons indicates an increase in baseline mortality of 0.056% when considering the citation count and 0.072% when considering the latest colony count (Table 5.58).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Howth Head Coast SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.58: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Howth Head Coast SPA[25].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.30	0.03 – 0.74	0.045	0.004 – 0.112	0.057	0.005 – 0.144
Post-breeding migration	0.02	0.00 – 0.06	0.004	0.000 – 0.009	0.005	0.000 – 0.012
Return migration	0.05	0.00 – 0.14	0.008	0.000 – 0.021	0.010	0.000 – 0.027
Non-breeding Total	0.07	0.00 – 0.20	0.011	0.001 – 0.030	0.014	0.001 – 0.038
Annual Total	0.37	0.03 – 0.94	0.056	0.005 – 0.142	0.072	0.006 – 0.182

5.4.13 Lambay Island SPA

Lambay Island SPA is located 14.4km from the array area, 15.3km from the ECC, 10.18km from the onshore development area and about 4km off the north coast of Co. Dublin. The SPA covers a range of habitats including a bedrock shoreline on the western side and steep cliffs ranging from 15m to 50m high extending along the northern, eastern, and much of the southern coasts of the island. The SPA is designated for three breeding population of international importance (cormorant; shag; guillemot, of which cormorant and shag have been screened out in relation to the offshore elements of the proposed development) and a further six nationally important breeding populations (fulmar; lesser-black backed gull; herring gull; kittiwake; razorbill; puffin). Additionally, the island supports nationally important non-breeding populations of greylag goose and herring gull.

All QIs, with the exception of, fulmar, greylag goose and puffin, have been screened in for the assessment of impacts arising from the onshore elements of the proposed development. For impacts arising from the offshore elements of the proposed development all QIs have been assessed with the exception of cormorant and shag which are not considered vulnerable to OWF impacts.

5.4.13.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Lambay Island SPA are considered within this section:

Table 5.59: qualifying interests and Conservation Objectives of Lambay Island SPA

Qualifying Interests Screened In	Conservation Objectives
Lesser Black-backed Gull [A183] Herring Gull [A184] Guillemot [A199] Razorbill [A200]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

[25] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188] Fulmar [A009] Cormorant [A017] Shag [A018]	• the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.13.2 Guillemot

Guillemot has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from displacement from the proposed development alone.

The array area is located 14.4km from Lambay Island SPA which is within MMF+1SD for guillemot (73.2+80.5km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Guillemot disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Ireland's Eye SPA are likely to be present within array area; therefore, guillemot have been screened in for the non-breeding bio-season.

5.4.13.2.1 Mitigation

Guillemot displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.2.2 Disturbance and Displacement (Construction and Decommissioning)

Two approaches to breeding seasons definitions were assessed for guillemot because site-specific DAS data suggested that the Furness approach to bio-seasons is not the most ecologically relevant. Though Furness (2015) suggest a breeding season of March to July, project-specific DAS data and available literature (e.g., Dunn et al. 2020) indicate that birds at the early and late stages of this period are not under the same energy constraints as in the core breeding season, and therefore a shorter season not incorporating the early and late stages of the season is considered more appropriate. Additionally, birds present in July are highly likely to be a result of post-breeding dispersal (as opposed to being breeding birds) based on available evidence and site-specific DAS data. Therefore, a more ecologically relevant breeding season of April to June has been used. Consequently, two approaches are laid out in the section below; a 'Site Specific Approach' using the breeding seasons evidenced using site-specific data, and a 'Generic Approach' using the Furness (2015) bio-season definitions. A full justification of this approach is provided in the Technical Baseline (Appendix 12).

The abundance of guillemots within the array area plus 2km buffer was estimated using both design-based and model-based methods. Across all months model-based methods consistently predicted fewer birds in the array area and 2km buffer (see Appendix 23: MRSea Modelling for Offshore Ornithology). For example, the mean-peak counts during the breeding season (generic approach) from model-based estimates was 8,642 compared with 13,703 using design-based abundances. This translates to roughly a 37% reduction in the estimated abundance based on the modelled approach. As a precautionary approach, design-based abundance estimates were used in the displacement assessment in this chapter. Nevertheless, this does not mean that the modelled estimates provide a less accurate prediction of the true number and distribution of birds throughout the array plus 2km buffer, and they should be considered in relation to the conclusions provided for guillemot.

Breeding Bio-season

Site Specific Approach

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from construction and decommissioning activities.

During the breeding bio-season, 1,813 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 49% (Apportioning Appendix 20), the total number of breeding adults in the array at risk of displacement is 888 (888.4) during the full breeding bio-season.

Of these 888 breeding adults, 93.8% are predicted to be breeding birds from Lambay Island SPA (Apportioning Appendix 20). Therefore, 826 (825.6) breeding adults at risk of displacement are attributed to Lambay Island SPA during the breeding bio-season (Table 7.39). The consequent mortality is estimated is two (2.06) breeding adults, provided a displacement rate of 25% and a mortality rate of 1% has been applied. Table 7.39 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of guillemot at Lambay Island SPA has declined considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 18,015 individuals fewer (59,983 birds). The potential impact on the population has been assessed against both the 2004 citation count and the latest colony count (See Table 7.39).

Based on the 2004 citation colony count of 77,998 breeding adults and annual background mortality of 4,758 (4,757.9) individuals, the addition of two predicted breeding adult mortalities would represent a 0.043% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 59,983 individuals and an annual background mortality of 3,659 (3,659.0) adults, this would represent a 0.056% increase in baseline mortality during the breeding bio-season.

Generic Approach

During the breeding bio-season, 13,703 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 49% (Apportioning Appendix 20), the total number of breeding adults in the array at risk of displacement is 6,715 (6,714.5) during the full breeding bio-season.

Of these 6,715 breeding adults, 93.8% are predicted to be breeding birds from Lambay Island SPA (Apportioning Appendix 20). Therefore, 6,240 (6,240.0) breeding adults at risk of displacement are attributed to Lambay Island SPA during the breeding bio-season (Table 7.40). The consequent mortality is estimated is 16 (15.60) breeding adults, provided a displacement rate of 25% and a mortality rate of 1% has been applied. Table 7.40 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of guillemot at Lambay Island SPA has declined considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 18,015 individuals fewer (59,983 birds). The potential impact on the population has been assessed against both the 2004 citation count and the latest colony count (See Table 7.40).

Based on the 2004 citation colony count of 77,998 breeding adults and annual background mortality of 4,758 (4,757.9) individuals, the addition of 15.60 predicted breeding adult mortalities would represent a 0.328% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 59,983 individuals and an annual background mortality of 3,659 (3,659.0) adults, this would represent a 0.426% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 29,765 individuals.

Assuming that 4.5% of these guillemot are deemed to be breeding adults from Lambay Island SPA during the non-breeding bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 1,339 (1,339.8) (Table 7.39). Provided, 25% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at three (3.35) individuals during the non-breeding bio-season. Table 7.39 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

As a result, the estimated increase in the baseline mortality during the non-breeding bio-season relative to the 2004 citation count and latest colony count would be 0.070% and 0.092%, respectively.

Annual Total

Site Specific Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 31,578 individuals, with 2,165 (2,165.4) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the constriction and decommissioning phases of the proposed development is fewer than six (5.41) breeding adults per annum across all bio-seasons. Table 7.39 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The predicted mortality of nine breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.114% when considering the citation colony count or an increase in baseline mortality of 0.148% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population.

Generic Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 43,468 individuals, with 7,579 (7,579.7) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is 19 (18.95) breeding adults per annum across all bio-seasons. Table 7.40 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The predicted mortality of 23 breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.398% when considering the citation colony count or an increase in baseline mortality of 0.518% when considering the latest colony count.

Conclusion of AEoI

Site Specific Approach

The predicted impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of a population. There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Lambay Island SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Generic Approach

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population. There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Lambay Island SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.60: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Guillemot at Lambay Island SPA for the Site Specific Approach, where 1,813 Guillemot are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the lLtest NPWS Colony Count and the 2004 Citation Colony Count[26].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Breeding	1085.9	2.71	1.63 – 19.0	0.057	0.034 - 0.399	0.074	0.045 - 0.519
Non-breeding	1725.6	4.31	2.59 - 30.2	0.091	0.054 - 0.635	0.118	0.071 - 0.825
Annual Total	2811.5	7.03	4.22 - 49.2	0.148	0.089 - 1.034	0.192	0.115 - 1.345
Mean							
Breeding	825.6	2.06	1.24 - 14.45	0.043	0.026 - 0.304	0.056	0.034 - 0.395
Non-breeding	1339.8	3.35	2.01 - 23.45	0.070	0.042 - 0.493	0.092	0.055 - 0.641
Annual Total	2165.4	5.41	3.25 - 37.89	0.114	0.068 - 0.796	0.148	0.089 - 1.036
LCI							
Breeding	572.8	1.43	0.86 - 10.02	0.030	0.018 - 0.211	0.039	0.023 - 0.274
Non-breeding	949.4	2.37	1.42 - 16.61	0.050	0.030 - 0.349	0.065	0.039 - 0.454
Annual Total	1522.2	3.81	2.28 - 26.64	0.080	0.048 - 0.560	0.104	0.062 - 0.728

[26] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.61: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Guillemot at Lambay Island SPA for the Generic Approach, Where 13,703 Guillemot are Estimated to Occur in the Array Area (+2km buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2004 Citation Colony Count[27].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Breeding	8384.8	20.96	12.58 - 146.73	0.441	0.264 - 3.084	0.573	0.344 - 4.010
Non-breeding	1725.6	4.31	2.59 - 30.20	0.091	0.054 - 0.635	0.118	0.071 - 0.825
Annual Total	10110.5	25.28	15.17 - 176.93	0.531	0.319 - 3.719	0.691	0.414 - 4.836
Mean							
Breeding	6240.0	15.60	9.36 - 109.2	0.328	0.197 - 2.295	0.426	0.256 - 2.984
Non-breeding	1339.8	3.35	2.01 - 23.45	0.070	0.042 - 0.493	0.092	0.055 - 0.641
Annual Total	7579.7	18.95	11.37 - 132.65	0.398	0.239 - 2.788	0.518	0.311 - 3.625
LCI							
Breeding	4070.9	10.18	6.11 - 71.24	0.214	0.128 - 1.497	0.278	0.167 - 1.947
Non-breeding	949.4	2.37	1.42 - 16.61	0.050	0.030 - 0.349	0.065	0.039 - 0.454
Annual Total	5020.2	12.55	7.53 - 87.85	0.264	0.158 - 1.847	0.343	0.206 - 2.401

[27] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.13.2.3 Disturbance and Displacement (Operation)

Breeding Bio-season

Site Specific Approach

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from operation and maintenance activities.

During the breeding bio-season, 1,813 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds is 49% (Apportioning Appendix 20), the total number of breeding adults in the array area plus 2km buffer at risk of displacement is 888 (888.4) during the full breeding bio-season.

Of these 888 breeding adults, 93.8% are predicted to be breeding birds from Lambay Island SPA (Apportioning Appendix 20). Therefore, 826 (825.6) breeding adults at risk of displacement are attributed to Lambay Island SPA during the breeding bio-season (Table 7.41). The consequent mortality is estimated four (4.13) breeding adults, provided a displacement rate of 50% and a mortality rate of 1% has been applied. Table 7.41 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The population of guillemot at Lambay Island SPA has declined considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 18,015 individuals fewer (59,983 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2015 (See Table 7.41).

Based on the 2004 citation colony count of 77,998 breeding adults and annual background mortality of 4,758 (4,757.9) individuals, the addition of four predicted breeding adult mortalities would represent a 0.087% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 59,983 individuals and an annual background mortality of 3,659 (3,659.0), this would represent a 0.113% increase in baseline mortality during the breeding bio-season.

Generic Approach

During the breeding bio-season, 13,703 guillemots are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds is 49% (Apportioning Appendix 20) the total number of breeding adults in the array area plus 2km buffer at risk of displacement is 6,715 (6,714.5) during the full breeding bio-season.

Of these 6,715 breeding adults, 93.8% are predicted to be breeding birds from Lambay Island SPA (Apportioning Appendix 20). Therefore, 6,240 (6,240.0) breeding adults at risk of displacement are attributed to Lambay Island SPA during the breeding bio-season (Table 7.42). The consequent mortality is estimated 31 (31.20) breeding adults, provided a displacement rate of 50% and a mortality rate of 1% has been applied. Table 7.42 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The population of guillemot at Lambay Island SPA has declined considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 18,015 individuals fewer (59,983 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2015 (See Table 7.42).

Based on the 2004 citation colony count of 77,998 breeding adults and annual background mortality of 4,758 (4,757.9) individuals, the addition of 31 predicted breeding adult mortalities would represent a 0.656% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 59,983 individuals and an annual background mortality of 3,659 (3,659.0), this would represent a 0.853% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

In the non-breeding bio-season the mean-peak number of guillemots estimated to occur in the array area and 2km buffer is 29,765 individuals.

Assuming that 4.5% of these guillemot are deemed to be breeding adults from Lambay Island SPA during the non-breeding bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 1,340 (1,339.8) (Table 7.41). Provided, 50% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at seven (6.70) individuals during the non-breeding bio-season. Table 7.41 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

As a result, the estimated increase in the baseline mortality during the non-breeding bio-season relative to the 2004 citation colony count and latest colony count would be 0.141% and 0.183%, respectively.

Annual Total

Site Specific Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 31,578 individuals, with 2,165 (2,165.4) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is 11 (10.83) breeding adults per annum across all bio-seasons. Table 7.41 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the guillemot QI of Lambay Island SPA is presented within Table 7.43

The predicted mortality of 11 breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.228% when considering the citation colony count or an increase in baseline mortality of 0.296% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Generic Approach

Throughout all bio-seasons, the number of guillemot estimated to occur in the array area plus a 2km buffer is 43,468 individuals, with 7,580 (7,579.7) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is 38 (37.90) breeding adults per annum across all bio-seasons. Table 7.42 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The predicted mortality of 38 breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.797% when considering the citation colony count or an increase in baseline mortality of 1.036% when considering the latest colony count. This level of impact is greater than a 1% increase and therefore warrants further investigation to determine population consequences of the impact. Further consideration is given to these impacts below through a PVA.

Assuming an annual mortality of 38 (37.90) breeding adults from Lambay Island SPA and 50% displacement and 1% mortality has been applied, the CGR and CPS are 0.999 and 0.975, respectively. This represents a less then a 0.1% reduction in growth rate and a reduction in final population size of 2.5% compared to the baseline scenario, over the 35-year period. For further details regarding the PVA presented here see the PVA Appendix 13.

As such, irrespective of current population trends, impacts considered to have less than 0.5% reduction in population growth rate are considered non-material. For further details justifying the PVA threshold see Appendix 13, and for details of the current guillemot population trends at Lambay Island SPA see Section 7.5.2.

Conclusion of AEoI

Site Specific Approach

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population.

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Lambay Island SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

General approach

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of the Lambay Island SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.62: Range-Based Displacement Mortalities During the Operational Phase for Guillemot at Lambay Island SPA, Where 1,813 Guillemot are Estimated to Occur in the Array Area (+2km buffer) During the Breeding Bio-season, Based on a Range of Displacement Impacts and the Latest NPWS Colony and the 2004 Citation Colony Count[28].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Breeding	1085.9	5.43	3.26 - 38.01	0.114	0.034 - 0.399	0.148	0.045 - 0.519
Non-breeding	1725.6	8.63	5.18 - 60.40	0.181	0.054 - 0.635	0.236	0.071 - 0.825
Annual Total	2811.5	14.06	8.43 - 98.40	0.295	0.089 - 1.034	0.384	0.115 - 1.345
Mean							
Breeding	825.6	4.13	2.48 - 28.9	0.087	0.026 - 0.304	0.113	0.034 - 0.395
Non-breeding	1339.8	6.70	4.02 - 46.89	0.141	0.042 - 0.493	0.183	0.055 - 0.641
Annual Total	2165.4	10.83	6.5 - 75.79	0.228	0.068 - 0.796	0.296	0.089 - 1.036
LCI							
Breeding	572.8	2.86	1.72 - 20.05	0.060	0.018 - 0.211	0.078	0.023 - 0.274
Non-breeding	949.4	4.75	2.85 - 33.23	0.100	0.030 - 0.349	0.130	0.039 - 0.454
Annual Total	1522.2	7.61	4.57 - 53.28	0.160	0.048 - 0.560	0.208	0.062 - 0.728

[28] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.63: Range-Based Displacement Mortalities During the Operational Phase for Guillemot at Lambay Island SPA, Where 13,703 Guillemot are Estimated to Occur in the Array Area (+2km Buffer) During the Breeding Bio-Season, Based on a Range of Displacement Impacts and the latest NPWS Colony Count and the 2004 Citation Colony Count[29].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Breeding	8384.8	41.92	25.15 - 293.47	0.881	0.529 - 6.168	1.146	0.687 - 8.021
Non-breeding	1725.6	8.63	5.18 - 60.40	0.181	0.109 - 1.269	0.236	0.141 - 1.651
Annual Total	10110.5	50.55	30.33 - 353.87	1.062	0.637 - 7.437	1.382	0.829 - 9.671
Mean							
Breeding	6240.0	31.20	18.72 - 218.40	0.656	0.393 - 4.590	0.853	0.512 - 5.969
Non-breeding	1339.8	6.70	4.02 - 46.89	0.141	0.084 - 0.986	0.183	0.110 - 1.282
Annual Total	7579.7	37.90	22.74 - 265.29	0.797	0.478 - 5.576	1.036	0.621 - 7.250
LCI							
Breeding	4070.9	20.35	12.21 - 142.48	0.428	0.257 - 2.995	0.556	0.334 - 3.894
Non-breeding	949.4	4.75	2.85 - 33.23	0.100	0.060 - 0.698	0.130	0.078 - 0.908
Annual Total	5020.2	25.10	15.06 - 175.71	0.528	0.317 - 3.693	0.686	0.412 - 4.802

[29] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.64: Mean Annual Abundance of Guillemot Apportioned to Lambay Island SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	11	22	43	65	87	108	130	152	173	195	217
20	4	9	22	43	87	130	173	217	260	303	346	390	433
30	6	13	32	65	130	195	260	325	390	455	520	585	650
40	9	17	43	87	173	260	346	433	520	606	693	779	866
50	11	22	54	108	217	325	433	541	650	758	866	974	1,083
60	13	26	65	130	260	390	520	650	779	909	1,039	1,169	1,299
70	15	30	76	152	303	455	606	758	909	1,061	1,212	1,364	1,516
80	17	35	87	173	346	520	693	866	1,039	1,212	1,386	1,559	1,732
90	19	39	97	195	390	585	779	974	1,169	1,364	1,559	1,754	1,949
100	22	43	108	217	433	650	866	1,083	1,299	1,516	1,732	1,949	2,165

Table 5.65: PVA Outputs for Breeding Adult Lambay Island SPA Guillemot Incorporating Mean Displacement Impacts of the Proposed Development Alone.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
50%, 1% (Site Specific Approach)	10.83	1.000	0.993	0.020%	0.727%
50%, 1% (Generic Approach)	37.90	0.999	0.975	0.070%	2.497%

5.4.13.3 Razorbill

Razorbill has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from displacement from the proposed development alone.

The array area is located 14.4km from Lambay Island SPA which is within MMF+1SD for razorbill (88.7+75.9km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Razorbill disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Lambay Island SPA are likely to be present within array area; therefore, razorbill have been screened in for the non-breeding bio-seasons.

5.4.13.3.1 Mitigation

Razorbill displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. ‘Hotspots’ of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.3.2 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

As determined in Table 7.24 Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from construction and decommissioning activities.

During the breeding bio-season, 168 razorbill are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 50% (Apportioning Appendix 20), the total number of breeding adults in the array at risk of displacement is 84 (84.0) during the full breeding bio-season.

Of these 84 breeding adults, 86.1% are predicted to be breeding birds from Lambay Island SPA (Apportioning Appendix 20). Therefore, 72 (71.7) breeding adults at risk of displacement are attributed to Lambay Island SPA during the breeding bio-season (Table 7.45). The consequent mortality is estimated is less than one (0.18) breeding adult, provided a displacement rate of 25% and a mortality rate of 1% has been applied. Table 7.45 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of razorbill at Lambay Island SPA has not changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 257 individuals fewer (7,353 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count (See Table 7.45).

Based on the 2001 citation population of 7,610 breeding adults and annual background mortality of 799 (799.1) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.022% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 7,353 individuals and an annual background mortality of 772 (772.1) adults, this would represent a 0.023% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

The mean-peak number of razorbills estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration-free winter bio-season.

Assuming that 1.2% of these razorbill are deemed to be breeding adults from Ireland’s Eye SPA during the migration bio-seasons and 2.0% during the migration-free winter bio-season (Table 7.45), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 39 (39.2) during the post- breeding migration bio-season, 6 (5.6) during the return migration and 41 (41.7) during the migration free winter bio-season (Table 7.45).

Provided, 25% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.10; 0.01 and 0.10 individuals, respectively). Table 7.45 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (15% displacement to 35% displacement, 1 to 5% mortality).

This consequent estimated mortality equates to an increase in baseline mortality of 0.012% in the post-breeding migration bio-season, 0.002% in the return migration and 0.013% in the migration-free winter bio-season based on the latest population counts and 0.013%, 0.002% and 0.013%, respectively relative to the 2001 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.22) breeding adult per annum. This represents an increase of 0.027% in baseline mortality based on the 2001 citation colony count and 0.028% increase when considering the latest colony count.

Annual Total

Throughout all bio-seasons, the number of razorbill estimated to occur in the array area plus a 2km buffer is 6,101 individuals, with 158 (158.1) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is less than one (0.40) breeding adult per annum across all bio-seasons. Table 7.45 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The predicted mortality of less than one breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.049% when considering the citation colony count or an increase in baseline mortality of 0.051% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Lambay Island SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.66: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Razorbill at Lambay Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[30].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Breeding	112.3	0.28	0.17 - 1.96	0.035	0.021 - 0.246	0.036	0.022 - 0.254
Post-breeding migration	62.6	0.16	0.09 - 1.10	0.020	0.012 - 0.137	0.020	0.012 - 0.142
Return-breeding migration	9.3	0.02	0.01 - 0.16	0.003	0.002 - 0.020	0.003	0.002 - 0.021
Migration-free winter	58.7	0.15	0.09 - 1.03	0.018	0.011 - 0.129	0.019	0.011 - 0.133
Total non-breeding	130.6	0.33	0.20 - 2.28	0.041	0.025 - 0.286	0.042	0.025 - 0.296
Annual Total	242.8	0.61	0.36 - 4.25	0.076	0.046 - 0.532	0.079	0.047 - 0.550
Mean							
Breeding	71.7	0.18	0.11 - 1.25	0.022	0.013 - 0.157	0.023	0.014 - 0.162
Post-breeding migration	39.2	0.10	0.06 - 0.69	0.012	0.007 - 0.086	0.013	0.008 - 0.089
Return-breeding migration	5.6	0.01	0.01 - 0.10	0.002	0.001 - 0.012	0.002	0.001 - 0.013
Migration-free winter	41.7	0.10	0.06 - 0.73	0.013	0.008 - 0.091	0.013	0.008 - 0.094
Total non-breeding	86.5	0.22	0.13 - 1.51	0.027	0.016 - 0.189	0.028	0.017 - 0.196
Annual Total	158.1	0.40	0.24 - 2.77	0.049	0.030 - 0.346	0.051	0.031 - 0.358
LCI							
Breeding	35.2	0.09	0.05 - 0.62	0.011	0.007 - 0.077	0.011	0.007 - 0.080
Post-breeding migration	17.3	0.04	0.03 - 0.30	0.005	0.003 - 0.038	0.006	0.003 - 0.039
Return-breeding migration	2.7	0.01	0.00 - 0.05	0.001	0.001 - 0.006	0.001	0.001 - 0.006
Migration-free winter	24.6	0.06	0.04 - 0.43	0.008	0.005 - 0.054	0.008	0.005 - 0.056
Total non-breeding	44.6	0.11	0.07 - 0.78	0.014	0.008 - 0.098	0.014	0.009 - 0.101
Annual Total	79.9	0.20	0.12 - 1.4	0.025	0.015 - 0.175	0.026	0.016 - 0.181

[30] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population. There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Lambay Island SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.13.3.3 Disturbance and Displacement (Operation)

Breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from operation and maintenance activities.

During the breeding bio-season, 168 razorbills are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 50% (Apportioning Appendix 20) the total number of breeding adults in the array at risk of displacement is 84 (84.0) during the full breeding bio-season.

Of these 84 breeding adults, 86.1% are predicted to be breeding birds from Ireland's Eye SPA (Apportioning Appendix 20). Therefore, 72 (71.7) breeding adults at risk of displacement are attributed to Ireland's Eye SPA during the breeding bio-season (Table 7.46). The consequent mortality estimated is less than one (0.36) breeding adults, provided a displacement rate of 50% and a mortality rate of 1% has been applied. Table 7.46 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of razorbill at Lambay Island SPA has not changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 257 individuals fewer (7,353 birds). The potential impact on the population has been assessed against both the 2001 citation colony count and the latest colony count undertaken in 2015 (See Table 7.46).

Based on the 2001 citation colony count of 7,610 breeding adults and annual background mortality of 799 (799.1) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.045% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 7,353 individuals and an annual background mortality of 772 (772.1) adults, this would represent a 0.046% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

The mean-peak number of razorbills estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration- free winter bio-season.

Assuming that 1.2% of these razorbill within the array area are deemed to be breeding adults from Ireland's Eye SPA during the migration bio-seasons and 2.0% during the migration-free winter bio-season (Table 7.46), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 39 (39.2) during the post- breeding migration bio-season, six (5.6) during the return migration and 41 (41.7) during the migration free winter bio-season (Table 7.46).

Provided, 50% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.20; 0.03 and 0.21 individuals, respectively). Table 7.46 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

The consequent estimated mortality of less than one individual equates to an increase in baseline mortality of 0.025% in the post-breeding migration bio-season, 0.004% in the return migration and 0.027% in the migration-free winter bio-season based on the latest colony count and 0.025%, 0.004% and 0.026%, respectively relative to the 2001 citation colony count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.43) breeding adult per annum. This represents an increase of 0.054% in baseline mortality based on the 2001 citation colony count and 0.056% increase using the latest colony count.

5.4.13.3.4 Annual Total

Throughout all bio-seasons, the number of razorbill estimated to occur in the array area plus a 2km buffer is 6,101 individuals, with 158 (158.1) of these being breeding adults from the Lambay Island SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is less than one (0.79) breeding adult per annum across all bio-seasons. Table 7.46 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the razorbill QI of Lambay Island SPA is presented within Table 7.47.

The predicted mortality of less than one breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.099% when considering the citation colony count or an increase in baseline mortality of 0.102% when considering the latest colony count.

Table 5.67: Range-Based Displacement Mortalities During the Operational Phase for Razorbill at Lambay Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[31].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Breeding	112.3	0.56	0.34 - 3.93	0.070	0.042 - 0.492	0.073	0.044 - 0.509
Post-breeding migration	62.6	0.31	0.19 - 2.19	0.039	0.024 - 0.274	0.041	0.024 - 0.284
Return-breeding migration	9.3	0.05	0.03 - 0.32	0.006	0.003 - 0.041	0.006	0.004 - 0.042
Migration-free winter	58.7	0.29	0.18 - 2.06	0.037	0.022 - 0.257	0.038	0.023 - 0.266
Total non-breeding	130.6	0.65	0.39 - 4.57	0.082	0.049 - 0.572	0.085	0.051 - 0.592
Annual Total	242.8	1.21	0.73 - 8.50	0.152	0.091 - 1.064	0.157	0.094 - 1.101
Mean							
Breeding	71.7	0.36	0.22 - 2.51	0.045	0.027 - 0.314	0.046	0.028 - 0.325
Post-breeding migration	39.2	0.20	0.12 - 1.37	0.025	0.015 - 0.172	0.025	0.015 - 0.178
Return-breeding migration	5.6	0.03	0.02 - 0.20	0.004	0.002 - 0.025	0.004	0.002 - 0.025
Migration-free winter	41.7	0.21	0.12 - 1.46	0.026	0.016 - 0.182	0.027	0.016 - 0.189
Total non-breeding	86.5	0.43	0.26 - 3.03	0.054	0.032 - 0.379	0.056	0.034 - 0.392
Annual Total	158.1	0.79	0.47 - 5.53	0.099	0.059 - 0.693	0.102	0.061 - 0.717
LCI							
Breeding	35.2	0.18	0.11 - 1.23	0.022	0.013 - 0.154	0.023	0.014 - 0.160
Post-breeding migration	17.3	0.09	0.05 - 0.60	0.011	0.006 - 0.076	0.011	0.007 - 0.078
Return-breeding migration	2.7	0.01	0.01 - 0.10	0.002	0.001 - 0.012	0.002	0.001 - 0.012
Migration-free winter	24.6	0.12	0.07 - 0.86	0.015	0.009 - 0.108	0.016	0.010 - 0.112
Total non-breeding	44.6	0.22	0.13 - 1.56	0.028	0.017 - 0.196	0.029	0.017 - 0.202
Annual Total	79.9	0.40	0.24 - 2.80	0.050	0.030 - 0.350	0.052	0.031 - 0.362

[31] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.68: Mean Annual Abundance of Razorbill Apportioned to Lambay Island SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	0	1	2	3	5	6	8	9	11	13	14	16
20	0	1	2	3	6	9	13	16	19	22	25	28	32
30	0	1	2	5	9	14	19	24	28	33	38	43	47
40	1	1	3	6	13	19	25	32	38	44	51	57	63
50	1	2	4	8	16	24	32	40	47	55	63	71	79
60	1	2	5	9	19	28	38	47	57	66	76	85	95
70	1	2	6	11	22	33	44	55	66	77	88	100	111
80	1	3	6	13	25	38	51	63	76	88	101	114	126
90	1	3	7	14	28	43	57	71	85	100	114	128	142
100	2	3	8	16	32	47	63	79	95	111	126	142	158

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population. There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.13.4 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 14.4km from Lambay Island SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Lambay Island SPA has been assessed for the full breeding bio-season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January – February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.13.4.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, compared to a 22m air draft, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.4.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals (CRM Appendix 18 and 19). Assuming 47% of these five individuals, are breeding adults (Apportioning Appendix 20) the total number of breeding adults in the array impacted by collision is less than three (2.52) per annum during the migration-free breeding bio-season.

Provided 61.6% of these collisions are breeding birds from Lambay Island SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than two (1.57) breeding adults (Table 7.48).

The population of kittiwake at Lambay Island SPA has declined since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 1,254 individuals fewer (6,640 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count.

Based on a citation colony count of 7,294 breeding adults and annual adult background mortality of 1,153 (1,152.5) individuals, the addition of less than two breeding adult mortality would represent a 0.136% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 6,640 individuals and an annual background mortality of 969 (969.4) adults, this would represent a 0.161% increase in baseline mortality during the breeding bio-season (Table 7.48).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase are 6 (6.4) and 7 (7.4) individuals during the post-breeding migration bio-season and the return migration, respectively. Provided 0.7% and 0.9% of the kittiwake within the array area are deemed to be breeding adults from Lambay Island SPA during the post-breeding migration bio- season and the return migration, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.05) during the post-breeding migration bio- season and less than one (0.09) during the return migration.

Based on the 2004 citation colony count of breeding adults the addition of less than one predicted breeding adult mortality during the migration bio-seasons, would indicate an increase in baseline mortality of 0.004% during the post-breeding bio-season and 0.008% during the return migration. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 7.48).

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 0.012% in baseline mortality of the 2004 citation population and 0.014% increase using the latest colony count (Table 7.48).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Lambay Island SPA is less than two (1.71) breeding adults per annum (Table 7.48).

The annual predicted mortality of less than two breeding adults from Lambay Island SPA across all bio-seasons indicates an increase in baseline mortality of 0.148% and 0.176% when considering the 2004 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 7.48). There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.69: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Lambay Island SPA[32].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	1.57	0.14 – 3.92	0.136	0.013 – 0.340	0.161	0.015 – 0.404
Post-breeding migration	0.05	0.07 – 0.11	0.004	0.000 – 0.010	0.005	0.001 – 0.012
Return migration	0.09	0.09 – 0.26	0.008	0.000 – 0.022	0.010	0.000 – 0.027
Non-breeding Total	0.14	0.01 – 0.37	0.012	0.001 – 0.032	0.014	0.001 – 0.038
Annual Total	1.71	0.15 – 4.29	0.148	0.013 – 0.372	0.176	0.016 – 0.443

[32] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.13.5 Herring gull

Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 14.4km from Lambay Island SPA, which is within the MMF+1SD for herring gull (58.8+26.8km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Herring gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of herring gull from Lambay Island SPA has been assessed for the full breeding bio-season (March – August), the non-breeding bio-season (September – February), as defined by Furness (2015).

5.4.13.5.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 65% for gulls from the proposed development, compared to a 22m air draft. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.5.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 17 (17.45) individuals (CRM Appendix 18 and 19). Assuming 48% of these 20 individuals, are breeding adults and adult herring gull exhibit a sabbatical rate of 35% (Apportioning Appendix 17), the total number of breeding adults in the array impacted by collision is seven (6.98) per annum during the breeding bio-season.

Provided 17.8% of these collisions are breeding birds from Lambay Island SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than two (1.25) breeding adults (Table 7.49).

The population of herring gull at Lambay Island SPA has changed considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 – 2019 being 1,190 individuals greater (1,812 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2015 – 2019.

Based on a citation population of 622 breeding adults and annual adult background mortality of 103 (103.3) individuals, the addition of less than two breeding adult mortalities would represent a 1.211% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 1,812 individuals and an annual background mortality of 301 (300.8) adults, this would represent a 0.416% increase in baseline mortality during the breeding bio-season (Table 7.49).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 39 (39.71) individuals. Provided 1.0% of the herring gulls within the array area are deemed to be breeding adults from Lambay Island SPA during non-breeding bio-season (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.38) during the non-breeding bio- season (Table 7.49).

Based on the 2004 citation colony count of breeding adults the addition of less than one (0.37) predicted breeding adult mortality would indicate an increase in baseline mortality of 0.372% during the non-breeding season. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.128% increase in baseline mortality in the non-breeding bio-season (Table 7.49).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Lambay Island SPA is less than two (1.63) breeding adults per annum (Table 7.49).

The annual predicted mortality of less than two breeding adults from Lambay Island SPA across all bio-seasons indicates an increase in baseline mortality of 1.584% and 0.544% when considering the 2004 citation colony count and the latest colony count, respectively.

This level of impact would be indistinguishable from natural fluctuations in the population, when considering the latest colony count. However, when considering the 2004 citation colony count, the impacts do exceed the 1% increase in baseline mortality threshold. Given the growth in population size since the citation count and the low level of impact, it can be concluded that there is no potential for an AEoI to the COs of the herring gull QI of Lambay Island SPA. However, for completeness, further consideration is given to these impacts below through a PVA.

Assuming an annual mortality of less than two (1.63) breeding adults from Lambay Island SPA the CPR and CPS are 0.999 and 0.965, respectively. This represents a 0.099% reduction in growth rate and a reduction in final population size of 3.502%, compared to the baseline scenario, over the 35-year period. Irrespective of current population trends, these impacts are considered indistinguishable from natural population fluctuations.

As such, irrespective of current population trends, these impacts considered to have less than 0.5% reduction in population growth rate are considered non-material. For further details justifying the PVA threshold see Appendix 13, and for further details regarding the current herring gull population trends at Lambay Island SPA see Section 7.5.2.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collision. Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.70: Seasonal Collision Mortalities During the Operational Phase for Herring gull at Lambay Island SPA.

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	1.25	0.07 – 3.43	1.211	0.069 – 3.322	0.416	0.024 – 1.140
Non-breeding	0.38	0.08 – 0.89	0.372	0.082 – 0.865	0.128	0.028 – 0.297
Annual Total	1.64	0.16 – 4.32	1.584	0.151 – 4.187	0.544	0.052 – 1.437

Table 5.71: PVA Outputs for Breeding Adult Lambay Island SPA Herring gull Incorporating Mean Collision Impacts of the Proposed Development Alone.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
Project alone	1.64	0.999	0.965	0.099%	3.502%

5.4.13.6 Lesser black-backed gull

Lesser black-backed gull has been screened in for the operation phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 14.4km from Lambay Island SPA, which is within the MMF+1SD for lesser black-backed gull (127+109km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Lesser black-backed gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – March) as per Furness (2015).

Collision risk of lesser black-backed gull from Lambay Island SPA has been assessed for the migration-free breeding bio-season (May–July), the post-breeding migration bio-season (August–October), the return migration bio-season (March–April), and the migration- free winter season (November – February) as defined by Furness (2015).

5.4.13.6.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 65% for gulls from the proposed development, compared to a 22m air draft. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.6.2 Collision Risk (Operation)

Migration- free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is one (1.29) individual (CRM Appendix 18 and 19). Assuming 35% of the lesser black-backed gulls are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.45) per annum during the migration-free breeding bio-season. Provided 50% of these collisions are breeding birds from Lambay Island SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.22) breeding adults (Table 7.51).

The population of lesser black-backed gull at Lambay Island SPA has changed considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 – 2018 being 424 individuals greater (690 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2015 – 2018.

Based on a citation colony count of 266 breeding adults and annual adult background mortality of 31 (30.6) individuals, the addition of less than one breeding adult mortality would represent a 0.731% increase in baseline mortality during the migration-free breeding bio-season. Whereas, when considering the latest colony count of 690 individuals and an annual background mortality of 79 (79.4) adults, this would represent a 0.282% increase in baseline mortality during the migration-free breeding bio-season (Table 7.51).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase during the post-breeding migration bio-season, the return migration and the migration-free winter bio-season is less than one individual (0.0).

Provided 0.4% of the lesser black-backed gulls within the array area are deemed to be breeding adults from Lambay Island SPA during the migration bio-seasons and 1.3% during the migration-free winter (Apportioning Appendix 20), the consequent mortality of adult birds is almost zero (0.00) during the migration bio-seasons and the migration-free winter bio-season (Table 7.51).

When considering the non-breeding bio-season as a whole, the addition of almost zero (0.00) consequent mortalities of adult lesser black-backed gulls would indicate and increase in baseline mortality of 0.007% when assessed against the 2004 citation colony count. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.003% increase in baseline mortality during the entire non-breeding bio-season (Table 7.51).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Lambay Island SPA is less than one (0.23) breeding adult per annum (Table 7.51).

The annual predicted mortality of less than one breeding adult from Lambay Island SPA across all bio-seasons indicates an increase in baseline mortality of 0.737% and 0.284% when considering the 2004 citation colony count and the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population, when assessed against the latest colony count (Table 7.51).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population, when assessed against the latest colony count (Table 7.51). There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision. Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.72: Seasonal Collision Mortalities during the Operational Phase for Lesser black-backed gull at Lambay Island SPA[33].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.22	0.01 – 0.71	0.731	0.027 – 2.352	0.282	0.010 – 0.866
Non-breeding	0.00	0.00 – 0.00	0.007	0.000 – 0.023	0.003	0.000 – 0.009
Annual Total	0.23	0.01 – 0.72	0.737	0.027 – 2.348	0.284	0.010 – 0.905

5.4.13.7 Fulmar

Fulmar has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 14.4km from Lambay Island SPA, which is within the MMF+1SD for fulmar (542.3+657.9km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Fulmar will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – December) as per Furness (2015).

Collision risk of fulmar from Lambay Island SPA has been assessed for the full breeding bio-season (January – August), the post-breeding migration bio-season (September–October), the return migration bio-season (December–March), and the migration- free winter season (November) as defined by Furness (2015).

5.4.13.7.1 Mitigation

Fulmar are not considered sensitive to collision impacts from windfarms. However, by increasing the air draft to 40m LAT predicted impacts on this species are reduced to almost zero. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.13.7.2 Collision Risk (Operation)

Breeding bio-season

The predicted collision mortality during the breeding bio-season is less than one (0.01) individual. Provided 48% of these collisions are breeding birds from Lambay Island SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adult (Table 7.52).

The population of fulmar at Lambay Island SPA has changed considerably since the citation colony count in 2004 with the latest colony count undertaken in 2015 being 704 individuals fewer (750 birds). The potential impact on the population has been assessed against both the 2004 citation count and the latest colony count undertaken in 2015.

Based on a citation population of 1,454 breeding adults and annual adult background mortality of 93 (93.1) individuals, the addition of less than one breeding adult mortality would represent a 0.005% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest count of 750 individuals and an annual background mortality of 48 (48.0) adults, this would represent a 0.006% increase in baseline mortality during the breeding bio-season (Table 7.52).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is less than one (0.01) individual.

[33] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Provided less than 1% (0.18%) of the fulmar within the array area are deemed to be breeding adults from Lambay Island SPA during non-breeding bio-season (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.00) during the non-breeding bio- season (Table 7.52).

Based on the 2004 citation colony count of breeding adults the addition of less than one (0.00) predicted breeding adult mortality would indicate an increase in baseline mortality of 0.000% during the non-breeding season. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.000% increase in baseline mortality in the non-breeding bio-season (Table 7.52).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Lambay Island SPA is less than one (0.00) breeding adult per annum (Table 7.52).

The annual predicted mortality of less than one breeding adult from Lambay Island SPA across all bio-seasons indicates an increase in baseline mortality of 0.005% and 0.006% when considering the 2004 citation colony count and the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population (Table 7.52).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 7.52). There is, therefore, no potential for an AEoI to the COs of the fulmar QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the fulmar QI will be maintained in the long term with respect to potential for adverse effects from collision. Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.73: Seasonal Collision Mortalities during the Operational phase for fulmar at Lambay Island SPA[34].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.00	0.00 – 0.04	0.005	0.000 – 0.041	0.006	0.000 – 0.079
Non-breeding	0.00	0.00 – 0.00	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Annual Total	0.00	0.00 – 0.04	0.005	0.000 – 0.041	0.006	0.000 – 0.079

5.4.13.8 Impacts Arising from the Onshore Elements of the Proposed Development

5.4.13.8.1 Mitigation

The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

5.4.13.8.2 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the Lambay Island SPA to the onshore elements of the proposed development is 10.2km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009).

[34] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

It is possible, however, that QIs associated with the Lambay Island SPA utilise inland and intertidal habitats at the landfall site and are exposed to disturbance and displacement effects at this location outside of the SPA boundary.

Of the wintering QIs occurring at the landfall site, as set out in the assessment of North-west Irish Sea cSPA, for birds located on the shoreline, that is, locations where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts would occur at the shoreline. Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will be implemented along this coastal stretch which will further minimise the disturbance and displacement effect, however given the volume of works at the landfall QIs occurring along the shoreline are likely to be localised disturbed and displaced temporarily during onshore works. QIs recorded in the arable fields at the landfall site include herring gull and would be exposed to localised construction noise levels and visual disturbance and displacement from the onshore works. During the wintering period, a peak count of herring gull recorded in agricultural fields at the landfall site was 80 individuals, a number significantly lower than 1% of the national population.

Conclusion of AEoI

It is expected that with mitigation in place, local and temporary disturbance and displacement of QIs utilising the arable fields at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QIs located at the landfall c. 10.2km from the Lambay Island SPA. The coastline stretching south and north from the landfall site is used by QIs and will remain available to displaced QIs that occur outside the SPA boundary. It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the Lambay Island SPA.

5.4.13.9 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Lambay Island SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.14 Boyne Estuary SPA

Boyne Estuary SPA lies 10.8km northwest of the onshore cable route and onshore infrastructure, with nearest onshore works occurring at the landfall site. The SPA comprises most of the estuary of the Boyne River, a substantial river which drains a large catchment. The river channel is defined by training walls, these being breached in places. Intertidal flats occur along the sides of the channelled river and parts of the intertidal areas are fringed by salt marsh.

The onshore elements of the proposed development are not hydrologically connected to Boyne Estuary SPA, however considering their proximity there is potential for mobile QIs to occur outside of the SPA boundary and within the disturbance and displacement ZoI of the proposed onshore works.

All QIs, with the exception of little tern, have been screened in for the assessment of Boyne Estuary SPA due to their presence within the ZoI during baseline surveys at the landfall site.

5.4.14.1 Qualifying Interests and Conservation Objectives

All of the following QIs have been screened in and are listed as the qualifying interests of the SPA. The below sets out the Qualifying Feature and the COs for each.

Table 5.74: qualifying interests and Conservation Objectives of Boyne Estuary SPA

Qualifying Interests Screened In	Conservation Objectives
Shelduck [A048] Oystercatcher [A130] Golden Plover [A140]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests (QIs) for this SPA, which is defined by the following attributes and targets:

Qualifying Interests Screened In	Conservation Objectives
Grey Plover [A141] Lapwing (Vanellus vanellus) [A142] Knot [A143] Sanderling [A144] Black-tailed Godwit [A156] Redshank [A162] Turnstone (Arenaria interpres) [A169]	Population trend (% change): The long-term population trend is stable or increasing, and, Distribution (range, timing and intensity of use of areas): No significant decrease in the range, timing or intensity of use of areas by the SCI, other than occurring from natural patterns of variation

5.4.14.2 Impacts Arising from the Onshore Elements of the Proposed Development

5.4.14.2.1 Mitigation

The HDD compounds at the landfall site near the shoreline will have noise barriers on the northerly, easterly and southerly perimeters, to reduce noise levels in these directions. Noise barriers will be implemented, which also act as visual screens and mitigation, as detailed in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning. In addition, due to the protection of sea cliff habitats, a 50m exclusion works zone will be implemented at the coast which will further minimise the disturbance and displacement effect at the shoreline and further offshore. Toolbox talks will be delivered by the appointed ECoW to all construction staff on the sensitivity of waterbirds at the landfall site.

5.4.14.2.2 Disturbance and Displacement (Construction and Decommissioning)

The nearest point of the Boyne Estuary SPA to the onshore elements of the proposed development is 10.8km. It is not expected that disturbance and displacement effects will extend beyond a distance of c. 300m, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts et al., 2009). It is possible, however, that QIs associated with the SPA utilise inland and intertidal habitats at the landfall site and are exposed to disturbance and displacement effects at this location outside of the SPA boundary.

Of the wintering QIs occurring at the landfall site, as set out in the assessment of North-west Irish Sea cSPA, for birds located on the shoreline, that is, locations where the sea cliffs along the shoreline block line of sight to the HDD compounds, the cliff would act as a further noise barrier to noise emitted from the HDD compounds and mitigated noise levels would be a further 10dB lower, meaning that no instances of noise levels exceeding the criteria for moderate or low impacts would occur at the shoreline. Due to the protection of Annex I habitats along the sea cliffs a 50m exclusion works zone will be implemented along this coastal stretch which will further minimise the disturbance and displacement effect, on QIs occurring along the shoreline. QIs of the Boyne Estuary SPA recorded in the arable fields at the landfall site include golden plover, lapwing and redshank and would be exposed to localised construction noise levels and visual disturbance and displacement from the onshore works. All three QI occurred in low numbers and significantly lower than 1% of the national population.

It is expected that with mitigation in place, local and temporary disturbance and displacement of QIs utilising the arable fields at the landfall site will occur for the period of works, however this effect is not expected to have AEoI of the site due to the small numbers of QIs located at the landfall c. 10.8km from the Boyne Estuary SPA. The coastline stretching south and north from the landfall site is used by QIs and will remain available to displaced QIs that occur outside the SPA boundary. It can be concluded that the implementation of the noise barriers, that also act as visual screens, as outlined in the CEMP (Appendix 8) to mitigate against disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the Boyne Estuary SPA.

Conclusion of AEoI

It can be concluded that the implementation of the noise barriers, which also act as visual mitigation, in the CEMP (Appendix 8) for disturbance and displacement at the site during construction and decommissioning, and the available coastline and area of arable fields, enables the conclusion that the construction and decommissioning of the onshore elements of the proposed development (alone) will not have AEoI on the Boyne Estuary SPA.

5.4.14.3 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Boyne Estuary SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.15 Poulaphouca Reservoir SPA

5.4.15.1 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Poulaphouca Reservoir SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.16 Wicklow Head SPA

Wicklow Head SPA is a rocky headland situated 70.4km from the proposed development. The SPA is comprised of 60m high cliffs and includes a marine component up to 500m seaward from the base of the cliffs. This SPA supports a nationally important population of kittiwake, which have been considered in the ornithology assessment presented here for impacts arising from the offshore elements of the proposed development.

5.4.16.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Wicklow Head SPA are considered within this section:

Table 5.75: qualifying interests and Conservation Objectives of Wicklow Head SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.16.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The offshore development area is situated 70.4km from the Wicklow Head SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Wicklow Head SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.16.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.16.2.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals (CRM Appendix 18 and 19). Assuming 47% of these five individuals are breeding adults (Apportioning Appendix 20) the total number of breeding adults in the array impacted by collision is less than three (2.52) individuals per annum during the breeding bio-season.

Provided 0.8% of these collisions are breeding birds from Wicklow Head SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.02) breeding adults (Table 5.76).

The population of kittiwake at Wicklow Head SPA has declined since the citation colony count in 2002 with the latest colony undertaken in 2021 being 454 individuals fewer (1,458 birds). The potential impact on the population has been assessed against both the 2002 citation colony count and the latest colony count undertaken in 2021.

Based on a citation population of 1,912 breeding adults and annual adult background mortality of 279 (279.2) individuals, the addition of less than one breeding adult mortality would represent a 0.007% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 1,458 individuals and an annual background mortality of 213 (212.9) adults, this would represent a 0.010% increase in baseline mortality during the breeding bio-season (Table 5.76).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is seven (6.54) individuals, and 7 (7.42) individuals during the return migration, provided 0.2% of the kittiwake within the array area are deemed to be breeding adults from the Wicklow Head SPA during the post-breeding migration bio-season and the return migration (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.01) individual during the post-breeding migration bio-season and less than one (0.02) individual during the return migration bio-season.

Based on the 2002 citation colony count the addition of less than one (0.01) predicted breeding adult mortality during the post-migration breeding season and less than one (0.02) individual the return migration would indicate an increase in baseline mortality of 0.004% and 0.007%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality in the post-breeding migration bio-season and return migration, respectively (Table 5.76).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.03) breeding adult per annum. This represents an increase of 0.011% in baseline mortality of the 2002 citation colony count and 0.015% increase using the latest colony count (Table 5.76).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Wicklow Head SPA is less than one (0.05) breeding adult per annum.

The annual predicted mortality of less than one breeding adult from the Wicklow Head SPA across all bio-seasons indicates an increase in baseline mortality of 0.019% and 0.024% when considering the 2002 citation colony count and the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.76).

With a potential predicted mortality of well under a single breeding adult (0.05) per annum attributable to the Wicklow Head SPA annually, this level of impact can be considered non-material and therefore, will not affect the achievement of the COs for the SPA and as a result will not have an adverse effect on the integrity of the SPA.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 5.76). There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Wicklow Head SPA in relation to collision risk effects during the operational phase from the proposed development.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.76: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Wicklow Head SPA[35].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.02	0.00 – 0.05	0.007	0.001 – 0.019	0.010	0.001 – 0.024
Post-breeding migration	0.01	0.00 – 0.02	0.004	0.000 – 0.009	0.005	0.001 – 0.012
Return migration	0.02	0.00 – 0.06	0.007	0.000 – 0.020	0.010	0.000 – 0.027
Non-breeding Total	0.03	0.00 – 0.08	0.011	0.001 – 0.029	0.015	0.001 – 0.038
Annual Total	0.05	0.00 – 0.13	0.019	0.001 – 0.048	0.024	0.002 – 0.063

5.4.17 Saltee Islands SPA

The Saltee Islands SPA encompasses two islands, Great Saltee and Little Saltee as well as 500m seaward around each island. This SPA is located 169.3km from the array area. Exposed rocky cliffs of 30m and 15m can be found on Great Saltee and Little Saltee, respectively, along the south and east coasts of the islands. Shingle and boulder shores, backed with clay cliffs, line the norther and western sides of both islands. This SPA supports an internationally important assemblage of over 20,000 breeding seabirds, with ten designated species (gannet, cormorant, shag, lesser-black backed gull, herring gull, kittiwake, guillemot, razorbill and puffin). With the exception of fulmar, cormorant and shag which are not considered vulnerable to OWF impacts, and puffin, which was reorded in negligible numbers in the array area plus relevant buffer, all designated species have been considered for the offshore elements of the proposed development in the ornithology assessment presented here.

5.4.17.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Saltee Islands SPA are considered within this section:

Table 5.77: qualifying interests and Conservation Objectives of Saltee Island SPA

Qualifying Interests Screened In	Conservation Objectives
Guillemot [A199]; Razorbill [A200]; Kittiwake [A188]; Gannet [A016]; and Lesser black-backed gull [A183].	To maintain the favourable conservation condition of Guillemot in the Saltee Islands SPA, which is defined by the following list of attributes and targets: • Breeding population abundance: individual adult- No significant decline. • Productivity rate- No significant decline • Distribution: breeding colonies- No significant decline • Prey biomass available- No significant decline • Barriers to connectivity- No significant increase • Disturbance at the breeding site- No significant increase; and • Disturbance at marine areas immediately adjacent to the colony- No significant increase.

[35] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.17.2 Guillemot

Guillemot has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from displacement from the proposed development alone.

The array area is located 169.3km from the Saltee Island SPA which is outside MMF+1SD for guillemot (73.2+80.5km) (Woodward et al., 2019) and therefore has been screened out for the breeding bio-season. However, guillemot will disperse throughout the bio-geographical region outside of the breeding season and a proportion of individuals from Saltee Islands SPA are likely to be present within the array area; therefore, guillemot have been screened in for the non-breeding bio-seasons.

5.4.17.2.1 Mitigation

Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.17.2.2 Disturbance and Displacement (Construction and Decommissioning)

Non-breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from construction and decommissioning activities.

The mean-peak number of guillemot estimated to occur in the array area plus the 2km buffer during the non-breeding bio-season is 29,765 individuals.

Assuming that 1.3% of these guillemot within the array area are deemed to be breeding adults from Saltee Islands SPA during the non-breeding bio-seasons (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 391 (390.9) during the non-breeding bio-season.

Provided, 25% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at two (0.98) individuals during the non-breeding bio-season. Table 7.53 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

The population of guillemot at Saltee Islands SPA has declined since the citation colony count in 1998-2000 with the latest colony count undertaken in 2013 being 11,223 individuals fewer (17,501 birds). The potential impact on the population has been assessed against both the 1998-2000 citation colony count and the latest colony count.

Based on the 1998-2000 citation colony count of 28,724 breeding adults and annual background mortality of 1,752 (1,752.2) individuals, the addition of less than one predicted breeding adult mortalities would represent a 0.056% increase in baseline mortality during the non-breeding bio-season. Whereas, considering the latest colony count of 17,501 individuals and an annual background mortality of 1,068 (1,067.6) adults, this would represent a 0.092% increase in baseline mortality during the non-breeding bio-season.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Saltee Islands SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.78: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Guillemot at Saltee Islands SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 1998-2000 Citation Colony Count[36].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Non-breeding	503.5	1.26	0.76 - 8.81	0.072	0.043 - 0.503	0.118	0.071 - 0.825
Mean							
Non-breeding	390.9	0.98	0.59 - 6.84	0.056	0.033 - 0.39	0.092	0.055 - 0.641
LCI							
Non-breeding	277.0	0.69	0.42 - 4.85	0.040	0.024 - 0.277	0.065	0.039 - 0.454

[36] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.17.2.3 Disturbance and Displacement (Operation)

Non-breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for guillemot from operation and maintenance activities.

The mean-peak number of guillemot estimated to occur in the array area plus the 2km buffer during the non-breeding bio-season is 29,765 individuals.

Assuming that 1.3% of these are deemed to be breeding adults from Saltee Islands SPA during the non-breeding bio-seasons (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 391 (390.9) during the non-breeding bio-season (Table 7.54).

Provided, 50% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at two (1.95) individuals during the non-breeding bio-season. Table 7.54 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the guillemot QI of Saltee Islands SPA is presented within Table 7.54.

Based on the 1998-2000 citation colony count of 28,724 breeding adults and annual background mortality of 1,752 (1,752.2) individuals, the addition of less than two predicted breeding adult mortalities would represent a 0.112% increase in baseline mortality during the non-breeding bio-season. Whereas, considering the latest colony count of 17,501 individuals and an annual background mortality of 1,068 (1,067.6) adults, this would represent a 0.183% increase in baseline mortality during the non-breeding bio-season.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Saltee Islands SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.79: Range-Based Displacement Mortalities Buring the Operational Phase for Guillemot at Saltee Islands SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 1998-2000 Citation Colony Count[37].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Non-breeding	503.5	2.52	1.51 - 17.62	0.144	0.043 - 0.503	0.236	0.071 - 0.825
Mean							
Non-breeding	390.9	1.95	1.17 - 13.68	0.112	0.033 - 0.39	0.183	0.055 - 0.641
LCI							
Non-breeding	277.0	1.38	0.83 - 9.69	0.079	0.024 - 0.277	0.130	0.039 - 0.454

Table 5.80: Mean Annual Abundance of Guillemot Apportioned to Saltee Islands SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	1	2	4	8	12	16	20	23	27	31	35	39
20	1	2	4	8	16	23	31	39	47	55	63	70	78
30	1	2	6	12	23	35	47	59	70	82	94	106	117
40	2	3	8	16	31	47	63	78	94	109	125	141	156
50	2	4	10	20	39	59	78	98	117	137	156	176	196
60	2	5	12	23	47	70	94	117	141	164	188	211	235
70	3	5	14	27	55	82	109	137	164	192	219	246	274
80	3	6	16	31	63	94	125	156	188	219	250	282	313

[37] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
90	4	7	18	35	70	106	141	176	211	246	282	317	352
100	4	8	20	39	78	117	156	196	235	274	313	352	391

5.4.17.3 Razorbill

Razorbill has been screened in for the construction, operation and decommissioning phases to assess the potential for an AEoI from displacement from the proposed development alone.

The array area is located 169.3km from the Saltee Island SPA which is outside MMF+1SD for razorbill (88.7+75.9km) (Woodward et al., 2019) and therefore has been screened out for the breeding bio-season. However, razorbill will disperse throughout the bio-geographical region outside of the breeding season and a proportion of individuals from Saltee Islands SPA are likely to be present within array area; therefore, razorbill have been screened in for the non-breeding bio-seasons.

5.4.17.3.1 Mitigation

Auk displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on auk species. While undertaking array refinements, a key consideration was guillemot, for which high abundances of birds were consistently located in the south-east of the original project boundary during the breeding season, neighbouring the large guillemot colony of Lambay Island. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.17.3.2 Disturbance and Displacement (Construction and Decommissioning)

Non-breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from construction and decommissioning activities.

The mean-peak number of razorbill estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration- free winter bio-season.

Assuming that 0.5% of these razorbill within the array area are deemed to be breeding adults from Saltee Islands SPA during the migration bio-seasons and 0.8% during the migration-free winter bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 15 (15.6) during the post- breeding migration bio-season, two (2.2) during the return migration and 16 (16.6) during the migration free winter bio-season (Table 7.56).

Provided, 25% displacement and 1% mortality has been applied, the total predicted consequent mortality from displacement is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.04; 0.01 and 0.04 individuals, respectively). Table 7.56 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1 to 5% mortality).

This consequent estimated mortality equates to an increase in baseline mortality of 0.007% in the post-breeding migration bio-season, 0.001% in the return migration and 0.008% in the migration-free winter bio-season based on the latest population counts and 0.013%, 0.002% and 0.013% respectively relative to the 2019 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.09) breeding adult per annum. This represents an increase of 0.016% in baseline mortality of the 2019 citation population and 0.028% increase using the latest colony count.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Saltee Islands SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.81: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Razorbill at Saltee Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2019 Citation Colony Count38.

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality	25% displacement, 1% mortality	15-35% displacement, 1 - 5% mortality
UCI							
Post-breeding migration	25.0	0.06	0.04 - 0.44	0.012	0.007 - 0.083	0.020	0.012 - 0.142
Return-breeding migration	3.7	0.01	0.01 - 0.06	0.002	0.001 - 0.012	0.003	0.002 - 0.021
Migration-free winter	23.4	0.06	0.04 - 0.41	0.011	0.007 - 0.078	0.019	0.011 - 0.133
Total non-breeding	52.0	0.13	0.08 - 0.91	0.025	0.015 - 0.173	0.042	0.025 - 0.296
Mean							
Post-breeding migration	15.6	0.04	0.02 - 0.27	0.007	0.004 - 0.052	0.013	0.008 - 0.089
Return-breeding migration	2.2	0.01	0.00 - 0.04	0.001	0.001 - 0.007	0.002	0.001 - 0.013
Migration-free winter	16.6	0.04	0.02 - 0.29	0.008	0.005 - 0.055	0.013	0.008 - 0.094
Total non-breeding	34.5	0.09	0.05 - 0.6	0.016	0.010 - 0.115	0.028	0.017 - 0.196
LCI							
Post-breeding migration	6.9	0.02	0.01 - 0.12	0.003	0.002 - 0.023	0.006	0.003 - 0.039
Return-breeding migration	1.1	0.00	0.00 - 0.02	0.001	0.000 - 0.004	0.001	0.001 - 0.006
Migration-free winter	9.8	0.02	0.01 - 0.17	0.005	0.003 - 0.033	0.008	0.005 - 0.056
Total non-breeding	17.8	0.04	0.03 - 0.31	0.008	0.005 - 0.059	0.014	0.009 - 0.101

[38] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.17.3.3 Disturbance and Displacement (Operation)

Non-breeding Bio-season

As determined in Table 5.11 Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for razorbill from operation and maintenance activities.

The mean-peak number of razorbills estimated to occur in the array area plus the 2km buffer during the post-breeding migration bio-season is 3,371 individuals, 483 individuals during the return migration and 2,079 individuals in the migration- free winter bio-season.

Assuming that 0.5% of these razorbill within the array area are deemed to be breeding adults from Saltee Islands SPA during the migration bio-seasons and 0.8% during the migration-free winter bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 15 (15.6) during the post- breeding migration bio-season, two (2.2) during the return migration and 16 (16.6) during the migration free winter bio-season (Table 7.57).

Provided, 50% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during the post-breeding migration bio-season, the return migration, and the migration-free winter bio-season (0.08; 0.01 and 0.08 individuals, respectively). Table 7.57 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the razorbill QI of Saltee Islands SPA Table 7.58.

This consequent estimated mortality equates to an increase in baseline mortality of 0.015% in the post-breeding migration bio-season, 0.002% in the return migration and 0.016% in the migration-free winter bio-season based on the latest population counts and 0.025%, 0.004% and 0.027% respectively relative to the 2019 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.17) breeding adult per annum. This represents an increase of 0.033% in baseline mortality of the 2019 citation population and 0.056% increase using the latest colony count.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Saltee Islands SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.82: Range-Based Displacement Mortalities During the Operational Phase for Razorbill at Saltee Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2019 Citation Colony Count[39].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
UCI							
Post-breeding migration	25.0	0.12	0.07 - 0.87	0.024	0.014 - 0.166	0.041	0.024 - 0.284
Return-breeding migration	3.7	0.02	0.01 - 0.13	0.004	0.002 - 0.025	0.006	0.004 - 0.042
Migration-free winter	23.4	0.12	0.07 - 0.82	0.022	0.013 - 0.156	0.038	0.023 - 0.266
Total non-breeding	52.0	0.26	0.16 - 1.82	0.049	0.030 - 0.346	0.085	0.051 - 0.592
Mean							
Post-breeding migration	15.6	0.08	0.05 - 0.55	0.015	0.009 - 0.104	0.025	0.015 - 0.178
Return-breeding migration	2.2	0.01	0.01 - 0.08	0.002	0.001 - 0.015	0.004	0.002 - 0.025
Migration-free winter	16.6	0.08	0.05 - 0.58	0.016	0.009 - 0.110	0.027	0.016 - 0.189
Total non-breeding	34.5	0.17	0.10 - 1.21	0.033	0.020 - 0.229	0.056	0.034 - 0.392
LCI							
Post-breeding migration	6.9	0.03	0.02 - 0.24	0.007	0.004 - 0.046	0.011	0.007 - 0.078
Return-breeding migration	1.1	0.01	0.00 - 0.04	0.001	0.001 - 0.007	0.002	0.001 - 0.012
Migration-free winter	9.8	0.05	0.03 - 0.34	0.009	0.006 - 0.065	0.016	0.010 - 0.112
Total non-breeding	17.8	0.09	0.05 - 0.62	0.017	0.010 - 0.118	0.029	0.017 - 0.202

[39] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Table 5.83: Mean Annual Abundance of Razorbill Apportioned to Saltee Islands SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	1	1	1	2	2	2	3	3	4
20	0	0	0	1	1	2	3	4	4	5	6	6	7
30	0	0	1	1	2	3	4	5	6	7	8	9	11
40	0	0	1	1	3	4	6	7	8	10	11	13	14
50	0	0	1	2	4	5	7	9	11	12	14	16	18
60	0	0	1	2	4	6	8	11	13	15	17	19	21
70	0	0	1	2	5	7	10	12	15	17	20	22	25
80	0	1	1	3	6	8	11	14	17	20	22	25	28
90	0	1	2	3	6	9	13	16	19	22	25	28	32
100	0	1	2	4	7	11	14	18	21	25	28	32	35

5.4.17.4 Gannet

Gannet has been screened in to assess for the potential for an AEoI from displacement from the proposed development alone during the construction, operation and decommissioning phases in addition to the potential for an AEoI from collision during the operational phase.

The array area is located 169.3km from Saltee Islands SPA which is within MMF+1SD for gannet (315.2+194.2km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Gannet disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Saltee Islands SPA are likely to be present within array area; therefore, gannet have been screened in for the non-breeding bio-season.

Collision risk of gannet from Saltee Islands has been assessed for the full breeding bio-season (March – September), the post-breeding migration bio-season (October – November) and the return migration bio-season (December – February), gannet do not have a migration- free winter season, as defined by Furness (2015).

5.4.17.4.1 Mitigation

Gannets are prone to both collision and displacement impacts. Displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on bird species. Although not a key consideration when undertaking array refinements, any reduction in array size benefits gannets by reducing the project footprint.

In addition, gannet are prone to collision risk. The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development compared to a 22m air draft. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.17.4.2 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

As determined in Table 7.24, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from construction and decommissioning activities.

During the breeding bio-season, 304 gannet are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51% (Apportioning Appendix 20) the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 2.1% are predicted to be breeding birds from Saltee Islands SPA (Apportioning Appendix 20). Therefore, 3 (3.3) breeding adults at risk of displacement are attributed to Saltee Islands SPA during the breeding bio-season (Table 7.59). The consequent mortality is estimated to be less than one (0.02) breeding adult, provided a displacement rate of 35% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 30% to 40% is also presented in Table 7.59.

The population of gannet at Saltee Islands has changed considerably since the citation colony count in 2004 with the latest colony count undertaken in 2013 – 2014 being 4,552 individuals greater (9,444 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2013 - 2014 (See Table 7.59).

Based on the 2004 citation colony count of 4,892 breeding adults and annual background mortality of 396 (396.3) individuals, the addition of less than one (0.02) predicted breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 9,444 individuals and an annual background mortality of 765 (765.0) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannet estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 1.8% of these gannet within the array area are deemed to be breeding adults from Saltee Islands SPA during the post- breeding migration bio-season and 1.5% during the return migration (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is five (4.7) during the post- breeding migration bio-season and less than one (0.2) the return migration (Table 7.59).

Provided, 35% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one (0.02) individual during the both migration bio-seasons. Table 7.59 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 40% displacement, 1% to 5% mortality).

This consequent estimated mortality equates to an increase in baseline mortality of 0.004% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest colony count and 0.002% and 0.000%, respectively relative to the 2004 citation colony count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.02) breeding adult per annum. This represents an increase of 0.004% in baseline mortality based on the 2004 citation colony count and 0.002% increase when using the latest colony count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with eight (8.1) of these being breeding adults from the Saltee Islands SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is less than one (0.03) breeding adult per annum across all bio-seasons. Table 7.59 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 40% displacement, 1% to 5% mortality).

The predicted mortality of less than one (0.03) breeding adult from Saltee Islands SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.007% when considering the citation colony count or an increase in baseline mortality of 0.004% when considering the latest colony count

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Saltee Islands SPA in relation to disturbance and displacement effects during the construction and decommissioning phases from the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.84: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Gannet at Saltee Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2004 Citation Colony Count[40].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality
UCI							
Breeding	4.7	0.02	0.01 – 0.09	0.004	0.002 – 0.024	0.002	0.001 – 0.012
Post-breeding migration	7.6	0.03	0.02 – 0.15	0.007	0.006 – 0.038	0.003	0.003 – 0.020
Return-breeding migration	0.4	0.00	0.00 – 0.02	0.000	0.000 – 0.002	0.000	0.000 – 0.001
Total non-breeding	10.0	0.03	0.05 – 0.16	0.007	0.006 – 0.041	0.004	0.003 – 0.021
Annual Total	12.7	0.04	0.06 – 0.25	0.011	0.008 – 0.065	0.006	0.004 – 0.033
Mean							
Breeding	3.3	0.01	0.01 – 0.07	0.003	0.001 – 0.017	0.002	0.001 – 0.009
Post-breeding migration	4.7	0.02	0.01 – 0.09	0.004	0.003 – 0.024	0.002	0.002 – 0.012
Return-breeding migration	0.2	0.00	0.00 – 0.00	0.000	0.000 – 0.001	0.000	0.000 – 0.000
Total non-breeding	4.9	0.02	0.01 – 0.10	0.004	0.004 – 0.024	0.002	0.002 – 0.012
Annual Total	8.1	0.03	0.02 – 0.16	0.007	0.005 – 0.041	0.004	0.003 – 0.021
LCI							
Breeding	2.0	0.01	0.00 – 0.04	0.002	0.001 – 0.010	0.001	0.000 – 0.005
Post-breeding migration	2.1	0.01	0.01 – 0.04	0.002	0.002 – 0.011	0.001	0.001 – 0.006
Return-breeding migration	0.0	0.00	0.00 – 0.00	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Total non-breeding	2.1	0.01	0.01 – 0.04	0.002	0.002 – 0.011	0.001	0.001 – 0.006
Annual Total	4.1	0.01	0.01 – 0.08	0.004	0.002 – 0.021	0.002	0.001 – 0.011

[40] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.17.4.3 Disturbance and Displacement (Operation)

Breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from operation and maintenance activities.

During the breeding bio-season, 304 gannet are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51% (Apportioning Annex 17) the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 2.1% are predicted to be breeding birds from Saltee Islands (Apportioning Appendix 20), therefore, three (3.3) breeding adults at risk of displacement are attributed to Saltee Islands SPA during the breeding bio-season (Table 7.60). The consequent mortality is estimated is less than one (0.02) breeding adults, provided a displacement rate of 70% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented in Table 7.60.

The population of gannet at Saltee Islands has changed considerably since the citation colony count in 2004 with the latest colony count undertaken in 2013 – 2014 being 4,552 individuals greater (9,444 birds). The potential impact on the population has been assessed against both the 2004 citation colony count and the latest colony count undertaken in 2013 – 2014 (Table 7.60).

Based on the 2004 citation colony count of 4,892 breeding adults and annual background mortality of 396 (396.3) individuals, the addition of less than one (0.02) predicted breeding adult mortalities would represent a 0.006% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 9,444 individuals and an annual background mortality of 765 (765.0) adults, this would represent a 0.003% increase in baseline mortality during the breeding bio-season.

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannet estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 1.8% of these gannet within the array area are deemed to be breeding adults from Saltee Islands SPA during the post-breeding migration bio-season and 1.5% during the return migration, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is five (4.7) during the post- breeding migration bio-season and less than one (0.2) the return migration (Table 7.60).

Provided, 70% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one (0.03) during both the post-breeding migration bio-season and the return migration. However, based on guidance from SNCBs (MIG-Birds, 2022), Table 7.60 presents a displacement range and mortality range of 60% to 80% and 1% to 5%, respectively.

This consequent estimated mortality equates to an increase in baseline mortality of 0.008% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest colony count and 0.004% and 0.000% respectively relative to the 2004 citation colony count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.03) breeding adult per annum. This represents an increase of 0.008% in baseline mortality when assessed against the 2004 citation colony count and 0.004% increase when using the latest colony count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with eight (8.1) of these being breeding adults from the Saltee Islands SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is less than one (0.06) breeding adult per annum across all bio-seasons. Table 7.60 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (60% displacement to 80% displacement, 1% to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the gannet QI of Saltee Islands SPA is presented in Table 7.60.

The predicted mortality of less than one breeding adult from Saltee Islands SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.014% when considering the citation colony count or an increase in baseline mortality of 0.007% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population.

Conclusion of AEoI

There is, therefore, no potential for an AEoI to the COs of the gannet QI of Saltee Islands SPA in relation to disturbance and displacement effects during the operational phase from the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.85 Range-Based Displacement Mortalities During the Operational Phase for Gannet at Saltee Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2004 Citation Colony Count[41]

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality
UCI							
Breeding	4.7	0.03	0.02 – 0.19	0.008	0.004 – 0.048	0.004	0.002 – 0.025
Post-breeding migration	7.6	0.05	0.04 – 0.30	0.013	0.011 – 0.077	0.007	0.006 – 0.040
Return-breeding migration	0.4	0.00	0.00 – 0.02	0.001	0.001 – 0.004	0.000	0.000 – 0.002
Total Non-breeding	8.0	0.06	0.05 – 0.32	0.014	0.012 – 0.081	0.007	0.006 – 0.042
Annual Total	12.7	0.09	0.06 – 0.51	0.022	0.016 – 0.129	0.012	0.008 – 0.067
Mean							
Breeding	3.3	0.02	0.01 – 0.13	0.006	0.003 – 0.033	0.003	0.001 – 0.017
Post-breeding migration	4.7	0.03	0.03 – 0.18	0.008	0.007 – 0.047	0.004	0.004 – 0.024
Return-breeding migration	0.2	0.00	0.00 – 0.01	0.000	0.000 – 0.002	0.000	0.000 – 0.001
Total Non-breeding	4.9	0.03	0.03 – 0.19	0.008	0.007 – 0.049	0.004	0.004 – 0.025
Annual Total	8.1	0.06	0.04 – 0.32	0.014	0.010 – 0.082	0.007	0.005 – 0.043
LCI							
Breeding	2.0	0.01	0.01 – 0.08	0.004	0.002 – 0.021	0.002	0.001 – 0.011
Post-breeding migration	2.1	0.01	0.01 – 0.08	0.004	0.003 – 0.022	0.002	0.002 – 0.011
Return-breeding migration	0.0	0.00	0.00 – 0.00	0.000	0.000 – 0.000	0.000	0.000 – 0.000

[41] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality
Total Non-breeding	2.1	0.02	0.01 – 0.09	0.004	0.003 – 0.022	0.002	0.002 – 0.011
Annual Total	4.1	0.03	0.02 – 0.17	0.007	0.005 – 0.043	0.004	0.003 – 0.022

Table 5.86 Mean Annual Abundance of Gannet Apportioned to Saltee Islands SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	1	1	1	1	1
30	0	0	0	0	0	0	1	1	1	1	1	1	1
40	0	0	0	0	0	1	1	1	1	1	1	2	2
50	0	0	0	0	0	1	1	1	1	1	2	2	2
60	0	0	0	0	1	1	1	1	2	2	2	2	3
70	0	0	0	0	1	1	1	1	2	2	2	3	3
80	0	0	0	0	1	1	1	2	2	2	3	3	3
90	0	0	0	0	1	1	2	2	2	3	3	3	4
100	0	0	0	0	1	1	2	2	3	3	3	4	4

5.4.17.4.4 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is one (1.1) individual (CRM Appendix 18 and 19). Assuming 51% of the gannet within the array area are breeding adults (Apportioning Annex 17) the total number of breeding adults in the array impacted by collision is less than one (0.6) individual per annum during the breeding bio-season.

Provided 2.1% of these collisions are breeding birds from Saltee Islands SPA (Apportioning Appendix 17), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.01) breeding adult (Table 5.66).

The population of gannet at the Saltee Island SPA has changed considerably since the citation colony count undertaken in 2004, with the latest colony count undertaken in 2013 – 2014 being 4,552 individuals greater (9,444 birds). The potential impact on the population has been assessed against both the 2004 citation count and the latest colony count.

Based on a citation population of 4,892 breeding adults and annual adult background mortality of 396 (396.3) individuals, the addition of less than one breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 9,444 individuals and an annual background mortality of 765 (765.0) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.66).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is one (1.0) individual, and less than one (0.1) individual during the return migration, provided 1.8 % and 1.5% of the gannet within the array area are deemed to be breeding adults from the Saltee Islands SPA during the post-breeding migration bio- season and the return migration, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.01) individual during the post-breeding migration bio- season and less than one (0.00) during the return migration bio-season (Table 5.66).

Based on a citation population of 4,892 breeding adults and annual adult background mortality of 396 (396.3) individuals, the addition of less than one breeding adult mortality would represent a 0.001% increase in baseline mortality during the post- breeding migration bio-season and an increase of 0.000% during the return migration. Similarly, when considering the latest colony count of 9,444 individuals and an annual background mortality of 765 (765.0) adults, this would also represent a 0.001% increase in baseline mortality during the post-breeding migration and 0.000% during the return migration (Table 5.66).

This equates to a total consequent mortality from collision across the entire non-breeding bio-season of less than one (0.01) breeding adult per annum. This represents an increase of 0.001% in baseline mortality of when assessed against the 2004 citation colony count and the latest colony count (Table 5.66).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Saltee Islands SPA is less than one (0.02) breeding adults per annum (Table 5.66). The annual predicted mortality of less than one breeding adults from the Saltee Islands SPA across all bio-seasons indicates an increase in baseline mortality of 0.004% and 0.002% when considering the citation colony count the latest colony count, respectively. This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.66).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 5.66). There is, therefore, no potential for an AEoI to the COs of the gannet QI of Saltee Islands SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.87: Seasonal Collision Mortalities During the Operational Phase for Gannet at Saltee Islands SPA[42].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.01	0.00 – 0.04	0.003	0.000 – 0.010	0.002	0.000 – 0.005
Post-breeding migration	0.01	0.00 – 0.02	0.001	0.000 – 0.005	0.001	0.000 – 0.003
Return migration	0.00	0.00 – 0.00	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Non-breeding Total	0.01	0.00 – 0.02	0.001	0.000 – 0.005	0.001	0.000 – 0.003
Annual Total	0.02	0.00 – 0.06	0.004	0.000 – 0.015	0.002	0.000 – 0.008

Combined Collision risk and Disturbance and displacement

Gannet have been screened in for both collision risk and displacement assessments during the operational phase; there is therefore a potential for these two potential impacts to adversely affect the gannet population at Saltee Islands SPA combined.

Based on the separate assessments of gannet from Saltee Islands SPA above, the combined predicted annual impact from collision risk and displacement is less than one (0.07) breeding adult mortality. This represents an increase in baseline mortality of 0.010% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Saltee Islands SPA in relation to combined collision risk and displacement effects from operational phase from the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.17.5 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 169.3km from the Saltee Island SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Saltee Islands has been assessed for the full breeding season (March–August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January – February), this species does not have a migration- free winter season, as defined by Furness (2015).

[42] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.17.5.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, compared to a 22m air draft, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.17.5.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 5 (5.4) individuals (CRM Appendix 18 and 19). Assuming 47% of these 5 individuals are breeding adults (Apportioning Appendix 20) the total number of breeding adults in the array impacted by collision is less than 3 (2.5) per annum during the breeding bio-season.

Provided 0.2% of these collisions are breeding birds from the Saltee Islands SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.01) breeding adult (Table 5.67).

The population of kittiwake at the Saltee Islands has changed considerably since the citation colony count in 1998 - 2000 with the latest colony count undertaken in 2015 - 2018 being 2,174 individuals fewer (2,076 birds). The potential impact on the population has been assessed against both the 1998 - 2000 citation count and the latest colony count undertaken in 2015 – 2018.

Based on a citation population of 4,250 breeding adults and annual adult background mortality of 621 (620.5) individuals, the addition of less than one breeding adult mortality would represent a 0.001% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 2,076 individuals and an annual background mortality of 303 (303.1) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.67).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is six (6.36) individuals, and seven (7.42) individuals during the return migration, provided 0.2% and 0.3% of the kittiwake within the array area are deemed to be breeding adults from the Saltee Islands SPA, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.01) individual during the post-breeding migration bio- season and less than one (0.03) during the return migration bio-season (Table 5.67).

Based on the 1998 – 2000 citation population of breeding adults the addition of less than one predicted breeding adult mortality during the post-migration breeding season and the return migration would indicate an increase in baseline mortality of 0.002% and 0.005%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 5.67).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.04) breeding adult per annum. This represents an increase of 0.007% in baseline mortality of the 1998 – 2000 citation colony count and 0.015% increase using the latest colony count (Table 5.67).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Saltee Islands SPA is less than one (0.05) breeding adult per annum (Table 5.67).

The annual predicted mortality of less than one breeding adults from the Saltee Islands SPA across all bio-seasons indicates an increase in baseline mortality of 0.008% and 0.016% when considering the 1998 – 2000 citation colony count and the latest colony count, respectively.

Conclusion of AEoI
This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 5.67). There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Saltee Islands SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.88: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Saltee Islands SPA[43].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.01	0.00 – 0.01	0.001	0.000 – 0.002	0.002	0.000 – 0.004
Post-breeding migration	0.01	0.00 – 0.04	0.002	0.000 – 0.006	0.005	0.001 – 0.012
Return migration	0.03	0.00 – 0.08	0.005	0.000 – 0.013	0.010	0.000 – 0.027
Non-breeding Total	0.04	0.00 – 0.12	0.007	0.000 – 0.019	0.015	0.001 – 0.038
Annual Total	0.05	0.00 – 0.13	0.008	0.000 – 0.021	0.016	0.001 – 0.043

5.4.17.6 Lesser black-backed gull
Lesser black-backed gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The offshore development area is situated 169.3km from Saltee Island SPA, which is within the MMF+1SD for lesser black-backed gull (127+109km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Lesser black-backed gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the offshore development area and therefore have been screened in for non-breeding bio-season (September – March) as per Furness (2015).

Collision risk of lesser black-backed gull from Saltee Island has been assessed for the migration-free breeding season (May–July), the post-breeding migration bio-season (August–October), the return migration bio-season (March–April), and the migration- free winter season (November – February) as defined by Furness (2015).

5.4.17.6.1 Mitigation
The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decreases collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, compared to a 22m air draft, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.17.6.2 Collision Risk (Operation)

Migration- free Breeding Bio-season
The predicted collision mortality during the migration- free breeding bio-season is 1 (1.29) individual. Assuming 35% of the lesser black-backed gull within the array area are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.45) per annum during the migration-free breeding bio-season.

[43] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Provided 0.2% of these collisions are breeding birds from the Saltee Islands SPA (Apportioning Appendix), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adults (Table 5.68).

The population of lesser black-backed gull at the Saltee Islands SPA has not changed considerably since the citation colony count in 1998 - 2000 with the latest colony count undertaken in 2014 being 66 individuals fewer (262 birds). The potential impact on the population has been assessed against both the 1998 – 2000 citation colony count and the latest colony count.

Based on a citation population of 328 breeding adults and annual adult background mortality of 38 (37.7) individuals, the addition of less than one breeding adult mortality would represent a 0.004% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 262 individuals and an annual background mortality of 30 (30.1) adults, this would represent a 0.005% increase in baseline mortality during the breeding bio-season (Table 5.68).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 37 (37.0) individuals, provided 0.2% of the lesser black-backed gulls within the array area are deemed to be breeding adults from the Saltee Islands SPA during the post-breeding migration bio-season and the return migration and 0.5% during the migration-free winter (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.00) during migrations and the migration- free winter bio-seasons (Table 5.68).

Based on the 1998 – 2000 citation colony count the addition of less than one predicted breeding adult mortality would indicate an increase in baseline mortality of 0.002% during the migration seasons. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.003% increase in baseline mortality in the migration seasons (Table 5.68).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Saltee Islands SPA is less than one (0.00) breeding adult per annum.

The annual predicted mortality of less than one breeding adult from the Saltee Islands SPA across all bio-seasons indicates an increase in baseline mortality of 0.006% and 0.004% when considering the 1998 – 2000 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population and would not represent an increase in mortality that was capable of adversely affecting the integrity of the SPA population (Table 5.68). There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Saltee Islands SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.89: Seasonal Collision Mortalities During the Operational Phase for Lesser Black-backed Gull at Saltee Islands SPA[44].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.00	0.00 – 0.00	0.002	0.000 – 0.007	0.003	0.000 – 0.009

[44] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Non-breeding	0.00	0.00 – 0.00	0.002	0.000 – 0.015	0.003	0.000 – 0.018
Annual Total	0.00	0.00 – 0.00	0.004	0.000 – 0.022	0.006	0.000 – 0.027

5.4.18 Morecambe Bay & Duddon Estuary SPA

5.4.18.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Morecambe Bay & Duddon Estuary SPA are considered within this section:

Table 5.90: qualifying interests and Conservation Objectives of the Morecambe Bay & Duddon Estuary SPA

Qualifying Interests Screened In	Conservation Objectives
Lesser black-backed gul [A183]	"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 interests • The structure and function of the habitats of the qualifying interests • The supporting processes on which the habitats of the qualifying interests rely • The population of each of the qualifying interests, and, • The distribution of the qualifying interests within the site."

Lesser black-backed gull was screened in for the Morecambe Bay and Duddon Estuary SPA in relation to collision risk due to this SPA being within mean maximum foraging range plus one SD. In the breeding season, of the one (1.29) collisions predicted from the proposed development, less than 0.1 (0.05) mortalities are apportioned to this SPA. Meanwhile in the non-breeding seasons, almost zero (0.00) mortalities are apportioned. Therefore any impact as a result of the proposed development is considered to be non-material and is not considered further here.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.19 Rathlin Island SPA

5.4.19.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Rahlin Island SPA are considered within this section:

Table 5.91: qualifying interests and Conservation Objectives of the Rathlin Island SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188] ; Lesser black-backed gull [A138]	"To maintain or enhance the population of the qualifying species: • Fledging success sufficient to maintain or enhance population; • To maintain or enhance the range of habitats utilised by the qualifying species; • To ensure that the integrity of the site is maintained; • To ensure there is no significant disturbance of the species and • To ensure that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species

	• Structure, function and supporting processes of habitats supporting the species”

Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 168.5km from the Rathlin Island SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Rathlin Island SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.19.1.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.19.1.2 Collision risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 5 (5.4) individuals. Assuming 47% of these 5 individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than 3 (2.5) per annum during the breeding bio-season.

Provided 3% of these collisions are breeding birds from the Rathlin Island SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.08) breeding adult (Table 5.92).

The population of kittiwake at the Rathlin Island SPA has changed considerably since the citation colony count in 1985 with the latest colony count undertaken in 2015 being 6,884 individuals fewer (13,706 birds). The potential impact on the population has been assessed against both the 1985 citation count and the latest colony count undertaken in 2015.

Based on a citation population of 6,822 breeding adults and annual adult background mortality of 996 (996.0) individuals, the addition of less than one breeding adult mortality would represent a 0.008% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 13,706 individuals and an annual background mortality of 2,001 (2.001.1) adults, this would represent a 0.004% increase in baseline mortality during the breeding bio-season (Table 5.92).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is 6 (6.5) individuals, and 7 (7.4) individuals during the return migration, provided 1.5% and 1.9% of the kittiwake within the array area are deemed to be breeding adults from the Saltee Islands SPA, respectively (Appendix 19). The consequent mortality of adult birds is less than one (0.10) individual during the post-breeding migration bio- season and less than one (0.19) during the return migration bio-season Table 5.92).

Based on the 1985 citation population of breeding adults the addition of less than one predicted breeding adult mortality during the post-migration breeding season and the return migration would indicate an increase in baseline mortality of 0.010% and 0.020%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 5.92).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.29) breeding adult per annum. This represents an increase of 0.029% in baseline mortality of the 1985 citation colony count and 0.015% increase using the latest colony count (Table 5.92).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Rathlin Island SPA is less than one (0.37) breeding adult per annum (Table 5.92).

The annual predicted mortality of less than one breeding adults from the Rathlin Island SPA across all bio-seasons indicates an increase in baseline mortality of 0.037% and 0.018% when considering the 1985 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.92).

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Rathlin Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.92: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Rathlin Island SPA[45].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.08	0.01 - 0.19	0.008	0.001 - 0.019	0.004	0.000 - 0.010
Post-breeding migration	0.10	0.01 - 0.23	0.010	0.001 - 0.000	0.005	0.000 - 0.012
Return migration	0.19	0.01 - 0.53	0.020	0.001 - 0.054	0.010	0.000 - 0.027
Non-breeding Total	0.29	0.02 - 0.77	0.029	0.002 - 0.077	0.015	0.001 - 0.038
Annual Total	0.37	0.02 - 0.96	0.037	0.002 - 0.096	0.018	0.001 - 0.048

Lesser black-backed gull

Lesser black-backed gull was screened in for the Morecambe Bay and Duddon Estuary SPA in relation to collision risk due to this SPA being within mean maximum foraging range plus one SD. In the breeding season, of the one (1.29) collisions predicted from the proposed development, only 0.7% of these are apportioned to this SPA. Meanwhile in the non-breeding seasons, almost zero (0.00) mortalities are apportioned. Therefore, any impact as a result of the proposed development is considered to be non-material and is not considered further here.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

[45] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.20 Ailsa Craig SPA

Ailsa Craig SPA is an island, situated in the outer part of the Firth of Clyde, 171.0km from the array area. The SPA encompasses cliffs up to 100 metres that encircle the island and provide nesting sites for a variety of seabirds, including the largest Northern gannet colonies in the world. The SPA boundary is coincident with Ailsa Craig SSSI and extends seaward by approximately 2km into the marine area surrounding the island.

5.4.20.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Ailsa Craig SPA are considered within this section:

Table 5.93: qualifying interests and Conservation Objectives of the Ailsa Craig SPA

Qualifying Interests Screened In	Conservation Objectives
Gannet [A016]; and Lesser black-backed gull [A138]; and Kittiwake [A188]	"To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and • To ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species"

5.4.20.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 171.0km from the Ailsa Craig SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Ailsa Craig SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.20.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.20.2.2 Collision risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is 5 (5.4) individuals. Assuming 47% of these 5 individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than 3 (2.5) per annum during the breeding bio-season.

Provided 0.2% of these collisions are breeding birds from the Ailsa Craig SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adult (Table 5.94).

The population of kittiwake at the Ailsa Craig SPA has declined considerably since the citation colony count in 1990 of 6,200 with the latest colony count undertaken in 2021 being 980 individuals. The potential impact on the population has been assessed against both the 1990 citation count and the latest colony count undertaken in 2021.

Based on a citation population of 6,200 breeding adults and annual adult background mortality of 905 (905.2) individuals, the addition of less than one breeding adult mortality would represent a 0.000% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 980 individuals and an annual background mortality of 143 (143.1) adults, this would represent a 0.003% increase in baseline mortality during the breeding bio-season (Table 5.94).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is 6 (6.5) individuals, and 7 (7.4) individuals during the return migration, provided 0.1% and 0.1% of the kittiwake within the array area are deemed to be breeding adults from the Saltee Islands SPA, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.01) individual during the post-breeding migration bio- season and less than one (0.01) during the return migration bio-season (Table 5.94).

Based on the 1990 citation population of breeding adults the addition of less than one predicted breeding adult mortality during the post-migration breeding season and the return migration would indicate an increase in baseline mortality of 0.001% and 0.002%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 5.94).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.05) breeding adult per annum. This represents an increase of 0.002% in baseline mortality of the 1990 citation colony count and 0.015% increase using the latest colony count.

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Ailsa Craig SPA is less than one (0.02) breeding adult per annum (Table 5.94).

The annual predicted mortality of less than one breeding adults from the Ailsa Craig SPA across all bio-seasons indicates an increase in baseline mortality of 0.003% and 0.017% when considering the 1990 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.94).

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Ailsa Criag SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.94: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Ailsa Craig SPA. Rounding errors do occur in this table[46].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.00	0.00 - 0.01	0.000	0.000 - 0.001	0.003	0.000 - 0.007
Post-breeding migration	0.01	0.00 - 0.02	0.001	0.000 - 0.002	0.005	0.000 - 0.012
Return migration	0.01	0.00 - 0.04	0.002	0.000 - 0.004	0.010	0.000 - 0.027
Non-breeding Total	0.02	0.00 - 0.05	0.002	0.000 - 0.006	0.015	0.001 - 0.038
Annual Total	0.02	0.00 - 0.07	0.003	0.000 - 0.007	0.017	0.001 - 0.046

5.4.20.3 Gannet

Gannet has been screened in to assess for the potential for an AEoI from displacement from the proposed development alone during the construction and decommissioning and the operational phase in addition to the potential for an AEoI from collision during the operational phase.

The proposed development is located 171.0km from the Ailsa Craig SPA which is within MMF+1SD for gannet (315.2+194.2km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Gannet disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Ailsa Criag SPA are likely to be present within array area; therefore, gannet have been screened in for the non-breeding bio-season.

Collision risk of gannet from Ailsa Craig has been assessed for the full breeding season (March – September), the post-breeding migration bio-season (October – November) and the return migration bio-season (December – February), gannet do not have a migration- free winter season, as defined by Furness (2015).

5.4.20.3.1 Mitigation

Gannets are prone to both collision and displacement impacts. Displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array refinement exercise with the aim to reduce displacement impacts on bird species. Although not a key consideration when undertaking array refinements, any reduction in array size benefits gannets by reducing the project footprint.

In addition, gannet are prone to collision risk. The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.20.3.2 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from construction and decommissioning activities.

[46] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

During the breeding bio-season, 304 gannet are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51%, the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 21.1% are predicted to be breeding birds from Ailsa Craig SPA (Apportioning Appendix 20). Therefore, 33 (32.8) breeding adults at risk of displacement are attributed to Ailsa Craig SPA during the breeding bio-season (Table 5.95). The consequent mortality is estimated is less than one (0.11) breeding adults, provided a displacement rate of 35% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 30% to 40% is also presented in.

The population of gannet at the Ailsa Craig SPA has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2014 being 20,452 individuals greater (66,452 birds). The potential impact on the population has been assessed against both the 2001 citation count and the latest colony count undertaken in 2014.

Based on the 2001 citation population of 46,000 breeding adults and annual background mortality of 3,726 (3,726.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest count of 66,452 individuals and an annual background mortality of 5,383 (5,382.6) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.95).

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannet estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 12.4% of these gannet within the array area are deemed to be breeding adults from the Ailsa Craig SPA during the post- breeding migration bio-season (Apportioning Appendix 20), the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 3 (32.9) individuals. Whereas, during the return migration, 10.3% of gannet with the array area are assumed to be breeding adults from Ailsa Craig SPA, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is less than two (1.3) (Table 5.95).

Provided, 35% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during both the post-breeding migration bio-season and the return migration. 0.12 and 0.00 mortalities, respectively. However, based on guidance from SNCBs (MIG-Birds, 2022), Table 5.95 presents a displacement range and mortality range of 30% to 40% and 1% to 5%, respectively.

This consequent estimated mortality equates to an increase in baseline mortality of 0.003% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest colony counts and 0.002%, 0.000%, respectively relative to the 2001 citation count (Table 5.95).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.20) breeding adult per annum. This represents an increase of 0.004% in baseline mortality of the 2001 citation population and 0.002% increase using the latest colony count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with 66 (66.3) of these being breeding adults from the Ailsa Craig SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development is less than one (0.12) breeding adults per annum across all bio-seasons. Table 5.95 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1% to 5% mortality).

The predicted mortality of less than one breeding adults from Ailsa Craig SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.006% when considering the citation population or an increase in baseline mortality of 0.004% when considering the latest colony count (Table 5.95).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population.

There is, therefore, no potential for an AEoI to the COs of the gannet QI of Ailsa Craig SPA in relation to disturbance and displacement effects from construction and decommissioning phases of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.95: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Gannet at Ailsa Craig SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[47].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality
UCI							
Breeding	47.1	0.16	0.08 – 0.94	0.004	0.002 – 0.024	0.002	0.001 – 0.012
Post-breeding migration	53.6	0.18	0.16 – 1.05	0.007	0.006 – 0.038	0.003	0.003 – 0.020
Return-breeding migration	3.1	0.01	0.01 – 0.06	0.000	0.000 – 0.002	0.000	0.000 – 0.001
Total Non-breeding	56.7	0.19	0.17 – 1.11	0.007	0.006 – 0.040	0.004	0.003 – 0.021
Annual Total	103.8	0.36	0.24 – 2.06	0.011	0.008 – 0.064	0.006	0.004 – 0.033
Mean							
Breeding	32.8	0.11	0.05 – 0.66	0.003	0.001 – 0.017	0.002	0.001 – 0.009
Post-breeding migration	32.9	0.12	0.10 – 0.66	0.003	0.003 – 0.018	0.002	0.002 – 0.012
Return-breeding migration	1.3	0.00	0.00 – 0.03	0.000	0.000 – 0.001	0.000	0.000 – 0.000
Total Non-breeding	34.2	0.12	0.10 – 0.67	0.003	0.004 – 0.018	0.002	0.002 – 0.013
Annual Total	67.0	0.23	0.15 – 1.34	0.006	0.005 – 0.036	0.004	0.003 – 0.025

[47] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality
LCI							
Breeding	20.4	0.07	0.03 – 0.41	0.002	0.001 – 0.010	0.001	0.001 – 0.005
Post-breeding migration	14.8	0.05	0.04 – 0.30	0.002	0.002 – 0.011	0.001	0.001 – 0.005
Return-breeding migration	0.3	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Total Non-breeding	15.1	0.05	0.05 – 0.30	0.002	0.002 – 0.011	0.001	0.001 – 0.006
Annual Total	35.5	0.12	0.08 – 0.71	0.004	0.002 – 0.021	0.002	0.001 – 0.011

5.4.20.3.3 Disturbance and Displacement (Operation)

Breeding Bio-season

As determined in Table 5.11 Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from operation and maintenance activities.

During the breeding bio-season, 304 gannets are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51% the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 21.1% are predicted to be breeding birds from Ailsa Craig SPA (Apportioning Appendix 20). Therefore, 33 (32.8) breeding adults at risk of displacement are attributed to Ailsa Craig SPA during the breeding bio-season. The consequent mortality is estimated is less than one (0.23) breeding adults, provided a displacement rate of 70% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented in Table 5.96.

The population of gannet at Ailsa Craig has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2014 being 20,452 individuals greater (66,452 birds). The potential impact on the population has been assessed against both the 2001 citation count and the latest colony count undertaken in 2014.

Based on the 2001 citation population of 46,000 breeding adults and annual background mortality of 3,726 (3,726.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.006% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest count of 66,452 individuals and an annual background mortality of 5,383 (5,382.6) adults, this would represent a 0.003% increase in baseline mortality during the breeding bio-season (Table 5.96).

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannets estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 12.2% of these gannets within the array area are deemed to be breeding adults from the Ailsa Craig SPA during the post- breeding migration bio-season (Apportioning Appendix 20) the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 32 (32.3) individuals. Whereas, during the return migration, 10.0% of gannet with the array area are assumed to be breeding adults from the Ailsa Craig SPA, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is less than two (1.3) (Table 5.96).

Provided, 70% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during both the post-breeding migration bio-season and the return migration. 0.23 and 0.01 mortalities, respectively. However, based on guidance from SNCBs (MIG-Birds, 2022), presents a displacement range and mortality range of 60% to 80% and 1% to 5%, respectively.

This consequent estimated mortality equates to an increase in baseline mortality of 0.008% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest population counts and 0.004%, 0.000%, respectively relative to the 2001 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.23) breeding adult per annum. This represents an increase of 0.008% in baseline mortality of the 2001 citation population and 0.004% increase using the latest population count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with 69 (69.0) of these being breeding adults from the Ailsa Craig SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is less than one (0.46) breeding adults per annum across all bio-seasons. Table 5.96 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (60%

displacement to 80% displacement, 1% to 10% mortality). An annual displacement matrix for predicted impacts apportioned to the gannet QI of Ailsa Craig SPA is presented within Table 5.96.

The predicted mortality of less than one breeding adult from Ailsa Craig SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.014% when considering the citation colony count or an increase in baseline mortality of 0.007% when considering the latest colony count (Table 5.96).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Ailsa Criag SPA in relation to disturbance and displacement effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.96: Range-Based Displacement Mortalities During the Operational Phase for Gannet at Ailsa Craig SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[48].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality
UCI							
Breeding	47.1	0.33	0.16 – 1.89	0.009	0.004 – 0.051	0.006	0.003 – 0.035
Post-breeding migration	52.6	0.37	0.32 – 2.11	0.010	0.008 – 0.056	0.007	0.006 – 0.039
Return-breeding migration	3.0	0.02	0.02 – 0.12	0.001	0.000 – 0.003	0.000	0.000 – 0.002
Total Non-breeding	55.6	0.39	0.33 – 2.23	0.010	0.009 – 0.060	0.007	0.007 – 0.045
Annual Total	102.8	0.72	0.49 – 4.11	0.019	0.013 – 0.110	0.013	0.009 – 0.076
Mean							
Breeding	32.8	0.23	0.11 – 1.31	0.006	0.003 – 0.033	0.003	0.001 – 0.017
Post-breeding migration	32.3	0.23	0.19 – 1.29	0.008	0.007 – 0.046	0.004	0.004 – 0.024
Return-breeding migration	1.3	0.01	0.01 – 0.05	0.000	0.000 – 0.002	0.000	0.000 – 0.001
Total Non-breeding	33.5	0.23	0.20 – 1.34	0.008	0.007 – 0.048	0.004	0.004 – 0.025
Annual Total	66.3	0.46	0.31 – 2.65	0.014	0.010 – 0.081	0.007	0.005 – 0.042
LCI							
Breeding	20.4	0.14	0.07 – 0.81	0.004	0.002 – 0.022	0.003	0.001 – 0.015

[48] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality	70% displacement, 1% mortality	60-80% displacement, 1 - 5% mortality
Post-breeding migration	14.8	0.10	0.09 – 0.59	0.003	0.002 – 0.016	0.002	0.002 – 0.011
Return-breeding migration	0.3	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Total Non-breeding	15.1	0.11	0.09 – 0.60	0.003	0.002 – 0.016	0.002	0.002 – 0.011
Annual Total	35.5	0.25	0.16 – 1.42	0.007	0.004 – 0.038	0.005	0.003 – 0.026

Table 5.97: Mean Annual Abundance of Gannet Apportioned to Ailsa Craig SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	1	1	2	3	3	4	5	5	6	7
20	0	0	1	1	3	4	5	7	8	9	11	12	13
30	0	0	1	2	4	6	8	10	12	14	16	18	20
40	0	1	1	3	5	8	11	13	16	18	21	24	26
50	0	1	2	3	7	10	13	17	20	23	26	30	33
60	0	1	2	4	8	12	16	20	24	28	32	36	40
70	0	1	2	5	9	14	18	23	28	32	37	42	46
80	1	1	3	5	11	16	21	26	32	37	42	48	53
90	1	1	3	6	12	18	24	30	36	42	48	53	59
100	1	1	3	7	13	20	26	33	40	46	53	59	66

5.4.20.3.4 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is one (1.1) individual. Assuming 51% of the gannet within the proposed development are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.6) per annum during the breeding bio-season (Table 5.98).

Provided 21.1% of these collisions are breeding birds from Ailsa Craig SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.12) breeding adults.

The population of gannet at the Ailsa Craig SPA has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2014 being 20,452 individuals greater (66,452 birds). The potential impact on the population has been assessed against both the 2001 citation count and the latest colony count.

Based on a citation population of 46,000 breeding adults and annual adult background mortality of 3,726 (3,726.0) individuals, the addition of less than one breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 66,452 individuals and an annual background mortality of 5,383 (5,382.6) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.98).

Non-breeding Bio- season

The predicted collision mortality is less than one (0.3) individual in the post-breeding migration bio-season, and less than one individual during the return migration (0.0). Provided 12.4 % and 10.3% of the gannet within the array area are deemed to be breeding adults from the Ailsa Craig SPA during the post-breeding migration bio- season and the return migration, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.04) during the post-breeding migration bio- season and less than one (0.00) during the return migration bio-season (Table 5.98).

Based on a citation colony count of 46,000 breeding adults and annual adult background mortality of 3,726 (3,726.0) individuals, the addition of less than one breeding adult mortality would represent a 0.001% increase in baseline mortality during the post-breeding migration bio-season and 0.000% during the return migration. Similarly, when considering the latest colony count of 66,452 individuals and an annual background mortality of 5,383 (5,382.6) adults, this would also represent a 0.001% increase in baseline mortality during the post-breeding migration and 0.000% during the return migration (Table 5.98).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.04) breeding adult per annum. This represents an increase of 0.001% in baseline mortality when assessed against the latest colony count.

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Ailsa Craig is less than one (0.16) breeding adults per annum (Table 5.98).

The annual predicted mortality of less than one breeding adults from the Ailsa Craig SPA across all bio-seasons indicates an increase in baseline mortality of 0.004% and 0.003% when considering the citation colony count the latest colony count, respectively (Table 5.98).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Ailsa Craig SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.98: Seasonal Collision Mortalities During the Operational Phase for Gannet at Ailsa Craig SPA[49].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.12	0.01 – 0.39	0.003	0.000 – 0.010	0.002	0.000 – 0.007
Post-breeding migration	0.04	0.00 – 0.14	0.001	0.000 – 0.004	0.001	0.000 – 0.003
Return migration	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Non-breeding Total	0.04	0.00 – 0.14	0.001	0.000 – 0.004	0.001	0.000 – 0.003
Annual Total	0.16	0.01 – 0.53	0.004	0.000 – 0.014	0.003	0.000 – 0.010

5.4.20.3.5 Combined Collision Risk and Disturbance and Displacement

Gannet have been screened in for both collision risk and displacement assessments during the operational phase there is therefore a potential for these two potential impacts to adversely affect the gannet population at Ailsa Craig SPA combined.

Based on the separate assessments of gannet from Ailsa Craig SPA in Section 5.4.19.1.5 and Section 5.4.19.1.6 above, the combines predicted annual impact from collision risk and displacement is less than one (0.88) breeding adult mortality. This represents an increase in baseline mortality of 0.024% when considering the latest colony count and 0.016% when considering the 2001 citation colony count.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Ailsa Craig SPA in relation to combined collision risk and displacement effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.20.4 Lesser black-backed gull

Lesser black-backed gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The proposed development is situated 171.0km from the Ailsa Craig SPA which is within the MMF+1SD for lesser black-backed gull (127+109km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Lesser black-backed gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the proposed development and therefore have been screened in for non-breeding bio-season (September – March) as per Furness (2015).

Collision risk of lesser black-backed gull from the Ailsa Craig SPA has been assessed for the migration-free breeding season (May–July), the post-breeding migration bio-season (August–October), the return migration bio-season (March–April), and the migration- free winter season (November – February) as defined by Furness (2015).

[49] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.20.4.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.20.4.2 Collision Risk (Operation)

Migration- free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is one (1.3) individual. Assuming 35% of lesser black-backed gulls within the array are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.45) per annum during the migration-free breeding bio-season.

Provided 0.4% of these collisions are breeding birds from the Ailsa Craig SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adult (Table 5.99).

The population of lesser black-backed gull at the Ailsa Craig SPA has changed considerably since the citation colony count in 1990 with the latest colony count undertaken in 2019 being 3,222 individuals fewer (378 birds). The potential impact on the population has been assessed against both the 1990 citation count and the latest colony count undertaken in 2019.

Based on a citation population of 3,600 breeding adults and annual adult background mortality of 414 (414.0) individuals, the addition of less than one breeding adult mortality would represent a 0.000% increase in baseline mortality during the migration-free breeding bio-season. Whereas, when considering the latest colony count of 378 individuals and an annual background mortality of 44 (43.5) adults, this would represent a 0.004% increase in baseline mortality during the migration- free breeding bio-season (Table 5.99).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 37 (37.0) individuals, provided 0.2% of the lesser black-backed gulls within the array area are deemed to be breeding adults from the Ailsa Craig SPA during the post-breeding migration bio-season and the return migration (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.00) during the migration bio-seasons.

Based on the 1990 citation population of breeding adults the addition of less than one (0.00) predicted breeding adult mortality during the migration bio-seasons would indicate an increase in baseline mortality of 0.000%. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.003% increase in baseline mortality in the migration bio-seasons (Table 5.99).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Ailsa Craig SPA is less than one (0.00) breeding adult per annum.

The annual predicted mortality of less than one breeding adult from the Ailsa Craig SPA across all bio-seasons indicates an increase in baseline mortality of 0.000% and 0.007% when considering the 1990 citation population and the latest colony count, respectively (Table 5.99).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Ailsa Criag SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.99: Seasonal Collision Mortalities During the Operational Phase for Lesser Black-backed Gull at Ailsa Craig SPA[50].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.00	0.00 – 0.01	0.000	0.000 – 0.001	0.004	0.000 – 0.013
Non-breeding	0.00	0.00 – 0.00	0.000	0.000 – 0.001	0.003	0.000 – 0.009
Annual Total	0.00	0.00 – 0.01	0.000	0.000 – 0.002	0.007	0.000 – 0.022

5.4.21 Helvick Head to Ballyquin SPA

5.4.21.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Helvick Head to Ballyquin SPA are considered within this section:

Table 5.100:Qualifying Interests and Conservation Objectives of Helvick Head to Ballyquin SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188]	To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when: • population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.4.21.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 209.4km from the Rathlin Island SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Helvick Head to Ballyquin SPA has been assessed for the full breeding season (March –August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.21.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

[50] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.21.2.2 Collision risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals. Assuming 47% of these 5 individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than 3 (2.52) per annum during the breeding bio-season.

Provided 0.01% of these collisions are breeding birds from the Helvick Head to Ballyquin SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adult (Table 5.101).

Based on a citation population of 1,037 breeding adults, undertake in 1969-1970, and annual adult background mortality of 151 (151.4) individuals, the addition of less than one breeding adult mortality would represent a 0.000% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 130 individuals, undertaken in 2018, and an annual background mortality of 19 (19.0) adults, this would represent a 0.000% increase in baseline mortality during the breeding bio-season (Table 5.101).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is seven (6.54) individuals, and seven (7.42) individuals during the return migration. Provided 0.01% and 0.02% of the kittiwake within the array area are deemed to be breeding adults from the Helvick Head to Ballyquin SPA, respectively (Apportioning Appendix 20), he consequent mortality of adult birds is less than 0.01 individual during the post-breeding migration bio- season and less than 0.01 during the return migration bio-season (Table 5.101).

Based on the 1985 citation population of breeding adults the addition of less than 0.01 predicted breeding adult mortality during the post-migration breeding season and the return migration would indicate an increase in baseline mortality of 0.001% and 0.005%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.001% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 5.101).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than 0.01 breeding adult per annum. This represents an increase of 0.002% in baseline mortality of the 1969-1970 citation colony count and 0.015% increase using the latest colony count (Table 5.101).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Helvick Head to Ballyquin SPA is less than 0.01 breeding adult per annum (Table 5.101).

The annual predicted mortality of less than one breeding adults from the Helvick Head to Ballyquin SPA across all bio-seasons indicates an increase in baseline mortality of 0.002% and 0.015% when considering the 1969-1970 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.101).There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Helvick Head to Ballyquin SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.101: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Helvick Head to Ballyquin SPA[51].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.00	0.00 – 0.00	0.000	0.000 – 0.000	0.001	0.000 – 0.003
Post-breeding migration	0.00	0.00 – 0.00	0.001	0.000 – 0.001	0.005	0.000 – 0.012
Return migration	0.00	0.00 – 0.00	0.001	0.000 – 0.003	0.010	0.000 – 0.027
Non-breeding Total	0.00	0.00 – 0.01	0.002	0.000 – 0.005	0.015	0.001 – 0.038
Annual Total	0.00	0.00 – 0.01	0.002	0.000 – 0.005	0.016	0.001 – 0.041

5.4.22 Ribble & Alt Estuaries SPA

The Ribble and Alt Estuaries SPA lies on the coast of Lancashire and Sefton in northwest England. The SPA encompasses both the Ribble Estuary SSSI and Sefton Coast SSSI. It comprises two estuaries, the larger being the Ribble, along with an area of sandy foreshore along the Sefton Coast, forming part of the chain of SPAs along the west coast that fringe the Irish Sea. The site supports internationally important populations of waterbirds in winter, namely swans, geese, ducks, and waders. It is also a key site for wader populations moving along the west coast of Britain during migration periods. Breeding birds, including large concentrations of gulls and terns are supported by the large areas of saltmarsh and coastal grazing marsh, these seabirds feed both offshore and inland, outside the SPA.

5.4.22.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Ribble & Alt Estuaries SPA are considered within this section:

Table 5.102: qualifying interests and Conservation Objectives of the Ribble & Alt Estuaries SPA

Qualifying Interests Screened In	Conservation Objectives
Lesser black-backed gull [A138]	"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 interests • The structure and function of the habitats of the qualifying interests • The supporting processes on which the habitats of the qualifying interests rely • The population of each of the qualifying interests, and, • The distribution of the qualifying interests within the site."

5.4.22.2 Lesser black-backed gull

Lesser black-backed gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 177.8km from the Ribble & Alt Estuaries SPA which is within the MMF+1SD for lesser black-backed gull (127+109km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Lesser black-backed gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the

[51] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

proposed development and therefore have been screened in for non-breeding bio-season (September – March) as per Furness (2015).

Collision risk of lesser black-backed gull from the Ribble & Alt Estuaries SPA has been assessed for the migration-free breeding season (May–July), the post-breeding migration bio-season (August–October), the return migration bio-season (March–April), and the migration- free winter season (November – February), as defined by Furness (2015).

5.4.22.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.22.2.2 Collision Risk (Operation)

Migration- free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is one (1.29) individual. Assuming 35% of the lesser black-backed gull are breeding adults that the total number of breeding adults in the array impacted by collision is less than one (0.45) per annum during the migration-free breeding bio-season.

Provided 11.8% of these collisions are breeding birds from the Ribble & Alt Estuaries SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.05) breeding adult (Table 5.103).

The population of lesser black-backed gull at the Ribble & Alt Estuaries SPA has changed considerably since the citation colony count in 1993 with the latest colony count undertaken in 2021 being 5,378 individuals greater (8,978 birds). The potential impact on the population has been assessed against both the 1993 citation count and the latest population count.

Based on a citation population of 3,600 breeding adults and annual adult background mortality of 414 (414.0) individuals, the addition of less than one breeding adult mortality would represent a 0.013% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 8,978 individuals and an annual background mortality of 1,033 (1032.5) adults, this would represent a 0.005% increase in baseline mortality during the breeding bio-season (Table 5.103).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is one (0.51) individual. Provided 5.3% of the lesser black-backed gull within the array area are deemed to be breeding adults from the Ribble and Alt Estuaries SPA during the post-breeding migration bio-season and the return migration bio-season (Apportioning Appendix 20) and 18.9% during the migration- free winter bio-season, the consequent mortality of adult birds is less than one (0.03) during the post-breeding migration, return migration and migration-free winter bio-seasons (Table 5.103).

Based on a citation population of 3,600 breeding adults and annual adult background mortality of 414 (414.0) individuals, the addition of less than one breeding adult mortality would represent a 0.007% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 8,978 individuals and an annual background mortality of 1,033 (1,032.5) adults, this would represent a 0.003% increase in baseline mortality during the breeding bio-season (Table 5.103).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Ribble & Alt Estuaries SPA is less than one (0.08) breeding adult per annum (Table 5.103).

The annual predicted mortality of less than one breeding adult from the Ribble & Alt Estuaries SPA across all bio-seasons indicates an increase in baseline mortality of 0.019% and 0.008% when considering the citation colony count and the latest colony count, respectively (Table 5.103).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Ribble & Alt Estuaries SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.103: Seasonal Collision Mortalities During the Operational Phase for Lesser Black-backed Gull at Ribble & Alt Estuaries SPA[52].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.05	0.00 – 0.17	0.013	0.001 – 0.041	0.005	0.000 – 0.016
Non-breeding	0.03	0.00 – 0.09	0.007	0.000 – 0.022	0.003	0.000 – 0.009
Annual Total	0.08	0.00 – 0.26	0.019	0.001 – 0.063	0.008	0.000 – 0.025

5.4.23 Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA

Skomer, Skokholm and the Seas off Pembrokeshire SPA is located off the south-west tip of Pembrokeshire in south-west Wales. The SPA extends beyond the 12 nm boundary, partially lying in both Welsh territorial waters and UK offshore waters. The islands of Skomer and Skokholm support the largest concentration of breeding seabirds in England and Wales. Including the largest breeding colony of Manx shearwater in the world (316,000 pairs), one of the largest colonies of lesser black-backed gull in Britain (> 10,000 apparently occupied sites). The site is also important for other seabird populations, namely razorbill, black-legged kittiwake, Atlantic puffin and common guillemot, supporting a breeding seabird assemblage of over 394,000 birds.

5.4.23.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Skomer, Skokholm and the Seas off Pembrokeshire SPA are considered within this section:

Table 5.104: qualifying interests and Conservation Objectives of the Skomer, Skokholm and the Seas off Pembrokeshire SPA

Qualifying Interests Screened In	Conservation Objectives
Lesser black-backed gull [A183]; and Kittiwake [A188].	"Breeding population of included species: • The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term. • The breeding population size of included species should be stable or increasing, aiming for at least 20,300, with a breeding productivity rate and an adult survival rate that allows this number to be maintained/increased. • Colonies of this species must not be lost as a result of anthropogenic influence. • The distribution of the population should be being maintained, or where appropriate increasing. • The distribution of this species within the site should not be constrained by anthropogenic factors. Reductions in the range of this species can only be acceptable if there is

[52] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

	significant risk of detriment, to the FCS of priority features of this SPA. • There should be sufficient habitat, of sufficient quality, to support the population in the long term. • The breeding and foraging habitat of this species should be stable or increasing in terms of its area, and its quality should remain unaffected by anthropogenic factors. • Factors affecting the population or its habitat should be under appropriate control. • There should be no mammalian land predators present in the SPA, and control measures should be in place to ensure that accidental introduction does not take place. • Access beyond designated footpaths, should be under appropriate control. • Factors affecting the species within the site should be under control

5.4.23.2 Lesser black-backed gull

Lesser black-backed gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The proposed boundary is situated 205.0km from the Skomer SPA which is within the MMF+1SD for lesser black-backed gull (127+109km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Lesser black-backed gull will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – March) as per Furness (2015).

Collision risk of lesser black-backed gull from the Skomer SPA has been assessed for the migration-free breeding season (May–July), the post-breeding migration bio-season (August–October), the return migration bio-season (March–April), and the migration- free winter season (November – February), as defined by Furness (2015).

5.4.23.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.23.2.2 Collision Risk (Operation)

Migration- free Breeding Bio-season

The predicted collision mortality during the migration- free breeding bio-season is one (1.3) individual. Assuming 35% of the lesser black-backed gulls are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.45) per annum during the migration-free breeding bio-season.

Provided 7.3% of these collisions are breeding birds from the Skomer SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.03) breeding adult (Table 5.105).

According to the latest colony count, undertaken in 2022, the population of lesser black-backed gull at the Skomer SPA is 14,524 individuals. Based the latest colony count, the addition of less than one breeding adult mortality would represent a 0.002% increase in baseline mortality during the migration-free breeding bio-season (Table 5.105).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the non-breeding bio-season is 37 (37.0) individuals, provided 8.9% of the lesser black-backed gulls within the array area are deemed to be breeding adults from the Skomer SPA during the post-breeding migration bio-season and the return migration (Apportioning Appendix 20), the consequent mortality of adult birds is less than one (0.04) during the migration seasons (Table 5.105).

Based on the latest colony count the addition of less than one (0.04) predicted breeding adult mortality during the migration seasons would indicate an increase in baseline mortality of 0.003%.

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to Skomer SPA is less than one (0.08) breeding adult per annum (Table 5.105).

The annual predicted mortality of less than one breeding adult from the Skomer SPA across all bio-seasons indicates an increase in baseline mortality of 0.005% when considering the latest colony count (Table 5.105).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Skomer SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.105: Seasonal Collision Mortalities During the Operational Phase for Lesser Black-backed Gull at Skomer, Skokholm, the Seas off Pembrokeshire SPA[53].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.03	0.00 – 0.10			0.002	0.000 – 0.006
Non-breeding	0.04	0.00 – 0.15			0.003	0.000 – 0.009
Annual Total	0.08	0.00 – 0.25			0.005	0.000 – 0.015

5.4.23.3 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone. Kittiwake is an assemblage feature of this SPA and so the conclusion of this assessment considers how any impact may effect the assemblage of features at this site.

The proposed boundary is situated 205.0km from the Skomer SPA which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Skomer SPA has been assessed for the full breeding season (March – August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.23.3.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development, and has

[53] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.23.3.2 Collision risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals. Assuming 47% of these 5 individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than 3 (2.52) per annum during the breeding bio-season.

Provided 0.3% of these collisions are breeding birds from the Skomar SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.01) breeding adult (Table 5.106).

The population of kittiwake at the Skomer SPA undertaken in 2015 was 3,088 individuals. Based on this latest population of 3,088 breeding adults and annual adult background mortality of 451 (450.8) individuals, the addition of less than one breeding adult mortality would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.106).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is seven (6.54) individuals, and seven (7.42) individuals during the return migration. Provided 0.3% and 0.4% of the kittiwake within the array area are deemed to be breeding adults from Skomer SPA, respectively (Apportioning Appendix 20).

The consequent mortality of adult birds is less than one (0.02) individual during the post-breeding migration bio- season and less than one (0.04) during the return migration bio-season.

Based on the latest colony count the consequent mortality of adult birds would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.07) breeding adult per annum. This represents an increase of 0.029% in baseline mortality of the 1985 citation colony count and 0.015% increase using the latest colony count (Table 5.106).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Skomer SPA is less than one (0.07) breeding adult per annum.

The annual predicted mortality of less than one breeding adult from the Skomer SPA across all bio-seasons indicates an increase in baseline mortality of 0.016% when considering the latest colony count.

Conclusion of AEoI

This level of impact is non-material and would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the kittiwake assemblage feature of Skomer SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the assemblage will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.106: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at Skomer SPA[54].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.01	0.00 – 0.02	0.002	0.000 – 0.004
Post-breeding migration	0.02	0.00 – 0.05	0.005	0.000 – 0.012
Return migration	0.04	0.00 – 0.12	0.010	0.000 – 0.027
Non-breeding Total	0.07	0.00 – 0.17	0.015	0.001 – 0.038
Annual Total	0.07	0.00 – 0.19	0.016	0.001 – 0.042

5.4.24 Grassholm SPA

Grassholm is a low-lying basalt island, located 207.2km from the array area and approximately 18km off the south-west Wales coast. The SPA supports the third largest breeding population of the north Atlantic gannet (Morus bassanus) in the world. Gannet are the only designated species at this SPA and are therefore the only species considered within the ornithological assessment presented below.

5.4.24.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the North Colonsay and Western Cliffs SPA are considered within this section:

Table 5.107: qualifying interests and Conservation Objectives of the North Colonsay and Western Cliffs SPA

Qualifying Interests Screened In	Conservation Objectives
Gannet [A016]	"The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied: • The population will not fall below 30,000 pairs in three consecutive years, • It will not drop by more than 25% of the previous year's figures in any one year. • There will be no decline in this population significantly greater than any decline in the North Atlantic population as a whole"

5.4.24.2 Gannet

Gannet has been screened in to assess for the potential for an AEoI from displacement from the proposed development alone during the construction and decommissioning and operational phase in addition to the potential for an AEoI from collision during the operational phase.

The array area is located 207.2km from the Grassholm SPA which is within MMF+1SD for gannet (315.2+194.2km) (Woodward et al., 2019) and therefore has been screened in for the breeding bio-season. Gannet disperse throughout the bio-geographical region outside of the breeding season, however, a proportion of individuals from Grassholm SPA are likely to be present within array area; therefore, gannet have been screened in for the non-breeding bio-season.

Collision risk of gannet from Grassholm has been assessed for the full breeding season (March – September), the post-breeding migration bio-season (October – November) and the return migration bio-season (December – February), gannet do not have a migration- free winter season, as defined by Furness (2015).

5.4.24.2.1 Mitigation

Gannets are prone to both collision and displacement impacts. Displacement assessments are undertaken based on the abundance of birds within the array area plus 2km buffer. 'Hotspots' of birds, which may indicate key foraging/loafing areas, were identified in the full survey area and considered within the array

[54] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

refinement exercise with the aim to reduce displacement impacts on bird species. Although not a key consideration when undertaking array refinements, any reduction in array size benefits gannets by reducing the project footprint.

In addition, gannet are prone to collision risk. The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.24.2.2 Disturbance and Displacement (Construction and Decommissioning)

Breeding Bio-season

As determined in Table 5.11, Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from construction and decommissioning activities.

During the breeding bio-season, 304 gannet are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51%, the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 12.7% are predicted to be breeding birds from Grassholm SPA (Apportioning Appendix 20). Therefore, 20 (19.8) breeding adults at risk of displacement are attributed to Grassholm SPA during the breeding bio-season (Table 5.108). The consequent mortality is estimated to be less than one (0.07) breeding adults, provided a displacement rate of 35% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 30% to 40% is also presented in Table 5.108.

The population of gannet at Grassholm SPA has changed considerably since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 6,022 individuals greater (72,022 birds). The potential impact on the population has been assessed against both the 2001 citation count and the latest colony count undertaken in 2015.

Based on the 2001 citation population of 66,000 breeding adults and annual background mortality of 5,346 (5,346.0) individuals, the addition of less than one predicted breeding adult mortality would represent a 0.001% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest count of 72,022 individuals and an annual background mortality of 5,384 (5,383.8) adults, this would represent a 0.001% increase in baseline mortality during the breeding bio-season (Table 5.108).

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannets estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 13.2% of these gannets within the array area are deemed to be breeding adults from Grassholm SPA during the post- breeding migration bio-season (Apportioning Appendix 20) the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 35 (35.0) individuals. Whereas, during the return migration, 10.9% of gannet with the array area are assumed to be breeding adults from Grassholm SPA, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is less than two (1.4) (Table 5.108).

Provided, 35% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during both the post-breeding migration bio-season and the return migration. 0.12 and 0.00 mortalities, respectively. However, based on guidance from SNCBs (MIG-Birds, 2022), Table 5.108presents a displacement range and mortality range of 30% to 40% and 1% to 5%, respectively.

This consequent estimated mortality equates to an increase in baseline mortality of 0.002% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest colony counts and 0.002%, 0.000%, respectively relative to the 2001 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.13) breeding adult per annum. This represents an increase of 0.002% in baseline mortality of the 2001 citation population and 0.002% when considering the latest colony count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with 56 (56.1) of these being breeding adults from the Grassholm SPA. The total predicted displacement consequent mortality throughout the construction and decommissioning phases of the proposed development t is less than one (0.20) breeding adults per annum across all bio-seasons. Table 5.108 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (15% displacement to 35% displacement, 1% to 5% mortality).

The predicted mortality of less than one breeding adult from Grassholm SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.004% when considering the citation population and 0.003% when considering the recent count.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population.There is, therefore, no potential for an AEoI to the COs of the gannet QI of Grassholm SPA in relation to disturbance and displacement effects from construction and decommissioning phases of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.108: Range-Based Displacement Mortalities During the Construction and Decommissioning Phases for Gannet at Grassholm SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[55].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		35% displacement, 1% mortality	30-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality	35% displacement, 1% mortality	20-40% displacement, 1 - 5% mortality
UCI							
Breeding	28.4	0.10	0.05 – 0.57	0.002	0.001 – 0.011	0.002	0.001 – 0.010
Post-breeding migration	57.0	0.20	0.17 – 1.14	0.004	0.003 – 0.021	0.003	0.003 – 0.020
Return-breeding migration	3.3	0.01	0.01 – 0.07	0.000	0.000 – 0.001	0.000	0.000 – 0.001
Total Non-breeding	60.3	0.21	0.18 – 1.21	0.004	0.003 – 0.023	0.004	0.003 – 0.021
Annual Total	88.7	0.31	0.23 – 1.77	0.006	0.004 – 0.033	0.005	0.004 – 0.030
Mean							
Breeding	19.8	0.07	0.03 – 0.40	0.001	0.001 – 0.007	0.001	0.001 – 0.007
Post-breeding migration	35.0	0.12	0.10 – 0.70	0.002	0.002 – 0.013	0.002	0.002 – 0.012
Return-breeding migration	1.4	0.00	0.00 – 0.03	0.000	0.000 – 0.001	0.000	0.000 – 0.000
Total Non-breeding	36.3	0.13	0.11 – 0.73	0.002	0.002 – 0.014	0.002	0.002 – 0.012
Annual Total	56.1	0.20	0.14 – 1.12	0.004	0.003 – 0.021	0.003	0.002 – 0.019
LCI							
Breeding	12.3	0.04	0.02 – 0.25	0.001	0.000 – 0.005	0.001	0.001 – 0.004
Post-breeding migration	16.0	0.06	0.05 – 0.32	0.001	0.001 – 0.006	0.001	0.001 – 0.005
Return-breeding migration	0.3	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Total Non-breeding	16.3	0.06	0.05 – 0.33	0.001	0.001 – 0.006	0.001	0.001 – 0.006
Annual Total	28.6	0.10	0.07 – 0.57	0.002	0.001 – 0.011	0.002	0.001 – 0.010

[55] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.24.2.3 Disturbance and Displacement (Operation)

Breeding Bio-season

As determined in Table 5.11 Project Option 1 has a greatest potential for adverse effects on disturbance and displacement than Project Option 2 for gannet from operation and maintenance activities.

During the breeding bio-season, 304 gannet are estimated to occur in the array area plus a 2km buffer. Provided the proportion of adult birds in the array is 51% the total number of breeding adults in the array at risk of displacement is 155 (155.4) during the full breeding bio-season.

Of these 155 breeding adults, 12.7% are predicted to be breeding birds from Grassholm SPA (Apportioning Appendix 20). Therefore, 20 (19.8) breeding adults at risk of displacement are attributed to Grassholm SPA during the breeding bio-season (Table 5.109). The consequent mortality is estimated is less than one (0.14) breeding adults, provided a displacement rate of 70% and a mortality rate of 1% has been applied. However, based on the SNCBs guidance (MIG-Birds, 2022), a displacement range of 60% to 80% is also presented in Table 5.109.

The addition of less than one predicted breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season based on the 2001 citation colony count of 66,000 breeding adults and annual background mortality of 5,346 (5,346.0) individuals and 0.002% when considering the latest colony count of 72,022 individuals and an annual background mortality of 5,384 (5,383.8) adults.

Non-breeding Bio-season

During the post-breeding migration bio-season, the mean-peak number of gannets estimated to occur in the array area plus the 2km buffer is 265 individuals, and 13 individuals during the return migration.

Assuming that 13.2% of these gannets within the array area are deemed to be breeding adults from Grassholm SPA during the post- breeding migration bio-season (Apportioning Appendix 20) the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is 35 (35.0) individuals. Whereas, during the return migration, 10.9% of gannet with the array area are assumed to be breeding adults from Grassholm SPA, the total abundance of breeding adults estimated to be displaced from the array plus 2km buffer is less than two (1.4) individuals (Table 5.109).

Provided, 70% displacement and 1% mortality has been applied, the total predicted consequent mortality from being displaced is estimated at less than one individual during both the post-breeding migration bio-season and the return migration. 0.24 and 0.01 mortalities, respectively. However, based on guidance from SNCBs (MIG-Birds, 2022), Table 5.109 presents a displacement range and mortality range of 60% to 80% and 1% to 5%, respectively.

This consequent estimated mortality equates to an increase in baseline mortality of 0.005% in the post-breeding migration bio-season and 0.000% in the return migration based on the latest colony counts and 0.004%, 0.000%, respectively relative to the 2001 citation count.

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.25) breeding adult per annum. This represents an increase of 0.005% in baseline mortality of the 2001 citation population and 0.004% when considering the latest colony count.

Annual Total

Throughout all bio-seasons, the number of gannet estimated to occur in the array area plus a 2km buffer is 582 individuals, with 37 (36.8) of these being breeding adults from the Grassholm SPA. The total predicted displacement consequent mortality throughout the operational phase of the proposed development is less than one (0.39) breeding adults per annum across all bio-seasons. Table 5.109 presents the displacement consequent mortalities as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 75% displacement, 1% to 5% mortality). An annual displacement matrix for predicted impacts apportioned to the gannet QI of Grassholm SPA is presented within Table 5.109 .

The predicted mortality of less than one breeding adult from Grassholm SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.007% when considering the citation population and 0.007% when considering the latest colony count (Table 5.109).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Grassholm SPA in relation to disturbance and displacement effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from displacement.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.109: Range-Based Displacement Mortalities During the Operational Phase for Gannet at Grassholm SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[56].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 5% mortality	70% displacement, 1% mortality	60-80% displacement, 5% mortality	70% displacement, 1% mortality	60-80% displacement, 5% mortality
UCI							
Breeding	28.4	0.20	0.09 – 1.14	0.004	0.002 – 0.021	0.003	0.002 – 0.019
Post-breeding migration	57.0	0.40	0.34 – 2.28	0.007	0.006 – 0.043	0.007	0.006 – 0.039
Return-breeding migration	3.3	0.02	0.02 – 0.13	0.000	0.000 – 0.002	0.000	0.000 – 0.002
Total Non-breeding	60.3	0.42	0.36 – 2.41	0.008	0.007 – 0.045	0.007	0.006 – 0.041
Annual Total	88.7	0.62	0.46 – 3.55	0.012	0.009 – 0.066	0.011	0.008 – 0.061
Mean							
Breeding	19.8	0.14	0.07 – 0.79	0.003	0.001 – 0.015	0.002	0.001 – 0.014
Post-breeding migration	35.0	0.24	0.21 – 1.40	0.005	0.004 – 0.026	0.004	0.004 – 0.024
Return-breeding migration	1.4	0.01	0.01 – 0.05	0.000	0.000 – 0.001	0.000	0.000 – 0.001
Total Non-breeding	36.3	0.25	0.22 – 1.45	0.005	0.004 – 0.027	0.004	0.004 – 0.025
Annual Total	56.1	0.39	0.28 – 2.24	0.007	0.005 – 0.042	0.007	0.005 – 0.038

[56] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		70% displacement, 1% mortality	60-80% displacement, 5% mortality	70% displacement, 1% mortality	60-80% displacement, 5% mortality	70% displacement, 1% mortality	60-80% displacement, 5% mortality
LCI							
Breeding	12.3	0.09	0.04 – 0.49	0.002	0.001 – 0.009	0.001	0.001 – 0.008
Post-breeding migration	16.0	0.11	0.10 – 0.64	0.002	0.002 – 0.012	0.002	0.002 – 0.011
Return-breeding migration	0.3	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Total Non-breeding	16.3	0.11	0.10 – 0.65	0.002	0.002 – 0.012	0.002	0.002 – 0.011
Annual Total	28.6	0.20	0.14 – 1.14	0.004	0.003 – 0.021	0.003	0.002 – 0.020

Table 5.110: Mean Annual Abundance of Gannet Apportioned to Grassholm SPA During the Operational Phase Displacement Matrix (Array Area Plus 2km Buffer).

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10	0	0	0	1	1	2	2	3	3	4	4	5	6
20	0	0	1	1	2	3	4	6	7	8	9	10	11
30	0	0	1	2	3	5	7	8	10	12	13	15	17
40	0	0	1	2	4	7	9	11	13	16	18	20	22
50	0	1	1	3	6	8	11	14	17	20	22	25	28
60	0	1	2	3	7	10	13	17	20	24	27	30	34
70	0	1	2	4	8	12	16	20	24	27	31	35	39
80	0	1	2	4	9	13	18	22	27	31	36	40	45

Displaced (%)	Mortality Rate (%)												
	1	**2**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
90	1	1	3	5	10	15	20	25	30	35	40	45	50
100	1	1	3	6	11	17	22	28	34	39	45	50	56

5.4.24.2.4 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is one (1.08) individual. Assuming 51% of the gannet within the proposed development are breeding adults the total number of breeding adults in the array impacted by collision is less than one (0.60) per annum during the breeding bio-season.

Provided 12.7% of these collisions are breeding birds from Grassholm SPA (Apportioning Appendix), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.07) breeding adults (Table 5.111).

The population of gannet at the Grassholm SPA has changed since the citation colony count in 2001 with the latest colony count undertaken in 2015 being 6,022 individuals greater (72,022 birds). The potential impact on the population has been assessed against both the 2001 citation count and the latest colony count.

Based on a citation colony count of 66,000 breeding adults and annual adult background mortality of 5,346 (5,346.0) individuals, the addition of less than one breeding adult mortality would represent a 0.003% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 72,022 individuals and an annual background mortality of 5,834 (5,833.8) adults, this would represent a 0.002% increase in baseline mortality during the breeding bio-season (Table 5.111).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is less than one (0.04) individual, and individual during the return migration (0.00), provided 13.4 % and 11.2% of the gannet within the array area are deemed to be breeding adults from the Ailsa Craig SPA during the post-breeding migration bio- season and the return migration, respectively (Apportioning Appendix 17). The consequent mortality of adult birds is less than one (0.05) during the both migration bio-seasons (Table 5.113).

Based on a citation colony count of 66,000 breeding adults and annual adult background mortality of 5,346 (5,346.0) individuals, the addition of less than one breeding adult mortality would represent a 0.001% increase in baseline mortality during the post-breeding migration bio-season and 0.000% during the return migration. Similarly, when considering the latest colony count of 72,022 individuals and an annual background mortality of 5,834 (5,833.8) adults, this would also represent a 0.001% increase in baseline mortality during the post-breeding migration and 0.000% during the return migration (Table 5.111).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.05) breeding adult per annum. This represents an increase of 0.001% in baseline mortality when assessed against the latest colony count.

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Grassholm SPA is less than one (0.12) breeding adults per annum (Table 5.111).

The annual predicted mortality of less than one breeding adults from the Grassholm SPA across all bio-seasons indicates an increase in baseline mortality of 0.004% when considering both the citation colony count and 0.003% when considering the latest colony count (Table 5.111).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Grassholm SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.111: Seasonal Collision Mortalities During the Operational Phase for Gannet at Grassholm SPA[57].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.07	0.00 – 0.23	0.003	0.000 – 0.004	0.002	0.000 – 0.004
Post-breeding migration	0.04	0.00 – 0.15	0.001	0.000 – 0.003	0.001	0.000 – 0.003
Return migration	0.00	0.00 – 0.01	0.000	0.000 – 0.000	0.000	0.000 – 0.000
Non-breeding Total	0.05	0.00 – 0.16	0.001	0.000 – 0.003	0.001	0.000 – 0.003
Annual Total	0.12	0.01 – 0.39	0.004	0.000 – 0.007	0.003	0.000 – 0.007

5.4.24.2.5 Combined Collision Risk and Disturbance and Displacement

Gannet have been screened in for both collision risk and displacement assessments during the operational phase there is therefore a potential for these two potential impacts to adversely affect the gannet population at Grassholm SPA combined.

Based on the separate assessments of gannet from Grassholm SPA above, the combines predicted annual impact from collision risk and displacement is less than one (0.74) breeding adult mortality. This represents an increase in baseline mortality of 0.014% when considering the latest colony count and 0.013% when considering the 2001 citation colony count.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the gannet QI of Grassholm SPA in relation to combined collision risk and displacement effects from operational phase of the proposed development alone and therefore, subject to natural change, the gannet QI will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

5.4.25 Blackwater Callows SPA

5.4.25.1 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Blackwater Callows SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.26 Horn Head to Fanad Head SPA

5.4.26.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the Horn Head to Fanad Head SPA are considered within this section:

Table 5.112: qualifying interests and Conservation Objectives of the Horn Head to Fanad Head SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188]	"To maintain or restore the favourable conservation condition of the bird species listed as Qualifying Interests for this SPA: The favourable conservation status of a species is achieved when:

[57] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

	• population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and • the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

5.4.26.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The array area is situated 190.7km from the Horn Head to Fanad Head SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from Horn Head to Fanad Head SPA has been assessed for the full breeding season (March –August), the post-breeding migration bio-season (September – December) and the return migration bio-season (January - February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.26.2.1 Mitigation

The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This decreases collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.26.2.2 Collision Risk (Operation)

Breeding Bio-season

The predicted collision mortality during the breeding bio-season is five (5.36) individuals. Assuming 47% of these five individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than three (2.52) per annum during the breeding bio-season.

Provided 0.16% of these collisions are breeding birds from the Horn Head to Fanad Head SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.00) breeding adult (Table 5.113).

The population of kittiwake at the Horn Head to Fanad Head SPA has not changed considerably since the citation colony count in 1999 with the latest colony count undertaken in 2015 being 213 individuals fewer (3,640 birds). The potential impact on the population has been assessed against both the 1999 citation count and the latest colony count undertaken in 2015.

Based on a citation population of 3,853 breeding adults and annual adult background mortality of 563 (562.5) individuals, the addition of less than one breeding adult mortality would represent a 0.001% increase in baseline mortality during the breeding bio-season. Whereas, when considering the latest colony count of 3,640 individuals and an annual background mortality of 531 (531.4) adults, this would represent a 0.001% increase in baseline mortality during the breeding bio-season (Table 5.113).

Non-breeding Bio- season

The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is 7 (6.5) individuals, and 7 (7.4) individuals during the return migration, provided 0.4% and 0.5% of the kittiwake within the array area are deemed to be breeding adults from the Horn Head to Fanad Head SPA, respectively (Apportioning Appendix 20). The consequent mortality of adult birds is less than one (0.03) individual during the post-breeding migration bio- season and less than one (0.05) during the return migration bio-season (Table 5.113).

Based on the 1999 citation population of breeding adults the addition of less than one predicted breeding adult mortality during the post-migration breeding season and the return migration would indicate an increase in baseline mortality of 0.005% and 0.009%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.005% and 0.010% increase in baseline mortality during the post-breeding migration bio-season and return migration, respectively (Table 5.113).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.08) breeding adult per annum. This represents an increase of 0.014% in baseline mortality of the 1999 citation colony count and 0.015% increase using the latest colony count (Table 5.113).

Annual Total

Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the Horn Head to Fanad Head SPA is less than one (0.08) breeding adult per annum (Table 5.113).

The annual predicted mortality of less than one breeding adults from the Horn Head to Fanad Head SPA across all bio-seasons indicates an increase in baseline mortality of 0.014% and 0.015% when considering the 1999 citation colony count and the latest colony count, respectively.

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population (Table 5.113). There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Horn Head to Fanad Head SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.113: Seasonal Collision Mortalities during the Operational Phase for Kittiwake at Horn Head to Fanad Head SPA[58].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	**95% LCI - UCI**	**Mean**	**95% LCI - UCI**	**Mean**	**95% LCI - UCI**
Breeding	0.00	0.00 – 0.01	0.001	0.000 – 0.002	0.001	0.000 – 0.002
Post-breeding migration	0.03	0.00 – 0.06	0.005	0.000 – 0.011	0.005	0.000 – 0.012
Return migration	0.05	0.00 – 0.14	0.009	0.000 – 0.025	0.010	0.000 – 0.027
Non-breeding Total	0.08	0.00 – 0.20	0.014	0.001 – 0.036	0.015	0.001 – 0.038
Annual Total	0.08	0.00 – 0.20	0.014	0.001 – 0.038	0.015	0.001 – 0.040

[58] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

5.4.27 Cork Harbour SPA

5.4.27.1 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Cork Harbour SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.28 Courtmacsherry SPA

5.4.28.1 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Courtmacsherry SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.29 North Colonsay and Western Cliffs SPA

North Colonsay and Western Cliffs SPA is located 259.5km from the proposed development array area and encompasses an area of rocky coast, cliffs, and maritime heath on the island of Colonsay in Argyll, Scotland. The SPA boundary extends seaward by 1km into the marine area and overlaps with the North Colonsay SSSI and the West Colonsay Seabird Cliffs SSSI boundaries. This site is of high ornithological importance as the northernmost stable population of chough (*Pyrrhocorax pyrrhocorax*) in Europe is supported within the SPA alongside population of more than 20,000 individual seabirds including kittiwake and guillemot. Of these species only kittiwake has been considered within the ornithological assessment presented below.

5.4.29.1 Qualifying Interests and Conservation Objectives

The following qualifying interests of the North Colonsay and Western Cliffs SPA are considered within this section:

Table 5.114: qualifying interests and Conservation Objectives of the North Colonsay and Western Cliffs SPA

Qualifying Interests Screened In	Conservation Objectives
Kittiwake [A188]	"To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and • To ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species"

5.4.29.2 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development alone.

The proposed development array area is situated 259.5km from the North Colonsay and Western Cliffs SPA, which is within the MMF+1SD for kittiwake (156.1+144.5km) (Woodward et al., 2019) and has therefore been screened in for the breeding season. Kittiwake will disperse throughout the bio-geographic region, during the non-breeding season. However, a proportion of birds from this SPA are estimated to be present within the proposed development array area and therefore have been screened in for non-breeding bio-season (September – February) as per Furness (2015).

Collision risk of kittiwake from North Colonsay and Western Cliffs SPA has been assessed for the full breeding bio-season (March – August), the post-breeding migration bio-season (September –December) and the return migration bio-season (January – February), this species does not have a migration- free winter season, as defined by Furness (2015).

5.4.29.2.1 Mitigation
The project has mitigated considerably for collision by increasing the air draft to 40m LAT. This can decrease collisions by up to 80% for some species (e.g. kittiwake) from the proposed development and has provided a demonstrable reduction in collision risk for this species. For more details on mitigation measures in place to reduce impacts to birds see Section 4.16.

5.4.29.2.2 Collision Risk (Operation)

Migration- free Breeding Bio-season
The predicted collision mortality during the breeding bio-season is five (5.4) individuals. Assuming 47% of these 5 individuals, are breeding adults the total number of breeding adults in the array impacted by collision is less than three (2.5) per annum during the migration-free breeding bio-season.

Provided 0.4% of these collisions are breeding birds from the North Colonsay and Western Cliffs SPA (Apportioning Appendix 20), then the resultant mortality during the breeding bio-season is estimated to be less than one (0.01) breeding adults (Table 5.115).

The population of kittiwake at the North Colonsay and Western Cliffs SPA has changed considerably since the citation colony count in 2009 with the latest colony count undertaken in 2020 being 3,295 individuals fewer (1,217 birds). The potential impact on the population has been assessed against both the 2009 citation count and the latest colony count undertaken in 2023.

Based on a citation colony count of 4,512 breeding adults and annual adult background mortality of 659 (658.8) individuals, the addition of less than one breeding adult mortality would represent a 0.009% increase in baseline mortality during the migration-free breeding bio-season. Whereas, considering the latest colony count of 1,217 individuals and an annual background mortality of 178 (177.7) adults, this would represent a 0.005% increase in baseline mortality during the breeding bio-season (Table 5.115).

Non-breeding Bio- season
The predicted collision mortality as a result of the operational phase in the post-breeding migration bio-season is 6 (6.5) individuals, and 7 (7.4) individuals during the return migration, provided 0.7% the kittiwake within the proposed development array area are deemed to be breeding adults from the North Colonsay and Western Cliffs SPA during the post-breeding migration bio- season and the return migration (Apportioning Appendix 20). The consequent mortality of adult birds is less than one during the both migration bio-seasons, 0.05 during the post- breeding migration bio-season and 0.07 during the return migration (Table 5.115).

Based on the 2009 citation population of breeding adults the addition of less than one (0.05) predicted breeding adult mortality during the post-migration breeding season and less than one (0.07) mortality during the return migration would indicate an increase in baseline mortality of 0.002% and 0.004%, respectively. Whereas the potential impact on the population when assessed against the latest colony count would represent a 0.026% and 0.040% increase in baseline mortality in the post-breeding migration bio-season and return migration, respectively (Table 5.115).

This equates to a total consequent mortality from displacement across the entire non-breeding bio-season of less than one (0.12) breeding adult per annum. This represents an increase of 0.006% in baseline mortality of the 2009 citation population and 0.065% increase using the latest population count.

Annual Total
Throughout the operational phase of the proposed development, the predicted resultant mortality across all bio-seasons, attributed to the North Colonsay and Western Cliffs SPA is less than one (0.13) breeding adult per annum (Table 5.115).

The annual predicted mortality of less than one breeding adults from the North Colonsay and Western Cliffs SPA across all bio-seasons indicates an increase in baseline mortality of 0.014% and 0.070% when considering the 2009 citation colony count and the latest colony count, respectively (Table 5.115).

Conclusion of AEoI

This level of impact would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of North Colonsay and Western Cliffs SPA in relation to collision risk effects from operational phase of the proposed development alone and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.115: Seasonal Collision Mortalities During the Operational Phase for Kittiwake at North Colonsay and Western Cliffs SPA[59].

Bio-season	Seasonal Predicted Collision Mortality		% increase in baseline mortality (citation count)		% increase in baseline mortality (latest count)	
	Mean	95% LCI - UCI	Mean	95% LCI - UCI	Mean	95% LCI - UCI
Breeding	0.01	0.00 – 0.02	0.009	0.001 – 0.021	0.005	0.000 – 0.012
Post-breeding migration	0.05	0.00 – 0.11	0.002	0.000 – 0.007	0.026	0.002 – 0.061
Return migration	0.07	0.00 – 0.15	0.004	0.000 – 0.013	0.040	0.002 – 0.084
Non-breeding Total	0.12	0.01 – 0.26	0.006	0.000 – 0.021	0.065	0.004 – 0.145
Annual Total	0.13	0.01 – 0.28	0.014	0.001 – 0.041	0.070	0.005 – 0.157

5.4.30 Clonakilty SPA

5.4.30.1 Migratory Collision Risk (Operation)

An assessment of migratory collision risk for QIs screened in for that impact at Clonakilty SPA is provided in Section 5.4.30.2, concluding no AEoI for all assessed species.

5.4.30.2 Migratory Waterbird Assessment

The following ornithological QIs have been screened in due to the potential risk of collision during migration periods (Table 5.116). For further details regarding the migratory CRM (mCRM) assessment see the Migratory Collison Risk Monitoring Appendix (Appendix 19).

The percentage increase in baseline mortality for each species is calculated using the summed citation counts for all SPAs within 100 km of the offshore development area and other SPAs beyond 100km that have >10% connectivity with the array area. The proportion to each SPA is calculated by dividing the SPA citation count by the summed total for all SPAs assessed. The predicted impact is then multiplied by the proportion to calculate the apportioned impact for each species per SPA. Using adult survival rates from the mCRM tool ("mCRM App"; HiDef Aerial Surveying Ltd., 2024) the baseline mortality for each species per SPA can be calculated.
Then the apportioned impact was divided by the SPA baseline mortality to calculate the percentage increase in baseline mortality for each QI of the relevant SPA. For further details regarding the approach to the mCRM see the Migratory Collision Risk Monitoring Appendix (Appendix 19).

The predicted annual collision mortality for each QI at designated sites screened in for this assessment are presented in Table 5.116. As outlined in the Migratory Collision Risk Monitoring Appendix (Appendix 19), species were only taken through to assessment if >1% of the Irish population was predicted to pass through the array area. From this process, greylag goose and bar-tailed godwit were screened out from further assessment.

---

[59] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

The number of annual collision mortalities estimated for all QI are very low as such any changes in the baseline mortality for all QI are predicted to be non-material and indistinguishable from natural fluctuations in their populations.

Conclusion of AEoI

Therefore, it is concluded that predicted mortality of all qualifying migratory waterbird QIs in relation to collision risk effects of the proposed development alone and in-combination with other projects would not adversely affect the integrity of the designated sites screened in for this assessment.

Based on the increased risk of effects of Project Option 1, the same conclusion of no AEoI is drawn for Project Option 2.

Table 5.116: Predicted Annual Collision Mortalities to Migratory Waterbird QIs for All Designated Sites Screened In for the Proposed Development.

Site	Qualifying Interest	SPA citation population	Summed SPA citation counts	Predicted annual collision mortality	% increase in baseline mortality (citation count)
North-West Irish Sea cSPA	Great northern diver	176	203	0.003	0.015
	Red-throated diver	Not assessed (<1% of Irish population predicted to pass through offshore development area)			
	Common scoter	14,567	14,567	0.398	0.001
Skerries Island SPA	Light-bellied brent goose	242	7,102	0.001	0.003
	Purple sandpiper	46	94	0.002	0.021
	Turnstone	242	2,331	0.006	0.017
Lambay Island	Greylag goose	Not assessed (<1% of Irish population predicted to pass through offshore development area)			
Rockabill SPA	Purple sandpiper	48	94	0.002	0.021
Poulaphouca Reservoir SPA	Greylag goose	701	-	0.000	0.000
Baldoyle Bay SPA	Bar-tailed godwit	Not assessed (<1% of Irish population predicted to pass through offshore development area)			
	Golden plover	2,120	40,136	0.025	0.004
	Grey plover	200	1,982	0.000	0.001
	Light-bellied brent goose	726	7,102	0.002	0.003
	Ringed plover	223	1,905	0.003	0.005
	Shelduck	147	8,221	0.001	0.008
Blackwater Callows SPA	Bewick’s Swan	4	251	0.000	0.000
	Black-tailed Godwit	251	8,455	0.003	0.022
	Curlew	457	8,867	0.002	0.005
	Lapwing	191	30,902	0.000	0.001

Site	Qualifying Interest	SPA citation population	Summed SPA citation counts	Predicted annual collision mortality	% increase in baseline mortality (citation count)
	Mallard	398	8,343	0.021	0.014
	Shoveler	26	642	0.001	0.013
	Teal	898	7,844	0.126	0.030
	Whooper Swan	212	1,140	0.029	0.068
	Wigeon	2,313	12,156	0.279	0.026
Boyne Estuary SPA	Black-tailed godwit	471	8,455	0.006	0.022
	Golden plover	6,070	40,136	0.072	0.004
	Grey plover	146	1,982	0.000	0.001
	Knot	1,944	19,778	0.005	0.002
	Lapwing	4,771	30,902	0.009	0.001
	Oystercatcher	1,179	27,872	0.005	0.004
	Redshank	583	10,166	0.005	0.003
	Sanderling	81	783	0.003	0.020
	Shelduck	218	8,221	0.002	0.008
	Turnstone	221	2,331	0.005	0.017
Clonakilty Bay SPA	Black-tailed Godwit	874	8,455	0.011	0.022
	Curlew	599	8,867	0.003	0.005
	Dunlin	1,172	41,364	0.008	0.003
	Shelduck	156	8,221	0.001	0.008
Cork Harbour SPA	Bar-tailed Godwit	Not assessed (<1% of Irish population predicted to pass through offshore development area)			
	Black-tailed Godwit	1,896	8,455	0.025	0.022
	Curlew	2,237	8,867	0.012	0.005
	Dunlin	9,621	4,1364	0.069	0.003
	Gadwall	6	116	0.000	0.000
	Golden Plover	3,342	40,136	0.039	0.004
	Goldeneye	21	13,237	0.000	0.005
	Great Crested Grebe	253	1,594	0.004	0.006
	Greenshank*	46	162	0.001	-

Site	Qualifying Interest	SPA citation population	Summed SPA citation counts	Predicted annual collision mortality	% increase in baseline mortality (citation count)
	Grey Plover	95	1,982	0.000	0.001
	Knot	26	19,778	0.000	0.002
	Lapwing	7,569	30,902	0.015	0.001
	Mallard	513	8,343	0.027	0.014
	Oystercatcher	1,809	27,872	0.008	0.004
	Pintail	57	679	0.006	0.029
	Pochard	72	32,783	0.000	0.001
	Red-breasted Merganser	121	752	0.011	0.046
	Redshank	2,149	10,166	0.018	0.003
	Ringed Plover	73	1,905	0.001	0.005
	Shelduck	2,009	8,221	0.018	0.008
	Shoveler	103	642	0.006	0.013
	Teal	1,065	7,844	0.150	0.030
	Tufted Duck	64	24,302	0.002	0.008
	Turnstone	113	2,331	0.003	0.017
	Whooper Swan	5	1,140	0.001	0.068
	Wigeon	1,791	12,156	0.216	0.026
Courtmacsherry Bay SPA	Bar-tailed Godwit	Not assessed (<1% of Irish population predicted to pass through offshore development area).			
	Black-tailed Godwit	506	8,455	0.007	0.022
	Curlew	1,357	8,867	0.007	0.005
	Dunlin	1,353	41,364	0.010	0.003
	Golden Plover	5,759	40,136	0.068	0.004
	Lapwing	2,713	30,902	0.005	0.001
	Red breasted Merganser	63	752	0.006	0.046
	Shelduck	175	8,221	0.002	0.008
	Wigeon	934	12,156	0.113	0.026
	Great northern diver	27	203	<0.001	0.015
Malahide Estuary SPA	Bar-tailed godwit	Not assessed (<1% of Irish population predicted to pass through offshore development area).			

Site	Qualifying Interest	SPA citation population	Summed SPA citation counts	Predicted annual collision mortality	% increase in baseline mortality (citation count)
	Black-tailed godwit	409	8,455	0.005	0.022
	Dunlin	1,594	41,364	0.011	0.003
	Golden plover	1,843	40,136	0.022	0.004
	Goldeneye	215	13,237	0.002	0.005
	Great crested grebe	63	1,594	0.001	0.006
	Grey plover	201	1,982	0.000	0.001
	Knot	915	19,778	0.002	0.002
	Light-bellied brent goose	1,104	7,102	0.003	0.003
	Oystercatcher	1,360	27872	0.006	0.004
	Pintail	58	679	0.006	0.029
	Red-breasted merganser	99	752	0.009	0.046
	Redshank	581	10,166	0.005	0.003
	Shelduck	439	8,221	0.004	0.008
River Nanny Estuary and Shore SPA	Golden plover	1,759	40,136	0.021	0.004
	Knot	1,140	19,778	0.003	0.002
	Oystercatcher	1,041	27,872	0.005	0.004
	Ringed plover	185	1,905	0.002	0.005
	Sanderling	240	783	0.008	0.020
Rogerstown Estuary SPA	Black-tailed godwit	195	8,455	0.003	0.022
	Dunlin	2,745	41,364	0.020	0.003
	Grey plover	229	1,982	0.000	0.001
	Knot	2,454	19,778	0.007	0.002
	Light-bellied brent goose	1,069	7,102	0.003	0.003
	Greylag goose	Not assessed (<1% of Irish population predicted to pass through offshore development area).			
	Oystercatcher	1,345	27872	0.006	0.004
	Redshank	450	10,166	0.004	0.003
	Ringed plover	188	1,905	0.002	0.005

Site	Qualifying Interest	SPA citation population	Summed SPA citation counts	Predicted annual collision mortality	% increase in baseline mortality (citation count)
	Shelduck	773	8,221	0.007	0.008
	Shoveler	59	642	0.003	0.013

*Adult survival rates could not be found for Greenshank therefore increase in baseline mortality could not be calculated for this species. Given the predicted annual collision mortality of 0.001 birds it can be assumed that any impacts on the population of this SPA are non-material and incapable of leading to an adverse effect on integrity.

5.5 Stage 2 Appropriate Assessment Alone Conclusion

It was concluded for all sites considered within this assessment that there is no AEoI of the sites or their COs resulting from the proposed development alone.

6. Stage 2 In-Combination Assessment

As detailed in Section 1.8, Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are also considered.

In-combination effects of both plans and projects must be considered (i.e. not solely other projects). It should also be noted that plans/projects extend beyond those covered by the 2000 Act.

Full details on the criteria, tiers and process used for the in-combination assessment can be found in Section 1.13. Accordingly, the following types of plans or projects have been screened in:

- Those under construction;
- Those projects that are only partially constructed at the time that baseline characterisation is undertaken;
- Projects in operation that have ongoing effects, e.g. collision risk;
- Projects that were only recently completed and so the full extent of the impacts arising from the development(s) may not be reflected in the baseline;
- Those plans and projects which may have consent or licences to undertake further work, such as maintenance dredging or notable maintenance works which may arise in additional effects.
- Permitted application(s), but not yet implemented;
- Submitted application(s), but not yet determined;
- Projects on the An Bord Pleanála website including those at pre-application stage;
- Identified in the relevant development plan (and emerging development plans - with appropriate weight given as they move closer to adoption) recognising that much information on any relevant proposals will be limited; and
- 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.

The screening process was based on a longlist of reasonably foreseeable proposals, which was further reduced to a shortlist for assessment based on whether a spatial or temporal overlap between the potential effects of the projects.

The short list of plans and projects identified for in combination assessment is presented and considered in the relevant Table for each of the four receptor headings listed below.

For the purposes of in combination consideration, and to avoid unnecessary repetition, the assessments have been presented using the following receptor headings, capturing all relevant sites for which they are designated:

- Coastal and marine habitats
- Migratory fish
- Marine mammals; and
- Ornithology

6.1 Coastal and Marine Habitats

For the purposes of the in-combination assessment a screening range of 24km from a designated site was applied to identify any plans and projects which may have the potential to interact with the proposed development to result in an AEoI.

The screening range has been determined by reference to the modelled tidal ellipse and sediment plume modelling which describes the maximum distance over which suspended sediments at concentrations above background levels may be displaced as 12km i.e. the distance at which no elevation above background suspended solids concentrations are observed for the maximum potential effect from the proposed development. The precautionary distance of 24km was selected to take into account the spatial extent of similar impacts arising from other projects.

For the in-combination effects assessment of the potential impacts on coastal and marine SACs related to the onshore development area, projects and plans occurring within the same hydrological catchment as the onshore development area and which have the potential to result in water quality effects were screened in.

Those SACs considered for in-combination assessment (see Table 6.1) are:

- Boyne Coast and Estuary SAC
- Malahide Estuary SAC
- Rockabill to Dalkey Island SAC
- Rogerstown Estuary SAC
- Baldoyle Bay SAC

Plans and projects shortlisted for in-combination assessment are provided and considered in Table 6.1 , with a subsequent assessment of the screened in designated sites (SACs), as identified through application of the 24km screening range.

Table 6.1 : Plans and Projects Identified for Consideration within the In-Combination Assessment.

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
Operations and Maintenance Facility (OMF) at Greenore	Tier 1 Pre-Consent	Owing to the early stage of the project within the planning process, exact information related to the proposed works is not available.	33.9	38.8	45.4	The proposed dates of the works related to the OMF may overlap with that of the proposed development. However, due to the distance of the OMF from the SACs identified (i.e. >24km) there is no potential for an in-combination effect with the proposed development.	The introduction of invasive species associated with the proposed development is anticipated to occur through the introduction of hard substrates in the form of foundation installation. This impact is therefore extremely localised and limited to the development area. There is no direct spatial overlap between the proposed development and the OMF. Consequently there is no potential for an in-combination effect between the proposed development and the OMF.	Habitat loss through physical disturbance is anticipated to only occur within the immediate vicinity of the works at the proposed development site. There is no direct spatial overlap between the proposed development and the OMF. This, allied to the distance of both the proposed development and the OMF from the identified SACs, indicates that there is no potential for an in-combination effect between the proposed development and the OMF.	Project screened out for In-Combination Assessment.	N/A
Oriel Wind Farm	Tier 2 - Concept/ Early Planning	Construction to take place between 2026-2028 with piling anticipated in 2027.	16.9	21.6	29.8	The proposed dates of the works related to Oriel Wind Farm may overlap with that of the proposed development. Therefore, given the distance between the Oriel Wind Farm site and the Boyne Coast and Estuary SAC there is potential for in-combination effects with the proposed development. Other SACs identified are >24km from the Oriel Wind Farm site.	The introduction of invasive species associated with the proposed development is anticipated to occur through the introduction of hard substrates in the form of foundation installation. This impact is therefore extremely localised and limited to the development area. There is no direct spatial overlap between the proposed development Oriel Windfarm. Consequently there is no potential for an in-combination effect between the proposed development and Oriel Wind Farm.	Habitat loss through physical disturbance is anticipated to only occur within the immediate vicinity of the works at the proposed development site. There is no direct spatial overlap between the proposed development and the Oriel Wind Farm site. This, allied to the distance of both the proposed development and the Oriel Wind Farm site from the identified SACs, indicates that there is no potential for an in-combination effect between the proposed development and the Oriel Wind Farm project.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Boyne Coast SAC

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
Drogheda Port Company	Tier 3 – Consented	Maintenance dredging between the period 2021 and 2029 within the commercial estuary of the river Boyne and associated release of dredged material from vessels at predefined dumping sites approximately 4km northeast (site A1) and 4km north (site A2) from the Drogheda port entrance.	15.3	14.3	13.67	The proposed dates of the Drogheda Port Company dredging programme may overlap with that of the proposed development. Therefore, given the distance between the Drogheda Port Company dredge and dredge dump sites and the Boyne Coast and Estuary SAC and Rockabill to Dalkey Island SAC there is potential for in-combination effects with the proposed development. Other SACs identified are >24km from the Oriel Wind Farm site.	The introduction of invasive species associated with the proposed development is anticipated to occur through the introduction of hard substrates in the form of foundation installation. This impact is therefore extremely localised and limited to the development area. There is no direct spatial overlap between the proposed development and the Drogheda Port Company dredge and disposal sites. Consequently there is no potential for an in-combination effect between the proposed development and the Drogheda Port Company dredge and disposal sites.	Habitat loss through physical disturbance is anticipated to only occur within the immediate vicinity of the works at the proposed development site. There is no direct spatial overlap between the proposed development and the Drogheda Port Company dredge and disposal sites. This, allied to the distance of both the proposed development and the Drogheda Port Company dredge and disposal sites from the identified SACs, indicates that there is no potential for an in-combination effect between the proposed development and Drogheda Port Company dredging programme.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Boyne Coast SAC Rockabill to Dalkey Island SAC
Warrenpoint	Tier 3 - Consented	Maintenance dredging from 2024 to 2027. The dredged material will be transported and deposited at the Warrenpoint B disposal site.	23.7	28.9	52.93	The proposed dates of the Warrenpoint dredging programme may overlap with that of the proposed development. However, due to the distance of the Warrenpoint dredging and disposal sites from the SACs identified (i.e. >24km)there is no potential for an in-combination effect with the proposed development.	The introduction of invasive species associated with the proposed development is anticipated to occur through the introduction of hard substrates in the form of foundation installation. This impact is therefore extremely localised and limited to the development area. There is no direct spatial overlap between the proposed development and the Warrenpoint dredge and disposal sites. Consequently there is no potential for an in-combination effect between the proposed development and the Warrenpoint dredge and disposal sites.	Habitat loss through physical disturbance is anticipated to only occur within the immediate vicinity of the works at the proposed development site. There is no direct spatial overlap between the proposed development and the Warrenpoint dredge and disposal sites. This, allied to the distance of both the proposed development and the Warrenpoint dredge and disposal sites from the identified SACs, indicates that there is no potential for an in-combination effect between the proposed development and Warrenpoint dredging programme.	Project screened out for In-Combination Assessment.	N/A

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
Planning ref. 316504	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, as proposed mitigation measures associated with the Tier 3 project result in no significant long term adverse impacts for that project alone, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Greater Dublin Drainage Project	Tier 3 – in planning	Greater Dublin Drainage Project	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
BusConnects Clongriffin to City Centre Core Bus Corridor Scheme	Tier 3 - Consented	Transport Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 313337	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 313494	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC

[1] Distance to the array area and the ECC are Not Applicable (NA) for these Tier 3 plans and projects as they are onshore plans and projects and relate to the in-combination assessment for the onshore development area. A distance has not been provided to the onshore development area, however, they have been identified as being located within the same hydrological catchment as the onshore development area, and are therefore screened in for the in-combination assessment.

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
						predicted with the proposed development.				
Planning ref. 316444	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 313362	Tier 3 - Consented	Residential Development	NA[1]	NA[1]	0.35	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 312112	Tier 3 - Consented	Residential Development	NA[1]	NA[1]	0.52	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 313361	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0.59	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
BusConnects Swords to City Centre Bus Corridor Scheme	Tier 3 – in planning	Transport Infrastructure	NA[1]	NA[1]	1.68	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Grid connection infrastructure for solar development	Tier 3 - Consented	Electricity Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
						are no likely significant direct or indirect in-combination effects predicted with the proposed development.				
Provision of a double circuit 110kV underground transmission line SID/01/19 (ABP 303687-19)	Tier 3 - Consented	Electricity Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. ABP 313360-22	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
School Development amendments	Tier 3 - Consented	School Development	NA[1]	NA[1]	0.26	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Belcamp Extension Project	Tier 3 - Consented	Electricity Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. F21A/0647	Tier 3 – in planning	Residential Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
Synchronous Compensator Development south of Belcamp Substation	Tier 3 - Consented	Electricity Infrastructure	NA[1]	NA[1]	0.003	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 3696/18	Tier 3 - Consented	Commercial Developments	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
MetroLink – Estuary through Swords, Dublin Airport, Ballymun, Glasnevin and City Centre to Charlemont, Co. Dublin	Tier 3 – in planning	Transport Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Metrolink 110kV proposed development of three 110kV electricity circuits	Tier 3 – in planning	Electricity Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. F23A/0034	Tier 3 - Consented	Commercial Development	NA[1]	NA[1]	0.25	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Fingal Coastal Way	Tier 3 – pending application	Greenway	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
						predicted with the proposed development.				
Development of an aviation fuel pipeline	Tier 3 - Consented	Infrastructure Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
R132 Connectivity Project	Tier 3 - Consented	Commercial Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Bremore Regional Park Development Project	Tier 3 – awaiting application	Greenway	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 305623	Tier 3 - Consented	Infrastructure Development	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 312855	Tier 3 - Consented	Transport Infrastructure	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there are no likely significant direct or indirect in-combination effects predicted with the proposed development.	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC
Planning ref. 301635	Tier 3 - Consented	Sports and Recreation	NA[1]	NA[1]	0	This project is within the same hydrological catchment as the onshore development area, however, there	No pathways exist for transfer of marine INNS between terrestrial and marine habitats.	No pathways exist between onshore and offshore physical processes.	Included for assessments relating to Suspended Sediment and Deposition, and Accidental Pollution.	Malahide Estuary SAC Rogerstown Estuary SAC Baldoyle Bay SAC

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to onshore cable route (km)	Suspended Sediment and Deposition	Accidental Pollution	Marine INNS	Physical processes	Screening conclusion In-Combination
						are no likely significant direct or indirect in-combination effects predicted with the proposed development.				

6.1.1 Malahide Estuary SAC

Based on the alone assessments for the proposed development (Section 5) and the consideration of plans and projects identified within Table 6.1 , Malahide Estuary SAC has been screened in for the following effects:

- Onshore suspended sediment / deposition.
- Onshore accidental pollution

Due to the proximity to the SAC and the maximum extent of any impacts the projects considered for the in-combination assessment for this designated site are those onshore projects and plans occurring within the same hydrological catchment as the development area.

6.1.1.1 Accidental Pollution (Construction, Operation and Decommissioning)

6.1.1.1.1 Assessment

During all phases of the proposed development substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt from onshore activities into the aquatic environment and ultimately reach the marine environment. Through the CEMP the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. These will include pollution contingency measures to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out onshore; a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; and a waste management plan. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident.

All other onshore projects considered in the in-combination assessment will be required to implement pollution contingency measures detailed in individual CEMPs.

No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of the proposed development. Consequently, it is considered that and there will be no significant onshore polluting effect from this project impacting coastal and marine habitats.

6.1.1.1.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Malahide Estuary SAC from Accidental Pollution associated with the proposed development when considered in combination with onshore developments.

6.1.1.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

6.1.1.2.1 Assessment

Increased suspended sediment arising from onshore works associated with the proposed development reaching the marine environment via surface water will be localised to the immediate downstream area of the works. Similarly, any SSC arising from other onshore projects within the same hydrological catchment will enter the SAC by the same route. However, through the implementation of the mitigation measures detailed within the CEMP, the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. All other onshore projects identified for in-combination assessment will be required to implement similar surface water contingency measures detailed in individual CEMPs.

Consequently, inputs of SSC from the proposed development and other onshore projects will be negligible and no significant in-combination effects are predicted from these onshore projects with the proposed development.

6.1.1.2.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Malahide Estuary SAC from Suspended Sediment and Deposition associated with the proposed development when considered in combination with onshore developments.

6.1.2 Rogerstown Estuary SAC

Based on the alone assessments for the proposed development (Section 5) and the consideration of plans and projects identified within Table 6.1 , Rogerstown Estuary SAC has been screened in for the following effects:

- Onshore suspended sediment / deposition.
- Onshore accidental pollution

Due to the proximity to the SAC and the maximum extent of any impacts (i.e. within 24km for SSC) the projects considered for the in-combination assessment for this designated site are those onshore projects and plans occurring within the same hydrological catchment as the development area.

6.1.2.1 Accidental Pollution (Construction, Operation and Decommissioning)

6.1.2.1.1 Assessment

During all phases of the proposed development substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt from onshore activities into the aquatic environment and ultimately reach the marine environment. Through the CEMP the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. These will include pollution contingency measures to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out onshore; a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; and a waste management plan. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident.

All other onshore projects considered in the in-combination assessment will be required to implement pollution contingency measures detailed in individual CEMPs.

No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of the proposed development. Consequently, it is considered that and there will be no significant onshore polluting effect from this project impacting coastal and marine habitats.

6.1.2.1.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Rogerstown Estuary SAC from Accidental Pollution associated with the proposed development when considered in combination with onshore developments.

6.1.2.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

6.1.2.2.1 Assessment

Increased suspended sediment arising from onshore works associated with the proposed development reaching the marine environment via surface water will be localised to the immediate downstream area of the works. Similarly, any SSC arising from other onshore projects within the same hydrological catchment will enter the SAC by the same route. However, through the implementation of the mitigation measures detailed within the CEMP, the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities.

All other onshore projects identified for in-combination assessment will be required to implement similar surface water contingency measures detailed in individual CEMPs.

Consequently, inputs of SSC from the proposed development and other onshore projects will be negligible and no significant in-combination effects are predicted from these onshore projects with the proposed development.

6.1.2.2.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Rogerstown Estuary SAC from Suspended Sediment and Deposition associated with the proposed development when considered in combination with onshore developments.

6.1.3 Baldoyle Bay SAC

Based on the alone assessments for the proposed development (Section 5) and the consideration of plans and projects identified within Table 6.1 , Baldoyle Bay Estuary SAC has been screened in for the following effects:

- Onshore suspended sediment / deposition.
- Onshore accidental pollution only.

Due to the proximity to the SAC and the maximum extent of any impacts (i.e. within 24km for SSC) the projects considered for the in-combination assessment for this designated site are those onshore projects and plans occurring within the same hydrological catchment as the development area.

6.1.3.1 Accidental Pollution (Construction, Operation and Decommissioning)

6.1.3.1.1 Assessment

During all phases of the proposed development substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt from onshore activities into the aquatic environment and ultimately reach the marine environment. Through the CEMP the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. These will include pollution contingency measures to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out onshore; a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; and a waste management plan. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident.

All other onshore projects considered in the in-combination assessment will be required to implement pollution contingency measures detailed in individual CEMPs.

No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of the proposed development. Consequently, it is considered that and there will be no significant onshore polluting effect from this project impacting coastal and marine habitats.

6.1.3.1.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on QIs for this impact from the proposed development when considered in combination with onshore developments.

6.1.3.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

6.1.3.2.1 Assessment

Increased suspended sediment arising from onshore works associated with the proposed development reaching the marine environment via surface water will be localised to the immediate downstream area of the works. Similarly, any SSC arising from other onshore projects within the same hydrological catchment will enter the SAC by the same route. However, through the implementation of the mitigation measures detailed within the CEMP, the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. All other onshore projects identified for in-combination assessment will be required to implement similar surface water contingency measures detailed in individual CEMPs.

Consequently, inputs of SSC from the proposed development and other onshore projects will be negligible and no significant in-combination effects are predicted from these onshore projects with the proposed development.

6.1.3.2.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Baldoyle Bay SAC from Suspended Sediment and Deposition associated with the proposed development when considered in combination with onshore developments.

6.1.4 Rockabill to Dalkey Island SAC

Based on the alone assessments for the proposed development (Section 5) and the consideration of plans and projects identified within Table 6.1 , Rockabill to Dalkey Island SAC has been screened in for the following effects:

- Suspended sediment / deposition;
- Accidental pollution.

Due to their proximity to the SAC and the maximum extent of any impacts (i.e. within 24km for SSC) the only project considered for the in-combination assessment for this site is the Drogheda Port Company dredging programme.

6.1.4.1 Accidental Pollution (Construction, Operation and Decommissioning)

6.1.4.1.1 Assessment

During all phases of the proposed development substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment. Through the offshore EMP the developer has identified best-practice techniques to minimise such inputs into the marine environment from all construction, operations and decommissioning activities. These will include a marine pollution contingency measures to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out below HWM; a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; and a waste management plan. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident.

Likewise, Drogheda Port has an Emergency Plan that includes its Pollution Response Plan for all activities within the port including dredging vessels[2].

---

[2] Drogheda Port Company Emergency Plan | Drogheda Port Company

No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of the proposed development. Additionally, site-specific surveys indicated that within the benthic assessments, the levels of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines (Natural Power Consultants, 2022 & 2023). Therefore, it is highly unlikely that any sediment disturbed by the projects considered in-combination will have a negative effect on the SAC.

6.1.4.1.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the project considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Rockabill to Dalkey Island SAC from Accidental Pollution associated with the proposed development when considered in combination with Drogheda Port Company dredging programme.

6.1.4.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

6.1.4.2.1 Assessment

Increases in SSC associated with proposed development are anticipated to extend up to approximately 12km from the source. Therefore, a 24km ZoI, which is based on twice the maximum spring tidal excursion, is considered precautionary and appropriate for any potential effects. Therefore, due regard has been afforded to the possibility of the works associated with the Drogheda Port Company dredging programmes and the proposed development occurring simultaneously.

In relation to the Drogheda Port Company dredging programme the cause of effects is primarily capital dredging and disposal. The potential effects from such works would be through temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. While the project timelines overlap, given the intermittent nature of the dredging work at Drogheda and the distance between the projects, significant in-combination effects are not anticipated between the proposed development and the Drogheda Port Company dredging programme.

With the exception of within the immediate vicinity of the activities, SSC levels within the resultant plumes from the projects being assessed here will be below background levels recorded during storm events. Because of this, it is considered that all benthic Qualifying Interests are expected to easily adapt to and/or tolerate the SSC plumes that are predicted both alone and cumulatively, particularly as SSC plumes are expected to quickly dissipate following cessation of activities.

For the decommissioning phase, the potential impacts are considered to be the same as construction, however with a lesser magnitude. Therefore, the same projects are considered for this stage of development and the same conclusions are drawn.

6.1.4.2.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effects from the proposed development alone and the above considerations for the project in-combination, it is considered that there is no potential for AEoI on the QIs of the Rockabill to Dalkey Island SAC from Suspended Sediment and Deposition associated in relation to the proposed development when considered in combination with onshore developments.

6.1.5 Boyne Coast and Estuary SAC

Based on the alone assessments for the proposed development (Section 5) and the consideration of plans and projects identified within Table 6.1 , Boyne Coast and Estuary SAC has been screened in for the following effects:

- Suspended sediment / deposition; and
- Accidental pollution.

Due to the proximity to the SAC and the maximum extent of any impacts (i.e. within 24km for SSC) the projects considered for the in-combination assessment for this site are the Drogheda Port Company dredging programme and Oriel Wind Farm.

6.1.5.1 Accidental Pollution (Construction, Operation and Decommissioning)

6.1.5.1.1 Assessment

During all phases of the proposed development substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment. Through the offshore EMP the developer has identified best-practice techniques to minimise such inputs into the marine environment from all construction, operation, and decommissioning activities. These will include marine pollution contingency measures to address the risks, methods, and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out below HWM; a chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; and a waste management plan. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident.

The other projects considered in this in combination assessment have similar measures through relevant environment management plans. For instance, Drogheda Port has an Emergency Plan that includes a Pollution Response Plan which considers all activities within the port including dredging vessels, while Oriel Wind Farm will be required to have environmental management plans in place similar to those for the proposed development.

No discharges (continuous or intermittent) of chemicals or construction materials which may be toxic or persistent within the marine environment are proposed during the construction phase of the proposed development. Additionally, site-specific surveys indicated that the levels of contaminants within the sediments within the offshore development area that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines (Natural Power Consultants, 2022 & 2023). Therefore, it is highly unlikely that any sediment disturbed by the projects considered in-combination will have a negative effect on the SAC.

6.1.5.1.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Boyne Coast and Estuary SAC from Accidental Pollution in relation to the proposed development when considered in combination with Drogheda Port Company maintenance dredging and Oriel Wind Farm.

6.1.5.2 Suspended Sediment and Deposition (Construction, Operation and Decommissioning)

6.1.5.2.1 Assessment

Increases in SSC associated with the proposed development are anticipated to extend up to approximately 12km from the source. Therefore, a 24km ZoI, which is based on twice the maximum spring tidal excursion, is considered precautionary and appropriate for any potential effects. Consequently, due regard has been afforded to the possibility of the works associated with the Drogheda Port Company dredging programme and Oriel Wind Farm and the proposed development occurring simultaneously.

In relation to the Drogheda Port Company maintenance dredging the cause of effects is primarily capital dredging and disposal. The potential effects from such works would be related to temporary increases in SSC and associated sediment deposition and smothering of the benthos and supporting habitats.

While the project timelines overlap, given the intermittent nature of the dredging work at Drogheda and the distance between the projects, significant in-combination effects are not anticipated between the proposed development and the Drogheda Port Company dredging programme.

In relation to the Oriel Wind Farm, the cause of effects is primarily simultaneous cabling. Owing to the early stage of the Oriel Wind Farm within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. Dates for construction for Oriel Wind Farm have been identified as 2026 to 2028, which overlaps with the construction of the proposed development. However, increased SSC rapidly dissipates immediately following the cessation of activities with the concentrations reducing quickly to background levels (i.e., within a couple of tidal cycles). This, allied to the distance between the two projects, would indicate that there would be no additive process for the increased SSC within the water column.

With the exception of within the immediate vicinity of the activities described the SSC levels within the plumes from all three projects considered here will be below background levels recorded during storm events. Consequently, it is considered that all benthic QIs are expected to easily adapt to and/or tolerate the SSC plumes that are predicted both alone and cumulatively, particularly as SSC plumes are expected to quickly dissipate following cessation of activities.

For the decommissioning phase, the potential impacts are considered to be the same as construction, Although at a lesser magnitude. Therefore, the same conclusions pertaining to the construction phase are drawn for the decommissioning phase.

6.1.5.2.2 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for the in-combination assessment, it is considered that there is no potential for AEoI on the QIs of the Boyne Coast and Estuary SAC in relation to Suspended Sediment and Deposition from the projects considered for in-combination assessment.

6.2 Migratory Fish

A range of proposed and consented plans and projects were scoped in for the in-combination assessment, based on the potential for AEoI from activities taking place in-combination with the proposed development. As for the project alone assessment, the only SAC considered in the in-combination assessment for qualifying migratory fish interests is the River Boyne and River Blackwater SAC.

To assess potential in-combination impacts from underwater noise, a screening range of 100km buffering the array area was applied. Based on project-specific noise modelling for the proposed development, the greatest impact range for the onset of TTS (186dB SEL_{cum}) for Group 1 (river lamprey) and Group 2 (Atlantic salmon) fleeing migratory fish during the piling of foundations is 51km (Underwater Noise Modelling Report). For any consented and proposed OWF within the Irish Sea, it is assumed that project parameters and maximum impact ranges for underwater noise would be similar to those for the proposed development. Therefore, a screening range of 100km is considered to be precautionary and likely to encapsulate the area within which potential significant in-combination effects on migratory fish might occur.

To assess potential in-combination impacts relating to seabed disturbance events including increases in SSC and sediment deposition and accidental pollution, a screening range of 24km from the River Boyne estuary has been applied. The screening range has been determined by reference to the project-specific sediment plume modelling, which describes the maximum distance over which suspended sediments at concentrations above background levels may be displaced as 12km (i.e. the distance at which no elevation above background suspended solids concentrations are observed for the maximum potential effect from the proposed development). The precautionary distance of 24km was selected to take into account the spatial extent of similar impacts arising from other projects in the vicinity of the SAC.

A screening range of 24km has also been applied to assess potential in-combination effects from EMF, based on the localised nature of any potential EMF effects on the qualifying interests and their likely movement and migration patterns while at sea. Those projects included within the in-combination assessment are listed in Table 6.1.

Construction of the proposed development is scheduled to take place between 2026 to 2029, with offshore construction currently anticipated to occur between 2027 and 2029, including preparation works. After construction, the proposed development will be operational for 35 years.

Table 6.1: Plans and Projects Screened into the In-Combination Assessment.

<table>
<tr><th>Plan or Project</th><th>Tier and Stage of Development</th><th>Planned Programme</th><th>Distance to array area (km)</th><th>Distance to ECC (km)</th><th>Distance to Proposed Development Boundary (km)</th><th>Underwater Noise</th><th>Suspended Sediment and Deposition</th><th>Accidental Pollution</th><th>EMF</th><th>Screening conclusion In-Combination</th></tr>
<tr><td>OMF at Greenore</td><td>Tier 1
Pre-Consent</td><td>Owing to the early stage of the project within the planning process, exact information related to the proposed works is not available.</td><td>33.9</td><td>38.8</td><td>NA</td><td>Piling may be required for the installation of the pontoon, which might affect migratory fish.</td><td colspan="2">The proposed dates of the works may overlap with that of the proposed development. However, due to the distance of the OMF from the offshore development area and the SAC, there is no potential for an in-combination effect with the proposed development.</td><td>Due to the nature of this project, impacts from EMF are not anticipated.</td><td>Included for assessments relating to Underwater Noise.</td></tr>
<tr><td>Oriel Wind Farm</td><td>Tier 2
Pre-consent</td><td>Construction anticipated to take place between 2026-2028 with piling anticipated in 2027.</td><td>16.9</td><td>21.6</td><td>NA</td><td rowspan="4">The proposed dates of the works may overlap with that of the proposed development.</td><td colspan="2">The proposed dates of the works may overlap with that of the proposed development. Therefore, combined with the proximity to the proposed development and the SAC, it is included in the in-combination assessment for this effect.</td><td>The installation of power cables at the proposed development would result in additional anthropogenic EMFs, which could affect electro- and magneto-sensitive receptors in-combination with EMF at Oriel Wind Farm.</td><td>Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, Accidental Pollution, and EMF.</td></tr>
<tr><td>Dublin Array</td><td>Tier 2
Pre-consent</td><td>Offshore construction programmed anticipated for 2028-2032.</td><td>32.9</td><td>37.6</td><td>NA</td><td colspan="2" rowspan="3">The proposed dates of the works may overlap with that of the proposed development. However, due to the distance of the projects from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development</td><td rowspan="3">Due to the distance of the projects from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development.</td><td rowspan="3">Included for assessments relating to Underwater Noise.</td></tr>
<tr><td>Codling Wind Park</td><td>Tier 2
Pre-consent</td><td>Construction anticipated for 2027-2028.</td><td>50.9</td><td>56.9</td><td>NA</td></tr>
<tr><td>Arklow Bank Phase 2</td><td>Tier 2
Pre-consent</td><td>Construction is anticipated to take place 2026-2030.</td><td>76.4</td><td>80.0</td><td>NA</td></tr>
<tr><td>Drogheda Port Company</td><td>Tier 3
Consented</td><td>Maintenance dredging between the period 2021 and 2029 within the commercial estuary of the river Boyne and associated release of dredged material from vessels at predefined dumping sites approximately 4km northeast (site A1) and 4km north (site A2) from the Drogheda port entrance.</td><td>15.3</td><td>14.3</td><td>NA</td><td colspan="3">The proposed dates of the works may overlap with that of the proposed development.</td><td>Due to the nature of these projects, impacts from EMF are not anticipated.</td><td>Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, and Accidental Pollution.</td></tr>
</table>

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to array area (km)	Distance to ECC (km)	Distance to Proposed Development Boundary (km)	Underwater Noise	Suspended Sediment and Deposition	Accidental Pollution	EMF	Screening conclusion In-Combination
Warrenpoint B	Tier 3 Consented	Sea disposal of dredging material from Warrenpoint Harbour for 2024-2027 to be disposed of at Warrenpoint B sea disposal site.	23.7	28.8	NA	The proposed dates of the works may overlap with that of the proposed development.			Due to the nature of these projects, impacts from EMF are not anticipated.	Included in assessments relating to Underwater Noise, Suspended Sediment and Deposition, and Accidental Pollution.
Dublin Port Company MP2 Project	Tier 3 Consented	Construction activities in Dublin Harbour scheduled to take place 2022-2032; works include dredging within Dublin Harbour and the release of dredged material from vessels west of Burford Bank in outer Dublin Bay. Various activities in Dublin Port including construction of passenger building and new jetty.	32.4	33.1	NA	The proposed dates of the works may overlap with that of the proposed development.	Due to the distance of the projects from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development.		Due to the nature of these projects, impacts from EMF are not anticipated.	Included for assessments relating to Underwater Noise.
Dublin Port maintenance dredging	Tier 3 Consented	Ongoing maintenance dredging at various locations in Dublin Port from 2022-2029	23.4	36.0	NA					
Mares Connect	Tier 3 Pre-consent	Subsea power cable; construction anticipated to take place 2024-2027	33.2	41.5	NA	The proposed dates of the works may overlap with that of the proposed development.	Due to the distance of the project from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development.		Due to the distance of the projects from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development	Included for assessments relating to Underwater Noise
Aqua Comms Havingsten Telecommunication Cable	Tier 3 Consented	Active telecommunications cable	0.7	9.7	NA	Due to the nature of these projects, underwater noise impacts are not anticipated.	Due to the nature of these projects, increases in SSC and sediment deposition are not anticipated.	Due to the nature of these projects, accidental pollution is not anticipated.	The installation of power cables at the proposed development would result in additional anthropogenic EMF, which could affect electro- and magneto-sensitive receptors in-combination with existing power cables.	Included for assessments relating to EMF.
EU NETWORKS Rockabill Telecommunications Cable	Tier 3 Consented	Active telecommunications cable	4.9	13.0	NA					
Eirgrid Interconnector Ltd East West Interconnector	Tier 3 Consented	Active power cable	5.0	11.4	NA					
Hibernia Atlantic HIBERNIA 'C'	Tier 3 Consented	Active telecommunications cable	7.7	17.0	NA					

Plan or Project	Tier and Stage of Development		Planned Programme	Distance to array area (km)		Distance to ECC (km)	Distance to Proposed Development Boundary (km)	Underwater Noise	Suspended Sediment and Deposition	Accidental Pollution	EMF	Screening conclusion In-Combination
Virgin Media SIRIUS SOUTH	Tier 3 Consented	Active telecommunications cable	9.4	18.7	NA							
Aqua Comms Celtix Connect Sea Fibre Networks	Tier 3 Consented	Active telecommunications cable	11.3	20.1	NA							
ZAYO Emerald Bridge One	Tier 3 Consented	Active telecommunications cable	12.1	20.2	NA							
BT ESAT 2	Tier 3 Consented	Active telecommunications cable	14.4	24.2	NA							
Proposed Mares Connect Electricity Interconnector Site Investigation	Tier 3 - Consented		Geophysical survey for five months in summer/autumn of 2024; included in in-combination assessment to account for potential survey delays	17.9		2.0	NA	Proposed survey period may overlap with construction phase.	Due to the nature of this project, impacts from Suspended Sediment and Deposition and Accidental Pollution are not anticipated.		Due to the nature of this project, impacts from EMF are not anticipated.	Included for assessments relating to Underwater Noise.
Codling Wind Park Site Investigation	Tier 3 - Consented		Ongoing geophysical and geotechnical site surveys to inform EIA/AA and construction; survey schedule unknown but assumed to cover period up to end of construction in 2028.	68.7		76.3	50.9	Proposed survey period may overlap with construction phase	Due to the nature of this project, impacts from Suspended Sediment and Deposition and Accidental Pollution are not anticipated.		Due to the nature of this project, impacts from EMF are not anticipated.	Included for assessments relating to Underwater Noise.
Arklow Bank Wind Park Phase 2	Tier 3 – Both consented and pre-consent		Ongoing geophysical and geotechnical site surveys; survey schedule unknown, assumed to cover period up to end of construction in 2030.	76.6		81.0	76.4	Proposed survey period may overlap with construction phase.				
Ringsend Wastewater Treatment Works Extension	Tier 3 Consented		Works include the construction of a marine outfall pipeline from Baldoyle Estuary to a discharge point 1km north-east of Ireland's Eye.	23.5		36.2	NA	The proposed dates of the works may overlap with that of the proposed development.	The proposed dates of the works may overlap with that of the proposed development. Due to the distance of the project from the offshore development area and the SAC, there is no potential for in-combination effects with the proposed development.		Due to the nature of this project, impacts from EMF are not anticipated.	Included for assessments relating to Underwater Noise..

6.2.1 River Boyne and River Blackwater SAC

Based on the alone assessments for the proposed development (Section 5.2), the plans and projects identified within Table 6.1 have been considered and the River Boyne and River Blackwater SAC is the only site that has been screened in, and for the following impacts:

- In-combination underwater noise and vibration (construction and decommissioning phase).
- In-combination increases in SSC and associated sediment deposition (construction, operation and decommissioning phase).
- In-combination accidental pollution (construction, operation, and decommissioning phase); and
- In-combination EMF (operational phase).

The screening and assessment for effects on the migratory fish QIs of the River Boyne and River Blackwater SAC concluded that exposure of individuals within the SAC boundary is unlikely, and therefore all effect-receptor pathways are limited to individuals at sea.

Due to their proximity to the proposed development for various effects (e.g., within 100km for noise effects as stated within the SISAA and described within Table 6.1), all east coast Irish Phase One projects are included in the in-combination assessment for this site. The Phase 1 projects include the Oriel Offshore Wind Farm (OWF), Dublin Array, the Codling Wind Park, and the Arklow Bank Phase 2 Offshore Wind Farm. Other projects that may contribute to in-combination effects through simultaneous or sequential activities prior to or during the construction phase of the proposed development include the construction of the OMF at Greenore, dredging and associated sediment disposal at the Drogheda and Dublin ports, construction of the Mares Connect power cable, and activities associated with the Greenore Port extension, the construction of the Arklow Bank Operations and Maintenance Base, and the extension of the Ringsend Wastewater Treatment Plant. In addition, existing and proposed power and telecommunications cables are considered for their potential to give rise to in-combination effects with EMFs emitted from cables installed at the proposed development.

6.2.1.1 In-combination Underwater Noise (Construction and Decommissioning Phase)

As presented in Table 6.1, all listed projects with the exception of existing power and telecommunications cables have been taken forward for this impact. While the assessment for the proposed development alone identified no potential for adverse effects from underwater noise, due to the proximity of the proposed development and the SAC with other projects, there is still a potential for effects to occur in-combination. As for the proposed development alone, potential in-combination effects on sensitive fish receptors include mortality and potential mortal injury, recoverable injury, TTS, and behavioural changes from underwater noise and vibration as a result of construction and decommissioning activities associated with the proposed development and other projects (inclusive of piling activities, UXO clearance, geophysical surveys, and non-impulse sounds from vessel operations and non-piling construction activities).

6.2.1.1.1 In-combination Underwater Noise from Piling (Construction Phase)

The greatest risk for in-combination underwater noise effects on migratory fish species has been identified as being that produced by impact piling during the construction phase of the Phase One OWF projects in the wider study area. In-combination effects may result from concurrent piling at different wind farm sites or the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

Owing to the early stage of the Phase One projects within the planning process, site specific information relating to the scale of piling (e.g., number of piles to be piled and hammer energies used) is limited. It is therefore assumed that project parameters for the installation of foundations would be similar to those applied for the proposed development, i.e., installation of larger diameter monopiles using impact piling and high hammer energies. Piling operations would represent intermittent occurrences at these offshore wind farm sites, with each individual piling event likely to be similar in duration to those at the proposed development.

Plans for the Oriel wind farm indicate that the proposed development will comprise up to 25 WTGs. Construction is anticipated to take place between 2026 and 2028, with piling of foundations anticipated to take place in 2027. This suggests that construction work would be mostly completed before offshore construction of the proposed development commences.

Plans for Dublin Array indicate that the development will comprise up to 49 WTGs, one OSP and two export cables. Dates for offshore construction have been identified as 2028-2032, which indicate that the majority of offshore construction for the proposed development would be completed before construction of Dublin Array commences.

Plans for Codling Wind Park indicate that the proposed development may comprise up to 140 WTGs, 6 export cables and up to 5 OSPs. Indicative dates for offshore construction activities at Codling Wind Park have been identified as 2027-2028, which suggests that work would overlap with the construction of the proposed development.

Plans for the Arklow Bank Phase 2 project indicate that the proposed development may comprise up to 60 WTGs, two export cables and a maximum of two OSPs. Indicative dates for construction have been identified as 2026 to 2030, which indicates overlap with the construction of the proposed development.

Due to the current planning stage of the relevant projects, there is no available data on either project scale or timings on which to undertake a full quantitative or semi-quantitative assessment; as such the discussion herein is qualitative, assuming that any impact ranges would be of a similar magnitude to those assessed for the proposed development, based on similar technology and project components. Similarly, the methods for installing foundations at the Phase 1 projects are currently unknown; it has therefore been assumed that all projects would use impact piling for foundation installation.

Piling operations will represent intermittent occurrences at these offshore wind farm sites, with each individual piling event likely to be similar in duration to those at the proposed development. The total duration of piling during the construction of all Phase One projects is anticipated to be at most short-term (i.e., lasting one to seven years).

Piling will also be required as part of the construction of the OMF at Greenore. The OMF will be located onshore as a part of an existing port facility at Greenore. It is expected that a new pontoon would need to be constructed, and therefore it is anticipated that piling will take place during the construction of the OMF. The remaining projects screened into the in-combination assessment for migratory fish do not involve piling and have therefore not been included in the assessments below.

6.2.1.1.1.1 River lamprey

The potential effects of underwater noise from piling on river lamprey during the construction of the proposed development alone are assessed in Section 5.2.3.3.1. Mortality and recoverable injury from piling noise at the proposed development are predicted to occur within a few hundred metres of piling activity. Given similar scales of development and technologies of the other Irish Phase One projects, it is anticipated that similar impact ranges would occur for these projects alone. River lamprey are reported to typically remain in estuarine areas during their marine stage (Maitland, 2003). All east coast Phase One projects are located offshore, suggesting that the impact ranges for the onset of mortality and recoverable injury for these projects would be located outside the areas of primary importance for river lamprey. Furthermore, the potential for mortal and recoverable injuries to occur is likely to be reduced due to the implementation of soft-start procedures, which would allow mobile species, like river lamprey, to leave the area before injurious effects can occur. Based on this and considering the low susceptibility of river lamprey to pressure-related injuries, the risk of mortal and recoverable injuries to river lamprey from the proposed development in-combination with other Phase One projects is low.

TTS in river lamprey from piling at the proposed development is predicted to occur up to 51km from the array area, with the relative risk of behavioural responses at these distances assessed as being low. A moderate risk of behavioural responses exists at intermediate (100s of metres) distances from the sound source, while at near (10s of metres) distance from the piling location the risk of behavioural responses is high (Popper et al., 2014).

Assuming similar noise propagation ranges for the other Phase 1 projects compared to the proposed development, noise emitted during piling at the Oriel Wind Farm (located about 17km to the north of the proposed development array area) and the Dublin Array (located about 33km to the south of the proposed development array area) may be sufficient to result in cumulative TTS or behavioural reactions in sensitive fish receptors, which may result in the temporary re-distribution of individuals between the affected areas. However, given the preference of river lampreys for inshore areas, it is likely that river lamprey would avoid the areas over which TTS or behavioural responses are likely to occur. Any potential TTS or behavioural responses would likely be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Moreover, piling of foundations at Dublin Array is expected to commence in 2029 after piling at the proposed development has been completed, and it is therefore concluded that the risk of cumulative noise effects from Dublin Array are low. Construction of the Oriel wind farm is anticipated to take place between 2026 and 2028, suggesting that construction work would be mostly completed before piling of foundations for the proposed development commences in 2028. The risk of cumulative TTS and behavioural effects from overlapping noise contours during concurrent piling operations at Arklow Bank Phase 2 and Codling Wind Park is considered to be low, given the distances (>50km) between these projects and the array area of the proposed development.

Piling might also be required during construction of the OMF when installing pontoons. Site-specific information relating to the duration and specifications (e.g., hammer energies) of these operations are currently not available. However, it is anticipated that piling at the OMF will take place between 2025 and 2026 before the piling of foundations within the array area. Moreover, given the distance of the OMF and the proposed development, the maximum impact ranges for the onset of mortality and recoverable injuries from these two projects are unlikely to overlap. Therefore, the potential for cumulative lethal or recoverable injury effects is limited. Moreover, piling for the OMF is anticipated to occur at most infrequently and would be temporary. Any potential TTS or behavioural responses would be temporary and reversible, and it is expected that river lamprey will resume to normal behaviour and distribution before the piling of foundations in the array area commences. Based on this, no discernible in-combination effects on river lamprey are expected to occur from piling at the proposed development and the OMF base at Greenore.

Given the low risk of in-combination mortal or recoverable injuries, the temporary nature of potential behavioural changes and/ or TTS, and the intermittent nature of piling, it is concluded that potential in-combination effects from impact piling will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC.

6.2.1.1.1.2 Atlantic salmon

Mortality and recoverable injury in Atlantic salmon as a result of piling noise at the proposed development are predicted to occur within a few hundred metres from the noise source. As discussed in the proposed development alone assessments, tracking data indicate that Atlantic salmon smolts from the River Boyne and its tributaries leave the Irish Sea in a northward direction (Barry et al., 2020), suggesting a low likelihood of salmon from the site to be present within the development areas of Dublin Array, Arklow Bank Phase 2, and Codling Wind Park. The tracking data further showed that smolts move rapidly away from the coast towards the deeper waters of the Irish Sea, suggesting that salmons native to the SAC would also avoid the piling locations of the Oriel wind farm. However, given this evidence is limited to a single study, it is assumed that there is still the potential for individuals from the Rivers Boyne and Blackwater to transit the Oriel development area. Assuming similar scales of development and technologies of the Irish Phase One projects, it is anticipated that similar magnitudes of effects would occur for these projects alone. The potential for mortal or recoverable injuries to occur is likely to be reduced due to the implementation of best practice soft-start procedures, which will allow Atlantic salmon to leave the area before injurious effects can occur. Therefore, while the concurrent or sequential piling of multiple Phase One wind farms has the potential to result in additive mortality and/ or recoverable injury, the adaptability of the receptor together with the implementation of best practice mitigation measures (e.g. soft-start procedures) is anticipated to minimise the risk of these effects occurring. Therefore, as for the proposed development alone, the risk of in-combination mortality and recoverable injury from piling is assessed as low.

TTS in Atlantic salmon from piling at the proposed development is predicted to occur up to 51km from the array area, with the relative risk of behavioural responses at these distances assessed as being low.

A moderate risk of behavioural responses exists at intermediate (100s of metres) distances from the sound source, while at near (10s of metres) distance from the piling location the risk of behavioural responses is high (Popper et al., 2014). Assuming similar impact ranges for the other Phase One projects and given the likelihood of salmon from the site entering and leaving the Irish Sea from the north (Barry et al., 2020), noise produced during piling operations at Arklow Bank Phase 2 and Codling Wind Park is considered unlikely to affect Atlantic salmon from the SAC. Noise propagation during piling at the Dublin Array and the Oriel Wind Farm may be sufficient to result in TTS or avoidance reactions in some migrating individuals from the site, potentially leading to an additive reduction in the spawning success in a small proportion of the population. However, piling at Dublin Array is expected to commence in 2029 after piling at the proposed development has been completed, and it is therefore concluded that the risk of in-combination noise effects from Dublin Array are low. Construction of the Oriel wind farm is anticipated to take place between 2026 and 2028, suggesting that construction work would be mostly completed before piling of foundations for the proposed development commences in 2028. It has therefore been assumed that there is potential for additional disturbances to Atlantic salmon in the years prior to the piling at the proposed development. Piling itself is anticipated to be intermittent, and any TTS or behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours and continue their migration during piling free days and shortly after piling has been completed.

Piling during the construction of the OMF base at Greenore is anticipated to take place between 2 to 3 years before the piling of foundations within the array area, with the piling of the pontoon anticipated to be temporary. It is therefore expected that sensitive receptors will resume to normal behaviour and distribution well before the piling of foundations in the array area commences. Based on this, no discernible in-combination effects on Atlantic salmon are expected to occur from piling at the proposed development and the OMF base.

Based on the above considerations, it is concluded that any potential in-combination effects on Atlantic salmon as a result of piling will not alter the survival, fitness or reproductive rates of the qualifying interest to the extent that could alter the population trajectory of the Atlantic salmon population of the River Boyne and River Blackwater SAC. Therefore, as for the proposed development alone, piling at the proposed development in-combination with the projects considered in the assessment is considered to have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC.

6.2.1.1.2 In-combination Underwater Noise from UXO Clearance

As discussed previously, UXO clearance has the potential to result in mortality and mortal injury, recoverable injury, TTS and behavioural changes to migratory fish, depending on the proximity of the individuals to the UXO location and the size of the UXO. For UXO clearance operations of the proposed development, mortality to river lamprey and Atlantic salmon during the high order detonation of UXO is expected to occur up to 810m from the detonation site, with similar impact ranges anticipated for the other Phase One projects. Therefore, the maximum impact ranges for the onset of lethal injuries for the Phase One projects are unlikely to overlap, and the risk of mortality from UXO clearance at the proposed development in-combination with UXO clearance at the other Phase One projects is considered to be low.

Comparable impact ranges are also anticipated for other potential effects, with the relative risk of recoverable injury in river lamprey considered to be high at the near field (10s of meters) and low at intermediate (100s of meters) and far (1000s of meters) distances from the sound source, while for Atlantic salmon, the relative risk of recoverable injury and behavioural responses is considered to be high at near (10s of meters) and intermediate (100s of meters) distances from the sound source and low at far (1000s of meters) distances. TTS and disturbance reactions will occur over larger areas, potentially reaching 10s of kilometers from the UXO location. UXO clearance is a discrete and brief (lasting less than one day) event, with impulse sounds anticipated to last seconds. Therefore, the likelihood of concurrent clearance events between projects is low, thereby reducing the likelihood of in-combination effects.

6.2.1.1.2.1 River lamprey

As for the project alone assessment, it is considered that the impact ranges for the onset of mortality and potential mortal injury, recoverable injury, TTS and behavioural responses would be mainly located outside the areas of primary importance for river lamprey, except for potential clearance operations within areas closer to shore.

However, given their low susceptibility to pressure-related injuries (see Section 5.2.2), the risk of lethal or recoverable physical injuries to river lamprey during UXO clearance is assessed as low. Any in-combination effects from TTS or behavioural responses would be temporary, with individuals expected to be able to re-colonise areas shortly after the clearance event. Moreover, each UXO detonation is a discrete and brief (lasting less than one day) event, which is not anticipated to cause long-term displacement of river lamprey from their marine habitats or migration routes into their spawning streams.

Based on the above considerations, it is concluded that UXO clearance at the proposed development in-combination with the projects considered in the assessment will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC.

6.2.1.1.2.2 Atlantic salmon

As for piling operations, Atlantic salmon native to the River Boyne and River Blackwater SAC are considered unlikely to be affected by UXO clearance operations within the proposed development boundaries of Arklow Bank Phase 2 and Codling Wind Park based on the distance of these projects from the offshore development area and the northward migration of salmon when leaving the SAC. Similarly, the risk of effects in-combination with UXO clearance operations at Dublin Array is considered low as offshore operations at Dublin Array are expected to commence after seabed preparation works at the proposed development would be completed.

UXO clearance at the Oriel wind farm site has the potential to interact with salmon from the SAC and might therefore contribute to in-combination effects. UXO clearance operations at the Oriel wind farm will likely follow a UXO mitigation hierarchy similar to that adopted for the proposed development (as this is standard practice for offshore wind farm developments), with high order UXO detonation only to be used when other clearance options are not possible. Where high order UXO clearance will be required, these events will be discrete and brief (lasting less than one day), with impulse sounds emitted lasting several seconds. While this may result in mortality to some individuals close to the detonation site, it is not anticipated to cause widespread and long-term displacement of salmon from specific migration routes. Any TTS or behavioural responses would be temporary, with individuals expected to be able to continue their migration following the clearance events.

Factoring in the low likelihood of high order UXO clearance at the proposed development combined with the infrequent and brief nature of the impact, the highly localised nature of potential mortality and recoverable injuries, and the temporary nature of potential TTS or behavioural changes, it is concluded that UXO clearance at the proposed development in-combinations with the projects considered in the assessment will not alter the survival, fitness or reproductive rates of Atlantic salmon to the extent that could alter the trajectory of the River Boyne and River Blackwater salmon population. In addition, any in-combination effects are not predicted to result in barrier effects that would prevent Atlantic salmon from accessing or leaving the SAC. Therefore, it is concluded that underwater noise emitted during UXO clearance at the proposed development in-combination with the projects considered in the assessment will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC.

6.2.1.1.3 In-combination Underwater Noise from Continuous Noise Sources

As discussed previously, non-impulse sounds such as those emitted during cable installation, the drilling of foundations, geophysical surveys or vessel traffic would not represent a risk of mortality and mortal injury to fish species. There is potential for auditory tissue injuries and TTS, but current evidence suggests that these effects are temporary and reversible (Popper et al., 2014). Similarly, any potential behavioural reactions would be temporary. Therefore, these activities are considered to have a much lower likelihood to result in significant adverse effects in fish compared to piling, both alone and in-combination with other projects.

It is anticipated that, following standard practices, vessel moving to and from offshore windfarm sites will, where practicable, use existing vessel routes for pre-existing vessel traffic, which fish will be accustomed to. They may also have become habituated to the noise generated by regular vessel movements, and therefore it is considered that potential in-combination effects may predominantly result from activities at the construction and decommissioning sites.

Assuming similar construction activities of the Phase One projects, any potential recoverable injuries or TSS as a result of non-impulse sounds are anticipated to be highly localised, and therefore the potential for in-combination effects is limited. Similarly, the risk of adverse in-combination behavioural reactions from overlapping noise contours or as a result of sequential disturbances from the other projects considered in the assessment is considered to be low, given the distance between the projects, the reversibility of the effects and the intermittent and short-term nature of the impact.

6.2.1.1.3.1 River lamprey

Any construction or vessel noise would be intermittent and temporary, and any TTS or effects on behaviour would also be temporary and reversible. Moreover, given their preference for estuarine areas during their marine stage (Maitland et al., 2003), river lamprey will mostly avoid the areas over which TTS or behavioural responses are likely to occur, with the exception of coastal areas near the landfall site. In addition, as a mobile species, river lamprey are considered able to move away from construction activities and might therefore not remain exposed to the impact for extended periods of time.

Based on the above considerations, it is concluded that non-impulse sounds generated during the construction and decommissioning of the proposed development in-combination with the projects considered in the assessment will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC.

6.2.1.1.3.2 Atlantic salmon

Atlantic salmon are likely to transit the study area and might also pass through the Oriel development areas during their migration. Given their migratory nature, Atlantic salmon are anticipated to be transient, and therefore any exposure to construction or vessel noise is anticipated to be temporary. Moreover, any construction noise would be intermittent, with any potential effects on the behaviour or distribution of Atlantic salmon anticipated to be reversible.

Based on the above considerations, it is concluded that non-impulse sounds generated during the construction and decommissioning of the proposed development in-combination with the projects considered in the assessment will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC.

6.2.1.2 In-combination Increases in SSC and Sediment Deposition (Construction, Operation and Decommissioning Phase)

Dredging and sediment disposal, seabed preparation works, and foundation and cable installation activities associated with other projects can cause temporary increases in SSC and associated sediment deposition, which if temporarily overlapping with works at the proposed development may give rise to additive effects on migratory fish. This impact is associated primarily with activities that take place during the construction and decommissioning phases.

Increases in SSC associated with the proposed development are anticipated to extend up to approximately 12km from the source. Sediment plumes and deposition generated by other projects in the vicinity of the proposed development are anticipated to behave in a similar pattern as the sediments being disturbed by the proposed development due to expected similarities in activities combined with a similar environmental setting and sediment characteristics. Therefore, the applied 24km screening range from the River Boyne estuary, which is based on twice the maximum spring tidal excursion, is considered precautionary and appropriate to assess potential in-combination impacts on the qualifying migratory fish species.

Based on the distance between the SAC and projects considered in the assessment, potential in-combination effects from sediment plumes are most likely to arise from works at the Oriel OWF, the Warrenpoint B disposal site and activities associated with the Drogheda Port project. Changes in SSC and sediment deposition as a result of the proposed development will be intermittent and temporary, with sediment plumes expected to quickly dissipate after cessation of the construction activities due to settling and wider dispersion. Based on the distance to the proposed development, sediment plumes generated during activities at the Oriel OWF may be sufficient to interact with plumes from the proposed development. However, the potential increases in SSC, when considered in-combination, are still anticipated to be temporary and intermittent, with SSC across overlapping plumes likely to be close to natural background levels.

Any potential simultaneous disturbance effects on migratory fish within the in-combination assessment area due to concurrent activities are expected to be localised, temporary and intermittent as sediment plumes are expected to quickly dissipate following cessation of activities.

Ongoing maintenance dredging activities at Drogheda Port (Drogheda Port Company project) and the disposal of dredged material offshore may also contribute to the cumulative increase in SSC and sediment deposition through simultaneous dredging or disposal activities. It is not known what volumes of sediment will be disturbed and/or released at the construction and disposal sites at any one time. However, given the distance between the project and the offshore development area (the nearest licensed sea disposal site for the Drogheda Port project is located >10km from the array area), the potential for sediment plumes to interact is considered to be low. Any changes in SSCs associated with the Drogheda Port project and disposal at Warrenpoint B are expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following the cessation of activities.

For the decommissioning phase, the potential impacts are considered to be the same as construction, however with a lesser magnitude. Therefore, the same projects are considered for this stage of development and the same conclusions are drawn.

6.2.1.2.1 River lamprey

As discussed previously, the capacity of river lamprey to accommodate increases in SSC and sediment deposition is assessed as high given the nature of resuspension and deposition within their natural higher energy estuarine environments. Moreover, river lamprey are mobile and would be able to relocate to nearby unimpacted areas. Therefore, the degree of overlap between river lamprey and areas subject to temporary, intermittent and localised increases in SSCs is predicted to be small in the context of available habitat, and any local in-combination changes in the species' distributions resulting from avoidance behaviour while at sea are expected to not be discernible from baseline conditions.

Based on the above considerations, it is concluded that increases in SSC and sediment deposition during the construction of the proposed development in-combination with the projects considered in the assessment will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC.

6.2.1.2.2 Atlantic salmon

With regards to Atlantic salmon, it has been concluded that temporary and intermitted increases in SSC at the proposed development might result in localised avoidance reactions during the duration of the plumes. However, due to the temporary and localised nature of the predicted changes in SSC and sediment deposition, any displacement will not result in a barrier effect that would prevent Atlantic salmon from leaving or accessing the SAC. Based on the distance between the Phase One projects and the Tier 3 projects and considering the northward migration of salmon when leaving the SAC, potential in-combination effects from sediment plumes are most likely to arise from works at the Oriel wind farm and the Drogheda Port project, with plumes originating from the other screened in projects considered unlikely to interact with the main migration routes of salmon to and from the SAC. Changes in SSCs associated with these projects are also expected to be temporary and intermittent, with sediment plumes expected to quickly dissipate following cessation of activities.

Based on the above considerations, it is concluded that increases in SSC and sediment deposition during the construction of the proposed development in-combination with the projects considered in the assessment will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC.

6.2.1.3 In-combination Accidental Pollution (Construction, Operation and Decommissioning Phase)

Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment. Through the CEMP and offshore EMP, the proposed development has identified best-practice techniques to minimise such inputs into the marine environment from all construction, operation and decommissioning activities. These will include a marine pollution contingency plan to address the risks, methods and procedures to deal with any spills and collision incidents of the authorised project in relation to all activities carried out below HWM.

The CEMP and offshore EMP will also include a chemical risk review with information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance. This commitment ensures the use of appropriate preventative measures and serves as mitigation against accidental pollution incidents.

No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the construction phase of the proposed development. Other projects considered here have similar measures through relevant environment management plans. For instance, Drogheda Port has an Emergency Plan that includes its Pollution Response Plan for all activities within the port including dredging vessels, while all Phase One projects will be required to have environmental management plans in place that follow national and international regulations and commitments (e.g., MARPOL).

Additionally, as described previously, the levels of sediment-bound contaminants are low within the array area and ECC when compared to background concentrations, and sediment-bound contaminants are likely to be rapidly diluted by tidal currents. Therefore, increased bio-availability that could potentially result in adverse eco-toxicological effects to fish species is not expected from the proposed development alone.

Given the lack of potential adverse effects on river lamprey and Atlantic salmon from the proposed development alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the qualifying fish interests of the River Boyne and River Blackwater SAC.

6.2.1.4 In-combination EMF (Operational Phase)

As discussed previously, any potential behavioural responses of river lamprey and Atlantic salmon to EMF are expected to be highly localised, based on the rapid attenuation of EMFs within the marine environment Based on similar technology and project designs, the extent of EMF emissions from the Oriel wind farm and other existing power cables within the in-combination assessment area is also expected to be highly localised and restricted to discrete areas within the immediate proximity of the cable lines.

6.2.1.4.1 River lamprey

River lamprey are reported to remain in estuarine areas during their marine stage (Maitland, 2003), which limits their exposure to EMF from subsea cables. Moreover, any localised behavioural changes are considered small compared to the overall extent of available habitat. Therefore, as per the proposed development alone assessment, EMF from cables within the in-combination assessment area are considered unlikely to result in a barrier effect that would prevent river lamprey from accessing or leaving the River Boyne and River Blackwater SAC.

Based on this, it is concluded that EMF from the proposed development in-combination with EMF for the considered projects will have no AEoI of river lamprey designated in the River Boyne and River Blackwater SAC.

6.2.1.4.2 Atlantic salmon

Atlantic salmon will be transient across the study area. Moreover, any localised behavioural changes are considered small compared to the overall extent of available marine habitat across the study area. Tagging studies suggest that returning salmon mainly swim close to the surface when approaching their natal rivers, with only occasional downward movements in the water column. Similar results were found for outward migrating smolts, which were mainly recorded near the surface (Davidsen; Quinn, 1990 cited in Davidsen). These studies suggest that Atlantic salmon have limited contact with the seabed and areas potentially affected by EMF. Moreover, given evidence showing a northward migration of salmon within the Irish Sea, in-combination effects from EMF are only likely to occur with existing cables in the vicinity of the proposed development area and the Oriel wind farm. Given the localised nature of EMF transmission into the water column and considering the preference of migrating salmon to remain close to the surface, any potential in-combination effects from EMFs on migrating Atlantic salmon are considered unlikely to result in a barrier effect that would prevent them from accessing or leaving the River Boyne and River Blackwater SAC.

Based on this, it is concluded that EMF from the proposed development in-combination with EMF for the considered projects will have no AEoI of Atlantic salmon designated in the River Boyne and River Blackwater SAC.

6.3 Marine Mammals

Based on the alone assessments for the proposed development (Section 5.3) and the consideration of plans and projects identified within Table 6.2, the relevant SAC sites with QI of marine mammals have been screened in for the following impacts:

- In-combination underwater noise (construction and decommissioning).
- In-combination vessel disturbance (construction, operation, and decommissioning).
- In-combination vessel collision (construction, operation, and decommissioning).
- In-combination changes to prey (construction, operation, and decommissioning; and
- In-combination accidental pollution (construction, operation, and decommissioning).

Inclusion of other plans, projects, and activities within the in-combination assessment for this site is based on whether there is overlap with the Celtic and Irish Seas (CIS) Management Unit (MU) (which is the MU of relevance for the harbour porpoise feature of this SAC) and the Irish Seas (IS) MU (which is the MU of relevance for the bottlenose dolphin). This includes all the Irish Phase 1 projects as well as a number of non-Irish OWFs and other types of development as set out within Table 6.2.

Table 6.2: Plans and Projects Screened In for Consideration within the Marine Mammals In-Combination Assessment.

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
NISA	OWF Construction 2028	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OMF	Coastal Assets Construction 2025 – 2026 Pre-Consent	1	33.9	38.8	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Codling Wind Park	OWF Construction 2027 – 2028 Pre-Consent	2	50.9	56.9	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Dublin Array	OWF Construction 2028 – 2031 Pre-Consent	2	32.9	37.6	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Arklow Bank	OWF Construction 2026 – 2030 Pre-Consent	2	76.4	80.0	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Oriel	OWF Construction 2026 – 2028 Pre-Consent	2	16.9	21.6	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Mona	OWF Construction 2026 – 2027	3	117.3	124.8	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Morgan	OWF Construction 2028 – 2029	3	111.5	119.9	The proposed dates of the works may overlap with that of the proposed	The proposed dates of the works may overlap with that of the	The proposed dates of the works may overlap with that of the	The proposed dates of the works may overlap with that of the	The proposed dates of the works may overlap with that of the	All identified impacts considered in-combination.

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					development. Therefore, it is included in the in-combination assessment for this effect.	proposed development. Therefore, it is included in the in-combination assessment for this effect.	proposed development. Therefore, it is included in the in-combination assessment for this effect.	proposed development. Therefore, it is included in the in-combination assessment for this effect.	proposed development. Therefore, it is included in the in-combination assessment for this effect.	
Awel y Môr	OWF Construction 2026 – 2030	3	131.6	139.5	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Morecambe	OWF Construction 2026 – 2029	3	138.9	146.5	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Erebus Floating Wind Demo	OWF Construction 2025 – 2027	3	235.1	239.6	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	All identified impacts considered in-combination.

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	
White Cross	OWF Construction 2026 – 2027	3	274.7	280.6	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
TwinHub	OWF Construction 2026	3	358.5	362.5	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination.
Greenlink Interconnector	Subsea Cable Construction 2023 – 2024	3	172.4	266.8	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Fair Head Phase 2	Tidal Construction 2023 – 2025	3	199.7	204.8	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Cardiff Bay Tidal Lagoon	Tidal Construction 2023 – 2026	3	306.9	316.9	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Saint-Brieuc	OWF Construction 2023 – 2024	3	567.8	577.3	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Isle of Man	OWF Construction 2030 – 2031	3	118.0	126.5	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
North Channel Wind 2	OWF Construction 2029 - 2030	3	112.9	120.0	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
North Channel Wind 1	OWF Construction 2029 – 2030	3	135.4	141.7	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Valorous	OWF Construction 2029	3	244.0	248.2	The proposed dates of the work are after the collection of the baseline data for	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	
Llyr 1	OWF Construction 2027	3	248.8	254.1	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Llyr 2	OWF Construction 2027	3	251.1	257.4	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Sceirde Rocks	OWF Construction 2026 – 2030	3	262.3	247.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	
Atlantic Marine Energy Test Site	OWF Construction 2024 – 2025	3	277.6	268.0	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Mares Connect	Subsea Cable Construction 2024 – 2027	3	33.2	41.5	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
CeltixConnect - Sea Fibre Networks	Subsea Cable Construction 2023 – 2026	3	11.3	20.1	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
West Anglesey	Tidal	3	78.3	87.7	The proposed dates of the work	The proposed dates of the	The proposed dates of the	The proposed dates of the	The proposed dates of the	All identified impacts

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Demonstration Zone	Construction 2023 – 2025				are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	considered in-combination
West Somerset Tidal Lagoon	Tidal Construction 2028 – 2031	3	311.0	320.8	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Dublin Port Company MP2 Project	Coastal Assets Construction 2023	3	32.4	33.1	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Arklow Waste Water Treatment Plant	Coastal Assets Construction 2023 – 2029	3	79.7	92.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is	The proposed dates of the works may overlap with that of the proposed development.	The proposed dates of the works may overlap with that of the proposed development.	The proposed dates of the works may overlap with that of the proposed development.	The proposed dates of the works may overlap with that of the proposed development.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					included in the in-combination assessment for this effect.	Therefore, it is included in the in-combination assessment for this effect.	Therefore, it is included in the in-combination assessment for this effect.	Therefore, it is included in the in-combination assessment for this effect.	Therefore, it is included in the in-combination assessment for this effect.	
Maintenance dredging River Boyne, Drogheda	Coastal Assets Construction 2023 – 2031	3	32.4	34.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Bremore Port	Coastal Assets Construction 2028 – 2030	3	16.3	0.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
NISA Site Investigations	Site Investigation Surveys Construction 2023 – 2026	3	3.1	10.8	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	
Lir Offshore Array Ltd. Site Investigations	Site Investigation Surveys Construction 2023	3	4.2	2.6	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Codling Wind Park Ltd. Site Investigations	Site Investigation Surveys Construction 2023	3	68.7	76.3	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
MaresConnect Site Investigations	Site Investigation Surveys Construction 2024 – 2028	3	17.9	2.0	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Clogher Head Site Investigations	Site Investigation Surveys Construction 2023	3	18.6	23.0	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Rockabill Cable Systems Ltd Site Investigations	Site Investigation Surveys Construction 2023 – 2031	3	18.6	15.1	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Oriel Windfarm Ltd Site Investigations	Site Investigation Surveys Construction 2023 – 2026	3	20.2	24.9	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Braymore Point Site Investigations	Site Investigation Surveys	3	20.7	23.1	The proposed dates of the work are after the collection of the baseline data for	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
	Construction 2023 – 2025				the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	
Sunrise Wind Ltd., Site Investigations	Site Investigation Surveys Construction 2023 – 2026	3	68.2	75.9	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Wicklow Sea Wind Ltd., Site Investigations	Site Investigation Surveys Construction 2023 – 2024	3	68.8	73.7	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Arklow Bank Wind Park Phase 2 Site Investigations	Site Investigation Surveys Construction 2023 – 2027	3	76.6	81.0	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	
Arklow Bank Wind Park Site Investigations	Site Investigation Surveys Construction 2024 – 2030	3	76.7	81.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Banba Wind Ltd., Site Investigations	Site Investigation Surveys Construction 2023 – 2026	3	80.9	87.9	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Hibernian Wind Power Site Investigations	Site Investigation Surveys Construction 2023	3	92.0	93.5	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Energia Site Investigations	Site Investigation Surveys Construction 2023 – 2025	3	91.2	97.4	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Mersey Tidal Power	Tidal Construction 2023 – 2031	3	192.0	200.1	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Milford Haven Estuary (META Phase 2) - Warrior Way	Tidal Decommissioning 2026	3	219.9	228.4	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Milford Haven Estuary (META Phase 2) -	Tidal Decommissioning 2026	3	220.7	228.5	The proposed dates of the work are after the collection of the baseline data for	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
East Pickard Bay					the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	
LirlC	Subsea Cable Construction 2028	3	112.0	118.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
XLinks	Subsea Cable Construction 2027 – 2029	3	287.1	295.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
MORECA MBE DP4 TO CPP1	Pipeline Decommissioning 2023	3	149.5	157.2	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	assessment for this effect.	
MORECA MBE CPP1 TO DP3	Pipeline Decommissioning 2023	3	149.5	157.2	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
MORECA MBE DP3 TO CPP1	Pipeline Decommissioning 2023	3	149.5	157.2	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Dublin Port Masterplan (3FM Plan)	Coastal Assets Construction 2023 – 2031	3	19.5	32.9	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
Dublin Port maintenance dredging	Coastal Assets Construction 2023 – 2031	3	19.5	32.9	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Development at Greenore Port	Coastal Assets Construction 2023 – 2031	3	32.5	34.2	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
Arklow Bank Wind Park Phase 2 OMF	Coastal Assets Construction 2023 – 2025	3	79.9	92.4	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	All identified impacts considered in-combination
EirGrid Celtic Interconnector	Coastal Assets Construction 2024 – 2026	3	5.0	11.4	The proposed dates of the work are after the collection of the baseline data for	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	The proposed dates of the work are after the collection of the baseline data	All identified impacts considered in-combination

Project	Project details	Tier	Distance to array (km)	Distance to ECC (km)	Underwater noise	Vessel disturbance	Vessel collision	Changes to prey	Accidental pollution	Conclusion in-combination
					the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	for the proposed development. Therefore, it is included in the in-combination assessment for this effect.	

6.3.1 Rockabill to Dalkey Island SAC

6.3.1.1 In-Combination Effects from Underwater Noise

While the assessment for the proposed development alone identified no potential for adverse effects from underwater noise, due to the proximity of the proposed development and the SAC with other projects there is still a potential for effects to occur in-combination. As for the proposed development alone, potential in-combination effects on harbour porpoise receptors include PTS, TTS and behavioural disturbance from underwater noise as a result of the construction activities associated with the proposed development and other projects (inclusive of piling activities, UXO clearance and other construction activities including geophysical surveys).

The greatest risk for in-combination underwater noise effects on the harbour porpoise feature of the SAC has been identified as being that produced by piling during the construction phase of the Phase 1 OWF projects. In-combination effects may result from concurrent piling at different wind farm sites or the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

Owing to the early stage of the Phase 1 projects within the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited. However, as discussed in section 6.3.1.1.2, information on potential piling schedules and construction timelines were shared between the proposed development and Dublin Array to inform modelling which supports the assessment of potential disturbance effects to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

Plans for the Oriel Wind Farm indicate that the proposed development will comprise a maximum of up to 25 WTGs. Construction is anticipated to take place between 2026 and 2028, with piling of foundations anticipated to take place in 2027. This suggests that construction work would be mostly completed before offshore construction of the proposed development commences.

Plans for Dublin Array indicate that the development will comprise a maximum of 49 WTGs, one OSP and two export cables. Dates for offshore construction have been identified as 2028-2032, which indicate that the majority of offshore construction for the proposed development would be complete before construction of Dublin Array commences.

Plans for Codling Wind Park indicate that the proposed development may comprise up to 140 WTGs, 6 export cables and up to 5 OSPs, suggesting the work will disturb a larger area of seabed that assessed for the proposed development. Dates for offshore construction activities at Codling Wind Park have been identified as 2027-2028, which indicates that work would overlap with the construction of the proposed development.

Plans for the Arklow Bank Phase 2 project indicate that the proposed development may comprise a maximum of 60 WTGs, two export cables and a maximum of two OSPs. Dates for construction have been identified as 2026 to 2030, which indicates overlap with the construction of the proposed development.

The timings for other OWF projects within the CIS MU are outlined within Table 6.2 above.

Due to the current planning stage of the relevant projects, there is no available data on either project scale or timings on which to undertake numerical noise modelling to inform a quantitative or semi-quantitative assessment of the effects of PTS or TTS, however, due to the proximity of both the proposed development and Dublin Array to the SAC, combined DEB modelling has been undertaken to inform the potential for an AEoI on this site from in-combination effects.

6.3.1.1.1 PTS and TTS

As described above, the PTS (and TTS) from piling noise is expected to result in a “notch” of reduced hearing sensitivity in exposed individuals within a frequency range that is considered to be of limited importance for biologically important purposes (Kastelein et al. 2017). As such, current scientific understanding is that PTS (and TTS) would not result in significant impacts on the fitness of individual harbour porpoises, for either adults or calves, although there is somewhat more uncertainty regarding impacts on the latter.

It is likely that, due to the mobile nature of harbour porpoise, individuals associated with the SAC community are likely to be present within the predicted impact ranges for PTS- and TTS-onset from construction and decommissioning activities associated with those projects considered in-combination with This the proposed development.

It is important to consider that harbour porpoise detections are reduced in the immediate vicinity of a pile prior to the commencement of piling, as a result of the presence of construction vessels, and thus it is assumed that porpoise are displaced from the immediate vicinity of the pile prior to piling commencing (Brandt et al. 2018, Rose et al. 2019, Benhemma-Le Gall et al. 2021, Benhemma-Le Gall et al. 2023). For example, harbour porpoise detections were found to gradually decline by up to 33% in the 48 hours before piling during the installation campaigns of both Beatrice and Moray East offshore wind farms (Benhemma-Le Gall et al., 2023). This is likely due to an increase in other construction-related activities and the presence of vessels in advance of pile driving, which deter harbour porpoises away from the works area, therefore reducing the risk of auditory injury (Benhemma-Le Gall et al., 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity of the pile driving site at the start of the activity. As such, the densities of harbour porpoise predicted to be within the potential impact ranges are likely to be reduced from the baseline and the scale of the effect thereby reduced in terms of individuals (proportion of the SAC population) exposed. This displacement effect is evidentially caused by the general type of vessel, rather than the specific activity it is undertaking (i.e. the displacement effect exists from prior to the first activity and as such is not a learnt behaviour from exposure to e.g. piling noise). As such, whilst not directly the subject of study for all noise sources, it is reasonable to assume that this same displacement effect will apply to other construction activities as well as decommissioning activities, thereby reducing the risk of PTS- and TTS-onset from construction and decommissioning activities generally.

6.3.1.1.1.1 Mitigation

Notwithstanding the low risk of PTS or TTS resulting in any biologically relevant effects to harbour porpoise, prior to any noise generating construction or decommissioning activities commencing on the proposed development or relevant Tier 2 projects, it is expected that MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible. These measures will also reduce the number of individuals at risk of TTS. As Annex II species, harbour porpoise are provided equally high protection across other jurisdictions, with standard mitigation measures in line with NPWS (2014) applying internationally. Therefore, it is reasonable to assume that equivalent mitigation would be applied on non-Irish projects to avoid PTS impacts.

6.3.1.1.1.2 Assessment

Regarding Target 2 (the only target related to in-combination underwater noise effects), individuals within or associated with the site will likely be present within the PTS- and TTS-onset impact ranges from construction and decommissioning activities, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), any PTS and TTS associated with in-combination underwater noise from construction and decommissioning activities is not predicted to result in any “significant negative impacts” on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is therefore considered that there will be no impact to the harbour porpoise feature of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.1.1.3 Conclusion of AEoI

Therefore, it is concluded that PTS and TTS arising from underwater noise associated with construction and decommissioning activities from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the harbour porpoise feature of the Rockabill to Dalkey Island SAC.

6.3.1.1.2 Behavioural Disturbance

To inform the assessment of potential for an AEoI on the harbour porpoise feature of the SAC from in-combination piling at the proposed development and Dublin Array (the two closest projects to the SAC), DEB modelling was run on three potential piling scenarios, covering both monopile and pin pile foundation types as well as different combinations of piling timings for the two projects (set out in full within Appendix 22).

Based on the modelling results, the only factor potentially affected by in-combination piling was calf survival. Using realistic, scientifically supported, disturbance rates (discussed within Appendix 22), reductions in calf survival were only identified for the maximum disturbance duration for each piling event, ranging between 1.5% - 2.2% depending on the specific scenario. For lower duration disturbance periods, no change to demographic rates were identified. An extreme disturbance rate (for which little scientific evidence exists), was also included within the modelling to account for the uncertainty in how harbour porpoise use the area around the project. Were this disturbance rate to hold, even under the greatest impact on foraging, the only parameter for which a significant change was identified was calf mortality.

The small change in calf mortality applies to the general population surrounding the proposed development and so is unlikely that even under these overly conservative scenarios that there would be any impact to individuals associated with the SAC. The DEB model shows that most of the change in calf mortality is associated with the timing of the piling events, with the assumed scenario having this coinciding with the calving season of harbour porpoises when porpoise calves are most vulnerable. Any other timings associated with piling would have a lesser effect by avoiding the time of greatest vulnerability.

As discussed within Appendix 22, a number of assumptions within the modelling are highly conservative and will likely overestimate the potential effects on the harbour porpoise population. Specifically, Chudzińska et al. (2024) demonstrate that if individual heterogeneity is allowed in the probability of response (i.e. different responses in different individuals), it dramatically reduces the predicted impact. Further, Graham et al. (2019) highlight that the probability of response declines as the piling campaign continues. As such, it is expected that impacts will be much less than those predicted by the extreme scenarios included in the modelling.

Regarding geophysical surveys, based on the modelling undertaken to inform the assessment therein, CSA (2020) identifies that Level B harassment ranges could extent up to 141m from the source. As noted above, this is expected to be fully contained within the potential disturbance/displacement effect of the vessels associated with the proposed development (e.g. Benhemma-Le Gall et al., 2023).

While harbour porpoises may be sensitive to disturbance from non-piling activities, construction period monitoring at the Beatrice and Moray East offshore wind farms indicated that porpoises were able to compensate for short-term local displacement arising from non-piling works (e.g. Benhemma-Le Gall et al. 2023), and thus it is not expected that individual vital rates would be impacted (Booth and Heinis, 2019).

It is noted in the JNCC guidance (2020) that UXO detonation is not expected to cause widespread and prolonged displacement of marine mammals. The impact is short-term and intermittent in nature with a temporary behavioural effect, which would be expected to be significantly less than that associated with piling. Very short, in most case single pulse events, which would be expected to on affect foraging behaviour over a period of at most minutes, are very unlikely to alter survival or reproductive rate to the extent to alter harbour porpoise population trajectory.

The OMF is not considered to have any contribution to potential in-combination noise effects. Due to the distance of the non-piling Tier 3 projects and the likely scale of effect from non-piling noise sources, these are not considered to have any meaningful contribution to an in-combination effect with the proposed development. For other piling projects Tier 2 and 3, which are expected to impact on the wider harbour population, and not necessarily those individuals associated with the SAC (with the SAC community being a component of the overall population within the MU), based on the DEB modelling only indicating effects to calf survival under highly conservative assumptions, and the extremely low likelihood that the same individual would be affected by each piling event within each project, let alone across all, it is predicted that there will be no change to vital rates of the harbour porpoise feature of the SAC for all plans, projects and activities in-combination with the proposed development. Impacts from noise from decommissioning are expected to no greater or less than those for construction (as described in the alone assessment).

6.3.1.1.2.1 Assessment

Regarding Target 2 (the only target related to in-combination underwater noise effects), individuals within or associated with the site will likely be disturbed and displaced by the underwater noise arising from construction and decommissioning activities, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with in-combination underwater noise from construction and decommissioning activities is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is therefore considered that there will be no impact to the harbour porpoise feature of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.1.2.2 Conclusion of AEoI

Therefore, it is concluded that disturbance arising from underwater noise associated with construction and decommissioning activities from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the harbour porpoise feature of the Rockabill to Dalkey Island SAC.

6.3.1.2 In-Combination Effects from Vessel Disturbance

Vessel disturbance to marine mammals is driven by a combination of underwater vessel noise and the physical presence of the vessel itself (e.g. Pirotta et al. 2015). Disturbance from vessels is therefore assessed here in general terms, covering disturbance driven by both underwater noise and vessel presence.

Vessel disturbance may affect individuals associated with the SAC both within and outwith the site, however, the greatest impact is likely to arise from vessel routing through the SAC. Whilst no clarity is available from other plans, projects or activities regarding vessel routes and construction or operations bases, it is possible that vessel routes for other projects may pass through the SAC.

Vessel noise from medium to large-sized vessels used for construction, operations and decommissioning (travelling at a speed of 10 knots) will result in an increase in the level of non-impulsive and continuous sound within and around the proposed development, typically with an estimated source level of 161 to 168SEL_{cum} dB re 1µPa@1m (rms), and in the frequency range of 10 to 100Hz although higher frequencies will also be produced (Erbe et al., 2019). OSPAR (2009) summarise the general characteristics of commercial vessel noise as continuous noise dominated by sounds from propellers, thrusters and various rotating machinery. In general, noise from support and supply vessels (50 to 100 m in length) are expected to have broadband source levels ranging 165 to 180 dB re 1µPa, with the majority of energy below 1kHz (OSPAR, 2009). Large commercial vessels (>100 m in length) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz, where the hearing sensitivity of harbour porpoise is relatively poor. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for harbour porpoises as per Appendix 6.

Several offshore studies focused on harbour porpoise behaviour around offshore wind farm construction sites have observed an increase in vessel presence to correlate with a decrease in harbour porpoise presence (Brandt et al. 2018, Benhemma-Le Gall et al. 2021). Benhemma-Le Gall et al. (2021) identified that there was no significant change of harbour porpoise occurrence detected beyond 4km of construction vessels. Therefore, whilst, as noted above, there will be a localised reduction of harbour porpoise density from the presence of vessels, this is spatially limited and is not considered to significantly constrain the foraging option for this species.

The land-based behavioural study of harbour porpoises in relation to vessel traffic in Swansea Bay by Oakley et al. (2017) identified 26% of observed negative porpoise behaviour (e.g. porpoises moving away from sound source or exhibited prolonged diving) being significantly correlated with the number of vessels present. Behavioural reactions observed in the study by Wisniewska et al. (2018) include increased fluking, interrupted foraging and change to vocalisations. This displacement can also be exemplified by surveying for harbour porpoise in an area with variable levels of vessel traffic, where reductions in local density suggest disturbance from the surrounding area. The study by Oakley et al. (2017) also revealed that vessel type was another important factor determining how porpoises react to vessel presence.

Smaller motorised boats (e.g. jet ski, speed boat, small fishing vessels) were associated with more negative behaviours than larger cargo ships. As vessels associated with offshore wind farms are typically larger and move slower than these types of small, motorised vessels, it would therefore be anticipated that the behavioural response would not be as severe.

While porpoise may be sensitive to disturbance from other vessels, 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. As the area surrounding the proposed development already experiences high levels of vessel traffic the introduction of additional vessels during all phases of projects is not a novel impact for marine mammals present in the area.

6.3.1.2.1 Assessment

Regarding Target 2, individuals within or associated with the site will likely be disturbed and displaced by the presence of vessels, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the disturbance associated with vessel presence is not predicted to result in any "significant negative impacts" on individuals or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is therefore considered that there will be no impact to the harbour porpoise feature of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.2.2 Conclusion of AEoI

Therefore, it is concluded that vessel disturbance arising from construction, operations and decommissioning activities from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the harbour porpoise feature of the Rockabill to Dalkey Island SAC.

6.3.1.3 In-Combination Effects from Vessel Collision

There is currently very limited information on the occurrence frequency of vessel collision as a source of marine mammal mortality, and there is little evidence from marine mammals stranded and recorded in Irish waters that vessel collisions is an important source of mortality. The Cetacean Strandings Investigation Programme (CSIP) in UK documents the annual number of reported strandings and includes the cause of death for post-mortem examined individuals. The post-mortem data show that very few strandings have vessel collision as the cause of death. While there is evidence that mortality from vessel collisions can and does occur, it is not considered as a key source of mortality as per previous post-mortem examinations in UK and Irish waters.

The harbour porpoise is deemed to be of low vulnerability to vessel collision, as this 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.

A maximum of 66 construction vessels may be on site simultaneously with a maximum total of 2386 return vessel trips to port throughout the construction phase for the proposed development alone and a similar number would be expected for the decommissioning stage. A maximum of 21 operational and maintenance vessels may be on site simultaneously with a maximum total of 1018 return vessel trips to port throughout the operational and maintenance phase Vessel numbers are not available for the projects considering in-combination at this stage. For the OMP (Tier 1), vessel numbers are expected to be low, for Tier 2 projects (other Phase 1 developments), vessel numbers for each project are likely to be of a similar scale to the proposed development. The majority of construction associated vessels will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port. Vessel traffic is expected to move along predictable routes around the proposed development, and to/from port to the proposed development site over the short periods of offshore activity, in line with existing Marine Wildlife Watching Codes. Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Construction, maintenance and decommissioning vessels are not expected to travel through the SAC outside of the proposed development footprints and defined routes.

It is thus not expected that the level of vessel activity from Tier 1, 2 and 3 projects om combination with the proposed development would cause an increase in the risk of mortality from collisions.

6.3.1.3.1 Assessment

Regarding Target 2 of the COs (the only relevant CO for this impact), individuals within or associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the proposed development is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the community at the site. Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the community of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the community at the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.3.2 Conclusion of AEoI

Therefore, it is concluded that in-combination increase in collision risk arising from vessel presence will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC

6.3.1.4 In-Combination Effects from Changes to Prey

As marine mammals are dependent on fish prey, there is potential for indirect effects on marine mammals as a result of direct impact on fish species or habitats that support them. During construction, maintenance or decommissioning activities, there is the potential for impacts upon these fish species, including direct damage (e.g. crushing) and disturbance, temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and/or accidental contamination, and additional underwater noise and vibration leading to mortality, injury, behavioural changes or auditory masking in fish.

The key prey species of harbour porpoises in Ireland include small cod (Trisopterus spp.), various Clupeoids, whiting, herring, and cephalopods (Berrow and Rogan 1995, Hernandez-Milian et al. 2011), Most of these fish species are categorised as Group 3 fish receptors (Popper et al., 2014) which possess a swim bladder involving in hearing. While there may be certain species that comprise the main part of porpoise's diet, harbour porpoises are considered to be generalist feeders and are thus not reliant on a single prey species.

As for harbour porpoise, their prey species are highly mobile and therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes and are therefore unlikely to have significant mortality associated with general construction, maintenance or decommissioning activities. As noted above, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper et al. 2014). Whilst underwater noise associated with piling or UXO clearance may result in localised mortality of fish, this is not predicted to result in wider scale effect and has no potential to result in population level impacts. Whilst disturbance associated with underwater noise may displace fish from a local area, the behaviour of fish in response to underwater noise is highly variable (e.g. Hawkins et al. 2014), and dependent on the behaviour which the fish is engaged with (e.g. Skaret et al. 2005).

6.3.1.4.1 Assessment

As identified above, the relevant CO for the SAC for impacts to prey is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised changes to the fish communities that the harbour porpoise depend on which may occur from the construction, maintenance and decommissioning of the proposed development in-combination with the Tier 1, 2 and 3 plans, projects and activities are not expected to result in the deterioration of the prey resource on which harbour porpoise depend. It is considered that there will be no impact to the harbour porpoise QI of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.4.2 *Conclusion of AEoI*

Therefore, it is concluded that changes to prey from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

6.3.1.5 *In-Combination Effects from Accidental Pollution*

Activities relating to the construction, maintenance and decommissioning of the proposed development may influence water quality as a result of the accidental release of fuels, oils and/or hydraulic fluids. With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates.

The proposed development will implement marine pollution contingency measures, including bunding to 110% of the volume of the containers all potential pollutants and contaminants involved in the construction of the proposed development and will have pre-agreed clean up processes established, with different responses for varying size spills in line with established incident management procedures. With these measures established, a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short term duration.

6.3.1.5.1 *Assessment*

The relevant CO for the SAC for impacts from accidental pollution is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (Target 2). Considering the specific technical clarifications of Target 2 (NPWS, 2013a), the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the harbour porpoise depend on or cause death or injury to individuals to an extent that may ultimately affect the harbour porpoise community within the site. It is considered that there will be no impact to the harbour porpoise QI of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.1.5.2 *Conclusion of AEoI*

Therefore, it is concluded that accidental pollution from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

6.3.2 Lambay Island SAC

6.3.2.1 *Assessment (Harbour porpoise)*

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of this site from the proposed development in-combination with other plans, projects and activities.

6.3.2.2 *In-Combination Effects from Underwater Noise (Grey/harbour seal)*

While the assessment for the proposed development alone identified no potential for adverse effects from underwater noise, due to the proximity of the proposed development and the SAC with other projects there is still a potential for effects to occur in-combination.

As for the proposed development alone, potential in-combination effects on grey seal and/or harbour seal receptors include PTS, TTS and behavioural disturbance from underwater noise as a result of the construction and decommissioning activities associated with the proposed development and other projects (inclusive of piling activities, UXO clearance and other activities including geophysical surveys).

The greatest risk for in-combination underwater noise effects on the grey seal and/or harbour seal feature of the SAC has been identified as being that produced by piling during the construction phase of the Phase 1 OWF projects. In-combination effects may result from concurrent piling at different wind farm sites or the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

Owing to the early stage of the Phase 1 projects within the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited, with the available information outlined above in the in-combination assessment for Rockabill to Dalkey Island SAC.

Due to the current planning stage of the relevant projects, there is no available data on either project scale or timings on which to undertake numerical noise modelling to inform a quantitative or semi-quantitative assessment of the effects of PTS or TTS and as such this is considered qualitatively.

6.3.2.2.1 PTS and TTS

As described above, whilst PTS is a permanent effect which cannot be recovered from, experts concluded at an expert elicitation workshop in 2018 that PTS was not likely to significantly affect the survival and reproduction rates of seal species, when assuming an impact of 6dB PTS in the range of 2 to 10kHz (Booth and Heinis, 2018). Although seals use sound both in air and water for communication, predator avoidance, and reproductive interactions, they are less dependent on hearing for foraging than cetaceans (Deecke et al., 2002). The seals also have very well developed tactile sensory systems used for foraging, but in certain conditions they may also listen to sounds produced by vocalising fish whilst hunting for prey (Dehnhardt et al., 2001; Shulte-Pelkum et al., 2007). Current scientific understanding is that PTS (and TTS) would not result in significant impacts on the fitness of individual grey or harbour seal.

It is likely that, due to the mobile nature of grey and harbour seal, individuals associated with the SAC population are likely to be present within the predicted impact ranges for PTS- and TTS-onset from construction and decommissioning activities associated with those projects considered in-combination with the proposed development.

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise is unlikely to be audible to seals when on land.

A study by Kastelein et al., (2013) measuring recovery rates of harbour seals following the exposure to a piling noise source of 193 dB re 1 μPa^2s ($SEL_{cum)}$ over six hours, found that TTS recovery to pre-exposure baseline level was estimated to occur within 72 minutes following the noise exposure. Similar recovery rates were documented in SEAMARCO (2011), which reported seals recover rapidly (around 30 minutes) under small TTS values. For TTS there are no thresholds to determine a biologically significant effect from TTS-onset. Given the temporary and reversible nature of TTS, it is anticipated that any animals experiencing this temporary shift in hearing would recover at a point in time, after they are no longer exposed to elevated noise levels. This includes as the animal moving further away from the sound source, which is the most likely response of an animal exposed to TTS noise levels. Therefore, the range of behavioural response (e.g. disturbance and/or displacement) is likely to overlap with potential TTS onset ranges, and animals exposed to such sound sources are likely to actively avoid TTS by moving away from the sound source.

6.3.2.2.1.1 Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to grey or harbour seal, prior to any noise generating construction or decommissioning activities commencing on the proposed development or relevant Tier 2 projects, it is expected that MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual grey or harbour seal to negligible.

These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

6.3.2.2.1.2 Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). PTS and TTS will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, the onset of PTS or TTS is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.2.2.1.3 Conclusion of AEoI

Therefore, it is concluded that in-combination PTS and TTS from underwater noise associated with construction or decommissioning activities will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC.

6.3.2.2.2 Behavioural Disturbance

Impacts from underwater noise are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Underwater noise will not result in a permanent barrier to site use as it only has an impact when emitted and due to the poor transfer of energy between the sea and air interface, underwater noise is not likely to be audible to seals when on land.

A study of tagged harbour seals in The Wash has shown that they are displaced from the vicinity of piles during pile-driving activities. Russell et al. (2016) showed that seal abundance was significantly reduced within an area of radius of 25km from a pile, during piling activities, with a 19 to 83% decline in abundance during pile-driving compared to during breaks in piling. The duration of the displacement was only short-term as seals returned to non-piling distributions within two hours after the end of a pile-driving event. Unlike harbour porpoise, both harbour and grey seals store energy in a thick layer of blubber, which means that they are more tolerant of periods of fasting when hauled out and resting between foraging trips, and when hauled out during the breeding and moulting periods. Therefore, they are unlikely to be particularly sensitive to short-term displacement from foraging grounds during periods of active piling, even if alternative foraging areas weren't available.

At an expert elicitation workshop in 2018 (Booth et al. 2019), experts agreed upon the most likely potential consequences of a six-hour period of zero energy intake. This was under the assumption that disturbance (from exposure to low frequency broadband pulsed noise e.g. pile-driving, airgun pulses) resulted in missed foraging opportunities. In general, it was agreed that harbour seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores.

There are still limited data on grey seal behavioural responses to pile driving. The key dataset on this topic is presented in Aarts et al. (2018) where 20 grey seals were tagged in the Wadden Sea to record their responses to pile driving at two offshore wind farms: Luchterduinen in 2014 and Gemini in 2015. The grey seals showed varying responses to the pile driving, including no response, altered surfacing and diving behaviour, and changes in swimming direction. The most common reaction was a decline in descent speed and a reduction in bottom time, which suggests a change in behaviour from foraging to horizontal movement. The distances at which seals responded varied significantly; in one instance a grey seal showed responses at 45km from the pile location, while other grey seals showed no response within 12km. Differences in responses could be attributed to differences in hearing sensitivity between individuals, differences in sound transmission with environmental conditions, or the behaviour and motivation for the seal to be in the area. The telemetry data also showed that seals returned to the pile driving area after pile driving ceased.

The disturbance expert elicitation workshop in 2018 (Booth et al. 2019) concluded that grey seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores and that the survival of 'weaned of the year' animals and fertility were determined to be most sensitive parameters to disturbance (i.e. reduced energy intake). However, in general, experts agreed that grey seals would be much more robust than harbour seals to the effects of disturbance due to their larger energy stores and more generalist and adaptable foraging strategies. It was agreed that grey seals would require moderate-high levels of repeated disturbance before there was any effect on fertility rates to reduce fertility.

Considering Tier 1, the OMF is planned to be situated near to the Strangford Lough SAC in Northern Ireland (also designated for harbour seals) and so impacts from piling for the OMF are unlikely to impact on individuals associated with the Lambay Island SAC. Additionally, there will be no temporal overlap with the construction of the proposed development and so in-combination effects are unlikely to either species.

Considering Tier 2, whilst the period of disturbance from all projects together may cover multiple years, the precise locations of disturbance will vary and as such, it is unlikely that the same individuals will continue to be affected. Based on the life-history of seals and the general resilience to periods of non-feeding, it is unlikely that there would be any impact to vital rates of harbour or grey seals associated with Lambay Island SAC from Tier 2 projects. The small scale of effects likely from the OMF (relative to the wind farm construction) and distance of this proposed development from the SAC is unlikely to contribute to any in-combination effect to the Lambay Island SAC.

Considering Tier 3, were all plans, projects or activities to occur, particularly with overlapping timescales, this could result in relatively high numbers of individuals being affected within the MUs for grey and harbour seals, and may lead to repeated disturbance of some individuals. The effects from the Tier 3 projects will be extended across the whole of the MU and will therefore affect multiple colonies. Considering the projects within the local area to the SAC, it is not considered that the additional disturbance from Tier 3 projects will result in any detrimental effects to individuals or the population associated with the SAC.

6.3.2.2.2.1 Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the grey and harbour seal populations at the site (Target 5). Disturbance will affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from underwater noise from construction, operation or decommissioning is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC.

6.3.2.2.2.2 Conclusion of AEoI

Therefore, it is concluded that in-combination disturbance arising from underwater noise will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC.

6.3.2.3 In-Combination Effects from Vessel Disturbance (grey/harbour seal)

As noted in the alone assessment, the relevant Targets for the assessment of the effects from in-combination vessel disturbance are Targets 2 – 5.

As detailed above, seals are relatively insensitive to disturbance from vessels, particularly when at sea. When hauled out, vessel approaches can result in raised alertness or increases in heat-rate (Bishop et al. 2015; Karpovich et al. 2015); whilst it is unclear what the long-term consequences of repeated vessel disturbance would be, it can be assumed that repeated disturbance may result in reductions in individual fitness through and increase in energy expenditure. The PTS and TTS impact ranges of vessel noise from medium and large-sized vessels are both estimated to be shorter than 100m for grey seals and harbour seals as per Appendix 6 (UWN modelling report).

6.3.2.3.1 Assessment

Regarding Targets 2 – 4, only vessels transiting within 1km of the haul out sites within the SAC have a potential pathway for effect, therefore, it is unlikely that vessels associated with the OMF will result in any impact to hauled out individuals. Considering the Tier 2 and 3 projects, it is reasonable to assume that any projects which may have vessels transit near the SAC (or any seal colony) will have similar vessel management measures as for the proposed development (as outlined in the alone assessment), thereby minimising the potential for any impacts to haul out sites. Specifically, it is not expected that there will be any significant interference or disturbance of breeding, moulting or resting behaviour with the vessels routed away from the haul out sites. There will also be no impact to the habitats used during breeding, moulting or resting. Regarding Target 5, seals are relatively insensitive to disturbance from vessels when at sea, often recorded around stationary vessels. Additionally, based on their capital breeder habits, short-term disturbance (such as that from vessels) is unlikely to pose a risk to individual fitness (Booth and Heinis, 2018). Therefore, whilst vessel disturbance will affect individuals within and/or associated with the site, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, disturbance from vessels is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the grey or harbour seal QIs of the SAC from vessel disturbance.

6.3.2.3.2 Conclusion of AEoI

Therefore, it is concluded that in-combination disturbance arising from vessel presence will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

6.3.2.4 In-Combination Effects from Vessel Collision (grey/harbour seal)

Impacts from collision risk are only considered relevant for Target 5 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 2 – 4 being focused on impacts to seals when out of the water. Collision risk will not result in a permanent barrier to site use and will not affect seals when on land.

As described in the alone assessment, grey seal and harbour seal are deemed to be of low vulnerability to vessel collision, given this 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 animals.

The majority of vessels associated with all tiers of projects will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port. It is reasonable to assume that vessels associated with other projects traffic will move along predictable routes around the proposed developments, and to/from port. Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Whilst survey vessels may not take predicable routes due to the need to provide full coverage of an area being surveyed, they are inherently slow-moving and therefore the risk of collision remains very low. It is thus not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

6.3.2.4.1 Assessment

Regarding Target 5, individuals within or associated with the SAC could in theory be at risk of vessel collision, however, with the use of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the proposed development is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the community at the site. Specifically, the in-combination risk of vessel collision is not expected to change from the baseline and so is not predicted to result in any "significant negative impacts" on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the grey seal or harbour seal QIs of the SAC from in-combination collision risk.

6.3.2.4.2 Conclusion of AEoI

Therefore, it is concluded that in-combination collision risk will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

In-Combination Effects from Changes to Prey (grey/harbour seal)

As described above in the alone assessment, seals are generalist feeders, and so are not reliant on a single prey species. Fish, being highly mobile, are at low risk of impacts arising from construction, operation and decommissioning of the Tier 1- 3 projects. Whilst individual fish may be disturbed or injured by specific activities, these are not likely to be at levels which would affect the community and therefore the wider distribution of prey items available for seals (as described in the alone assessment). Even all activities identified in Tiers 1 – 3 combined are unlikely to affect the availability of prey for seals associated with the Lambay Island SAC.

6.3.2.4.3 Assessment

The relevant CO for the SAC for impacts to prey is Target 5 which is to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from the construction, operation or decommissioning of Tier 1, 2 or 3 projects are not expected to result in the deterioration of the prey resource on which grey seal and harbour seal QIs depend. It is considered that there will be no impact to the grey seal and harbour seal QI of the SAC from in-combination changes to prey.

6.3.2.4.4 Conclusion of AEoI

Therefore, it is concluded that in-combination changes to prey will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

6.3.2.5 In-Combination Effects from Accidental Pollution (grey/harbour seal)

With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates from any identified project.

The proposed development has committed to a number of industry standard mitigation measures (as detailed in the alone assessment); the standard nature of these mitigation measures is such that it is reasonable to assume that other plans projects and activities will also implement similar measures, including 110% bunding and pre-agreed clean up processes. Therefore, it is expected that a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short-term duration.

6.3.2.5.1 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 5 to maintain human activities below levels which would adversely affect the grey seal or harbour seal populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the grey seal or harbour seal depend on or cause death or injury to individuals to an extent that may ultimately affect the grey seal or harbour seal populations within the site. It is considered that there will be no impact to the grey seal or harbour seal QI of the SAC from accidental pollution from the proposed development in-combination with other plans, projects or activities.

6.3.2.5.2 Conclusion of AEoI

Therefore, it is concluded that in-combination accidental pollution will not result in an AEoI to the grey seal or harbour seal Qis of the Lambay Island SAC.

6.3.3 Hook Head SAC

6.3.3.1 Assessment (Harbour porpoise)

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site.

Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.3.2 In-Combination Effects from Underwater Noise (Bottlenose dolphin)

While the assessment for the proposed development alone identified no potential for adverse effects from underwater noise, due to the proximity of the proposed development and the SAC with other projects there is still a potential for effects to occur in-combination. As for the proposed development alone, potential in-combination effects on bottlenose dolphin receptors include PTS, TTS and behavioural disturbance from underwater noise as a result of the construction and decommissioning activities associated with the proposed development and other projects (inclusive of piling activities, UXO clearance and other activities including geophysical surveys).

The greatest risk for in-combination underwater noise effects on the bottlenose dolphin feature of the SAC has been identified as being that produced by piling during the construction phase of the Phase 1 OWF projects. In-combination effects may result from concurrent piling at different wind farm sites or the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

Owing to the early stage of the Phase 1 projects within the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited, with the available information outlined above in the in-combination assessment for Rockabill to Dalkey Island SAC.

Due to the current planning stage of the relevant projects, there is no available data on either project scale or timings on which to undertake numerical noise modelling to inform a quantitative or semi-quantitative assessment of the effects of PTS or TTS and as such this is considered qualitatively.

6.3.3.2.1 PTS and TTS

As described above, whilst PTS is a permanent effect which cannot be recovered from, experts concluded at an expert elicitation workshop in 2018 that PTS was not likely to significantly affect the survival and reproduction rates of bottlenose dolphin, when assuming an impact of 6dB PTS in the range of 2 to 10kHz (Booth and Heinis, 2018).

Although no species-specific TTS recovery rate is available for bottlenose dolphins, there is no evidence to suggest that dolphin recovery will be significantly different from harbour porpoise recovery rates. The dolphins are expected to be able to recover from hearing shift when no longer exposed under piling noise.

It is also important to note that the PTS/TTS-onset thresholds and the hearing sensitivity of bottlenose dolphin based on Southall et al. (2019) typically result in small impact ranges (<100m), particularly compared to VHF cetaceans such as harbour porpoise and so bottlenose dolphins are at much lower risk of developing PTS or TTS in the first instance. This same low risk as seen for the proposed development alone is anticipated to apply for all noise generating activities across all Tiers.

6.3.3.2.1.1 Mitigation

Notwithstanding the low risk of PTS resulting in any biologically relevant effects to bottlenose dolphin, prior to any noise generating construction or decommissioning activities commencing on the proposed development or relevant Tier 2 projects, it is expected that MMOs and PAM will be used together as required, in line with NPWS (2014), to ensure that marine mammals are not present within the defined mitigation zone. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin to negligible. These measures will also reduce the number of individuals at risk of TTS, through a reduction in the potential impact zones and also by the partial displacement of individuals from the impact zone.

6.3.3.2.1.2 Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). PTS and TTS may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site.

Specifically, the onset of PTS or TTS is not predicted to result in any “significant negative impacts” on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from PTS and TTS from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.3.2.1.3 Conclusion of AEoI

Therefore, it is concluded that in-combination PTS and TTS arising from underwater noise associated with construction and commissioning will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

6.3.3.2.2 Behavioural Disturbance

To inform the potential for population level impacts to bottlenose dolphin from piling noise generated by all the Phase 1 offshore wind projects, iPCoD modelling was undertaken. Whilst this modelling is population level at the MU (and therefore not specific to the population trend within a specific SAC), it is useful in informing the wider effects from repeated disturbance events.

According to expert opinion from the expert elicitation workshop for iPCoD (Harwood et al. 2014), dolphins are expected to be able to adapt their behaviour, with the impact most likely to result in potential changes in calf survival (but not expected to affect adult survival or future reproductive rates) from an extended period of disturbance. At a recent expert elicitation, conducted for the purpose of modelling population impacts of the Deepwater Horizon oil spill (Schwacke et al., 2021), experts agreed that there would likely be a concave density dependence on fertility, which means that in reality, it would be expected that the impacted population would recover to carrying capacity (which is assumed to be equal to the size of un-impacted population – i.e., it is assumed the un-impacted population is at carrying capacity) rather than continuing at a stable trajectory that is smaller than that of the un-impacted population. As such, it is expected that were the population to reduce slightly during the period of disturbance, the population would be expected to recover back to the carrying capacity, rather than remaining at a lower population size.

Considering Tier 1, there will be no temporal overlap with the construction of the proposed development and so in-combination effects are unlikely to occur.

Considering Tier 2, it is expected that were any population changes identified at the MU scale these are expected to recover back to the baseline. However, were any population size changes to occur, it is unlikely that this would affect the population associated with the Hook Head SAC due to the distance of the site from the majority of the Tier 2 projects. Equally, this therefore reduces the likelihood of individuals associated with the SAC being affected by enough of the individual plans projects or activities to have an effect on vital rates. The small scale of effects likely from the OMF (relative to the wind farm construction) and distance from the SAC are not expected to contribute to any impact to individuals associated with the SAC.

Considering Tier 3 were all plans, projects or activities to occur, particularly with overlapping timescales, this could result in relatively high numbers of individuals being affected within the MU and may lead to repeated disturbance of some individuals. The effects from the Tier 3 projects will be extended across the whole of the MU. Considering the projects within the local area to the SAC, it is not considered that the additional disturbance from Tier 3 projects will result in any detrimental effects to individuals or the population associated with the SAC.

6.3.3.2.2.1 Assessment

As identified above, the relevant CO for the SAC for impacts arising from underwater noise is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (Target 2). Disturbance may affect individuals within and/or associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the population at the site. Specifically, disturbance is not predicted to result in any "significant negative impacts" on individuals or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site.

It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from disturbance from underwater noise from the proposed development in-combination with Tier 1, 2 or 3 plans, projects and activities.

6.3.3.2.2.2 Conclusion of AEoI

Therefore, it is concluded that in-combination disturbance arising from underwater noise associated with construction and decommissioning will not result in an AEoI to the bottlenose dolphin QI of Hook Head SAC.

6.3.3.3 In-Combination Effects from Vessel Disturbance (bottlenose dolphin)

As described in the alone assessment, bottlenose dolphin are relatively insensitive to vessel disturbance. The PTS and TTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100m for bottlenose dolphin as per Appendix 6 (UWN modelling report).

Vessel disturbance may affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, in-combination disturbance from vessels is not predicted to result in any significant negative impacts on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from the proposed development in-combination.

6.3.3.3.1 Assessment

Impacts from vessels are only considered relevant for Target 2 of the COs for the SAC, with Target 1 being relevant to permanent barrier effects and Targets 3 being focused on habitat use within the SAC. Vessels will not result in a permanent barrier to site use and due to the distance between the proposed development and the SAC there will be no impact on the habitats within the SAC.

Regarding Target 2, vessel disturbance may affect individuals associated with the site, however, as described above, this is not predicted to result in any significant change to individual fitness or reproductive success and so is therefore not expected to impact on the populations at the site. Specifically, in-combination disturbance from vessels is not predicted to result in any "significant negative impacts" on individuals or the populations of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the populations at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from the proposed development in-combination.

6.3.3.3.2 Conclusion of AEoI

Therefore, it is concluded that in-combination vessel disturbance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

6.3.3.4 In-Combination Effects from Vessel Collision (bottlenose dolphin)

As described in the alone assessment, bottlenose dolphin are deemed to be of low vulnerability to vessel collision, given this 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 animals.

The majority of vessels associated with all tiers of projects will be large vessels which are either stationary or slow-moving on-site throughout most periods of the construction phase, in addition to those transiting between the site and the port. It is reasonable to assume that vessels associated with other projects traffic will move along predictable routes around the proposed developments, and to/from port. Predictability of vessel movement is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek et al. 2001; Lusseau 2003, 2006). Whilst survey vessels may not take predicable routes due to the need to provide full coverage of an area being surveyed, they are inherently slow-moving and therefore the risk of collision remains very low. It is thus not expected that the level of vessel activity during construction would cause an increase in the risk of mortality from collisions.

6.3.3.4.1 Assessment

Regarding Target 2, individuals associated with the site could in theory be at risk of vessel collision, however, with the implementation of defined vessel routes and the slow speed of the vessels when on site, the presence of vessels associated with the proposed development is not predicted to increase the risk of vessel collision above the existing baseline and so is therefore not expected to impact on the population at the site. Specifically, the risk of in-combination vessel collision is not expected to change from the baseline and so is not predicted to result in any “significant negative impacts” on individuals and/or the population of the site, nor is it expected to result in death or injury to individuals to an extent that may ultimately affect the population at the site. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from the proposed development in-combination with other plans, projects and activities.

6.3.3.4.2 Conclusion of AEoI

Therefore, it is concluded that in-combination collision risk will not result in an AEoI to the bottlenose dolphin QI of Hook Head SAC.

6.3.3.5 In-Combination Effects from Changes to Prey (bottlenose dolphin)

As described above in the alone assessment, bottlenose dolphin are generalist feeders, and so are not reliant on a single prey species. Fish, being highly mobile, are at low risk of impacts arising from construction, operation and decommissioning of the Tier 1- 3 projects. Whilst individual fish may be disturbed or injured by specific activities, these are not likely to be at levels which would affect the community and therefore the wider distribution of prey items available for bottlenose dolphin (as described in the alone assessment). Even all activities identified in Tiers 1 – 3 combined are unlikely to affect the availability of prey for bottlenose dolphin associated with the SAC.

6.3.3.5.1 Assessment

The relevant CO for the SAC for impacts to prey is Target 2 which is to maintain human activities below levels which would adversely affect the populations at the site. Specifically, any small-scale, localised changes to the fish communities that the QIs depend on which may occur from the construction, operation or decommissioning of Tier 1, 2 or 3 projects are not expected to result in the deterioration of the prey resource on which the bottlenose dolphin QI depends. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from in-combination changes to prey.

6.3.3.5.2 Conclusion of AEoI

Therefore, it is considered that in-combination changes to prey risk will not result in an AEoI to the bottlenose dolphin QI of Hook Head SAC.

6.3.3.6 In-Combination Effects from Accidental Pollution (bottlenose dolphin)

With regards to the accidental release of fuels, oils and/or hydraulic fluids, the impact of pollution is associated with the construction of infrastructure and use of supply/service vessels may lead to direct impact of marine mammals or a reduction in prey availability either of which may affect species' survival rates from any identified project.

The proposed development has committed to a number of industry standard mitigation measures (as detailed in the alone assessment); the standard nature of these mitigation measures is such that it is reasonable to assume that other plans projects and activities will also implement similar measures, including 110% bunding and pre-agreed clean up processes. Therefore, it is expected that a major incident that may impact any species at a population level is considered very unlikely. It is predicted that any impact would be of local spatial extent and of a short-term duration.

6.3.3.6.1 Assessment

The relevant COs for the SAC for impacts from accidental pollution is Target 2 to maintain human activities below levels which would adversely affect the populations at the site. Specifically, the small-scale, localised impact which may occur from a pollution incident is not expected to result in any changes to the fish communities that the bottlenose dolphin depend on or cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin populations within the site.

It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from accidental pollution from the proposed development in-combination with other plans, projects or activities.

6.3.3.6.2 Conclusion of AEoI

Therefore, it is concluded that in-combination accidental pollution will not result in an AEoI to the bottlenose dolphin QI of Hook Head SAC.

6.3.4 Codling Fault Zone SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.5 North Anglesey Marine/ Gogledd Môn Forol SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.6 Murlough SAC

Given that the range of habitat for harbour seal available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Lambay Island SAC, which is designated for the same QI and is located nearer to the proposed development.

As Section 6.3.2 concluded no AEoI on harbour seal QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour seal QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.7 North Channel SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.8 Glannau Ynys Gybi/ Holy Island Coast SAC

Given that the range of habitat for grey seal available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Lambay Island SAC, which is designated for the same QI and is located nearer to the proposed development.

As Section 6.3.2 concluded no AEoI on grey seal QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the grey seal QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.9 West Wales Marine/ Gorllewin Cymru Forol SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development (and fully encompasses this SAC). As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.10 Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC

6.3.10.1 Assessment (Grey Seal)

Given that the range of habitat for grey seal available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Lambay Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.2 concluded no AEoI on grey seal QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the grey seal QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.10.2 Assessment (Bottlenose Dolphin)

Given that the range of habitat for bottlenose dolphin available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Hook Head SAC (see Section 6.3.3), which is designated for the same QI and concluded no AEoI on bottlenose dolphin QIs for all screened in-combination impacts. Despite the somewhat greater distance to the site than this SAC, the conclusions from Hook Head SAC regarding likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC still remain valid and it is considered that the potential for AEoI is the same for this site. Therefore, it is concluded that there is no AEoI from any impacts on the bottlenose dolphin QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.11 Blackwater Bank SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.12 Carnsore Point SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.13 Cardigan Bay/ Bae Ceredigion SAC

Given that the range of habitat for bottlenose dolphin available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Hook Head SAC (see Section 6.3.3), which is designated for the same QI and concluded no AEoI on bottlenose dolphin QIs for all screened in-combination impacts. Despite the somewhat greater distance to the site than this SAC, the conclusions from Hook Head SAC regarding likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC still remain valid and it is considered that the potential for AEoI is the same for this site. Therefore, it is concluded that there is no AEoI from any impacts on the bottlenose dolphin QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.14 Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.15 Roaringwater Bay and Islands SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.16 Blasket Islands SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.17 Kenmare River SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.18 Bunduff Lough and Machair/ Trawlua/ Mullaghmore SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.19 Nord Bretagne DH SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.20 West Connacht Coast SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.21 Mers Celtiques – Talus du golfe de Gascogne SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.22 Récifs et landes de la Hague SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.23 Anse de Vauville SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.24 Banc et récifs de Surtainville SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.25 Tregor Goëlo SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of this site from the proposed development in-combination with other plans, projects and activities.

6.3.26 Belgica Mound SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.27 Baie de Morlaix SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.28 Abers-Côtes des légendes SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.29 Ouessant-Molène SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.30 Chausey SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.31 Baie de Saint-Brieuc – Est SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.32 Côtes de Crozon SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.33 Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.34 Baie du Mont Saint-Michel SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.35 Kilkieran Bay and Islands SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.36 Chaussée de Sein SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.3.37 Inishmore Island SAC

Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As Section 6.3.1 concluded no AEoI on harbour porpoise QIs for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to the site and the consequently reduced likelihood of impacts to individuals associated with the SAC and scale of effect on the population of the SAC, it is considered that the potential for AEoI is the same or reduced for this site. Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of this site from the proposed development in-combination with other plans, projects and activities.

6.4 Ornithology

The scoping process for in-combination effects on ornithological QIs has been based on the species and their associated population designation (i.e., breeding species, over-wintering species and passage species) enabling a ZoI to be defined in which in-combination effects may occur.

In general, any impacts below a 1% increase in baseline mortality are considered to be indistinguishable from natural fluctuations in the baseline population. This is the level above which triggers further analysis in the form of a population viability analysis (PVA) is required.

Within the EIAR the proposed development has used a 0.1% increase in baseline mortality as the negligible threshold, however, a precautionary approach has been taken and screened in all impacts above 0.05% increase in baseline mortality from the Proposed development alone to any qualifying interest of an SPA into the in-combination assessment. This level means that 20 projects each with a similar level of impact on the population as the proposed development would be required to reach the threshold for further analysis from PVA, and considerably more to reach a level for which an AEoI may be concluded. It can be assumed that this level of impact provides a non-material contribution to the in-combination total and therefore any impacts below this threshold have been screened out from the in-combination section of this assessment. Table 6.3 summarises the proposed development alone impact and status for the in-combination assessment.

For the in-combination effects assessment of the onshore development area on SPAs, projects and plans occurring within 300m of the onshore development area at the landfall site and/or Malahide Estuary, or that occur within the same hydrological catchment of the onshore development area, and have potential to result in water quality effects, were screened in.

A distance of 300m is considered to be a threshold for disturbance and displacement effects on QIs as it is not expected that these effects will extend beyond a distance of c. 300m from construction works, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts *et al*., 2009). As such North-West Irish Sea cSPA and Malahide Estuary SPA have been considered in the in-combination assessment of disturbance and displacement effects. SPAs identified as having hydrologically or hydrogeologically connectivity with the onshore development area were North-West Irish Sea cSPA, Malahide Estuary SPA, Rogerstown Estuary SPA and Baldoyle Bay SPA, while the latter three overlap with the associated SACs which have been assessed under coastal and marine habitats for suspended sediment and deposition and accidental pollution. As such, see Section 6.1 for the in-combination assessment of water quality impacts on these wetland habitats for which QIs rely on.

Table 6.3: Summary of the Designated Sites and Ornithological QIs Considered for Collision and Disturbance and Displacement Assessment During the Operational Phase for the Proposed Development In-Combination.

Designated Site	Offshore and Intertidal Ornithology QI(s) screened in	Mean predicted impact (breeding adults)	Increase in baseline mortality	Progressed to In-combinatio n	Rationale for screening out
North-West Irish Sea cSPA	Great black-backed gull	16.24	0.434%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Black headed gull	0.20	0.001%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Common gull	5.51	0.047%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Manx shearwater	1.65	0.133%	No	Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and there are no other relevant projects which have been screened into the in-combination assessment and as such there is no potential for an in-combination effect.
	Common scoter	0.86	0.026%	No	Within the NWIS cSPA only Oriel have overlap of the ECC and therefore potential for an in-combination effect. However, Oriel did not assess common scoter and therefore there is no in-combination impact to assess. Therefore, there is no potential for AEoI in combination with other projects.
	Red-throated diver	0.60	0.201%	Yes (during construction and decommissionin g only)	During operation impacts to the nearshore ECC, which is where divers are located in the highest densities, are predicted to be minimal and restricted to emergency maintenance only. The is a very low presence of divers in the array area and so any maintenance activity offshore will not impact the NWIS cSPA wintering population.
	Great northern diver	0.02	0.022%	No	Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and there are no other relevant projects which have been screened into the in-combination assessment and as such there is no potential for an in-combination effect.
	Fulmar	0.04	0.001%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	European shag	-	-	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Cormorant	-	-	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.

Designated Site	Offshore and Intertidal Ornithology QI(s) screened in	Mean predicted impact (breeding adults)	Increase in baseline mortality	Progressed to In-combination	Rationale for screening out
	Little gull	-	-	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Kittiwake	19.32	0.019%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Lesser black-backed gull	0.45	0.002%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Herring gull	57.16	0.184%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Guillemot	157.89	0.351%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Razorbill	30.5	0.027%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Little tern	-	-	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Common tern	0.69	0.008%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Arctic tern	0.05	0.001%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
	Roseate tern	0.07	0.009%	No	Within the NWIS cSPA there are no other OWFs so there is no other collision risk or displacement risk to consider in-combination with the proposed development.
Rockabill SPA	Common tern	0.69	0.140%	No	0.69 adult mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect at 0.140% increase in baseline mortality, that would be well within the error margins of the assessment. There are no other relevant projects which have been screened into the in-combination assessment and as such there is no potential for an in-combination effect.
	Arctic tern	0.05	0.384%	No	Assessment alone concluded potential for trivial and inconsequential level of effect (0.05 adult mortalities are attributed to this SPA), that would be well within the error margins of the assessment. There are no other relevant projects which have been screened into the in-combination assessment and as such there is no potential for an in-combination effect.

Designated Site	Offshore and Intertidal Ornithology QI(s) screened in	Mean predicted impact (breeding adults)	Increase in baseline mortality	Progressed to In-combination	Rationale for screening out
	Roseate tern	0.07	0.018%	No	Assessment alone concluded potential for trivial and inconsequential level of effect (0.07 adult mortalities are attributed to this SPA), that would be well within the error margins of the assessment. There are no other relevant projects which have been screened into the in-combination assessment and as such there is no potential for an in-combination effect.
Skerries Islands SPA	Herring gull	0.03	0.024%	Yes	N/A
Ireland's Eye SPA	Guillemot	0.64	0.444%	Yes	N/A
	Razorbill	0.13	0.076%	Yes	N/A
	Kittiwake	0.10	0.088%	Yes	N/A
	Herring gull	0.33	0.315%	Yes	N/A
Saltee Islands SPA	Guillemot	1.95	0.237%	Yes	N/A
	Razorbill	0.17	0.055%	Yes	N/A
	Kittiwake	0.05	0.016%	No	Less than 0.05 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect.
	Lesser black-backed gull	0.00	0.008%	No	Less than 0.01 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect.
	Gannet	0.07	0.010%	No	0.07 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect
Howth Head Coast SPA	Kittiwake	0.37	0.072%	Yes	N/A
Lambay Island SPA	Guillemot	10.83	0.296%	Yes	N/A
	Razorbill	0.79	0.102%	Yes	N/A

Designated Site	Offshore and Intertidal Ornithology QI(s) screened in	Mean predicted impact (breeding adults)	Increase in baseline mortality	Progressed to In-combination	Rationale for screening out
	Kittiwake	1.71	0.176%	Yes	N/A
	Herring gull	1.62	0.537%	Yes	N/A
	Lesser black-backed gull	0.23	0.284%	Yes	N/A
	Fulmar	0.04	0.006%	No	0.04 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any material contribution to an in-combination effect
Wicklow Head SPA	Kittiwake	0.05	0.022%	No	Given the proposed development alone impact on kittiwake from Wicklow Head SPA is 0.05 individuals representing a 0.022% increase in baseline mortality, it can be assumed that the impact is so small as to not to make any material contribution to the in-combination total. For example, it is estimated that the proposed development will contribute approximately one kittiwake mortality from this SPA every twenty years.
Rathlin Island SPA	Kittiwake	0.37	0.018%	No	Given the proposed development alone impact on kittiwake from Wicklow Head SPA is 0.37 individuals representing a 0.018% increase in baseline mortality, it can be assumed that the impact is so small as to not to make any material contribution to the in-combination total.
Ailsa Craig SPA	Kittiwake	0.02	0.017%	No	Less than 0.02 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect.
	Gannet	0.88	0.024%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.
	Lesser black-backed gull	0.00	0.007%	No	Less than 0.00 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect.
Helvick Head SPA	Kittiwake	0.00	0.001%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.

Designated Site	Offshore and Intertidal Ornithology QI(s) screened in	Mean predicted impact (breeding adults)	Increase in baseline mortality	Progressed to In-combination	Rationale for screening out
Ribble & Alt Estuaries SPA	Lesser black-backed gull	0.08	0.008%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA	Kittiwake	0.07	0.016%	No	Less than 0.07 individual mortalities are attributed to this SPA. Assessment alone concluded potential for trivial and inconsequential level of effect, that would well within the error margins of the assessment and therefore no potential for any contribution for an in-combination effect.
	Lesser black-backed gull	0.08	0.005%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.
Grassholm SPA	Gannet	0.51	0.013%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.
Horn Head to Fanad Head SPA	Kittiwake	0.08	0.015%	No	Less than 0.05% increase in baseline mortality from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.
North Colonsay and Western Cliffs SPA	Kittiwake	0.13	0.070%	No	Less than 0.13 adults from the proposed development alone and therefore has no material contribution to the in-combination numbers and there this impact has been screened out.

In-combination effects on seabird ornithological receptors with developments other than OWFs and tidal energy projects are considered to be unlikely due to the specific impacts (collisions and displacement) generated by turbine arrays or offshore ECC construction activities in the offshore environment. Other impacts on birds, for example fisheries bycatch, are not included in the in-combination assessment. These longstanding impacts are considered to be part of the baseline and there is generally inconsistent and unreliable data to quantify any impacts. Therefore, impacts from these industries (such as fisheries) are not included in the longlist.

A range of proposed, consented, under-construction, and operational OWFs in Irish and UK waters were screened in for the in-combination assessment, based on the potential for AEoI from activities taking place at these sites in-combination with the proposed development.

It is noted that some identified developments may not actually be taken forward, or fully built as outlined within their planning applications/consents. This is predominantly relevant for projects which are 'proposed' or identified in development plans but yet to submit a NIS, or report to inform appropriate assessment (RIAA) for UK projects. To account for this potential uncertainty, a tiering approach is undertaken, assigning tiers to each project which reflects their current stage within the planning and development process. This approach uses the following categorisations:

- Tier 1
  - the OMF which is required for the operation of the proposed development.
- Tier 2
  - Phase One Projects (proposed offshore renewable energy projects) located off the east coast of Ireland. Such projects include Oriel Windfarm, Codling Wind Park I and II, Arklow Bank II and Dublin Array. The proposed development is also a Phase One Project. Whilst none of these other Phase One Projects have submitted applications to the planning authority (ABP) at the time of writing of this NIS, they have been included in the cumulative impact assessment given the location and nature of these projects, given that they have all been awarded Marine Area Consent (MAC) and have more certainty of proceeding through the consenting process at the same time as the proposed development and given feedback from ABP during pre-application consultations. As outlined in Section 15.2.7, a single value for Phase one projects is included in the cumulative assessment. Given its location on the Irish west coast, and lack of functional connectivity with east coast SPAs, Sceirde OWF was the only Irish Phase One project not included in the in-combination assessment.
- Tier 3
  - Operational projects
- Projects under construction
- Projects which have been consented
- Projects for which an application has been submitted; and
- Projects that have published preliminary environmental impacts assessments.
  - Projects which have been scoped into the assessment and their relevant tiers are presented in Table 6.4 below. It should be noted that projects which fit the criteria for inclusion are only included for the cumulative effects assessment if there is sufficient data available to do so. The following projects do not have available information to add to a quantitative cumulative assessment and therefore not considered further in the impact assessment.
- Projects which have submitted a scoping report
- Projects which have been identified in a relevant development plan (but have not submitted a scoping report); and
- Projects which have been identified in other plans and programmes.

It should be noted that several OWFs included within the in-combination assessment are operational. Impacts from these projects can be considered less relevant, since impact from these projects may form part of the baseline conditions because demographic rates and regional population trends are inclusive of these impacts. There is also evidence that birds may become habituated to these impacts over time, thus older OWFs are expected to have a reduced magnitude of impact relative to those predicted from their application. However, operational OWFs remain included within this in-combination assessment as a precautionary approach. Though considered part of the baseline, there remains potential for some impacts to not be fully accounted for (e.g., it is unknown whether OWF impacts are accounted for within demographic rates used within the assessment). This approach is in line with the approach taken across the majority of UK projects (e.g., Awel y Mor). Projects included within the in-combination assessment are as follows:

Table 6.4: In Combination Projects Screened In for Further Assessment.

Development Type	Project Name	Distance to array area (km)	Distance to ECC (km)	Distance to the Proposed Development Boundary (km)	Current Status	Planned Programme	Tier
OWF	Awel-y-Mor	131.6	139.5	NA	Consented	2026 - 2030	3
	Erebus	235.1	239.6	NA	Consented	2025 - 2027	3
	Morgan	111.5	119.9	NA	Concept/ Early Planning	2028 - 2029	3
	Mona	117.3	124.8	NA	Application submitted	2026 - 2027	3
	Gwynt y Mor	143.2	151.2	NA	Operational	N/A	3
	Rhyl Flats	144.5	152.8	NA	Operational	N/A	3
	Burbo Bank Extension	163.4	171.1	NA	Operational	N/A	3
	North Hoyle	157.5	165.5	NA	Operational	N/A	3
	Walney Extension 3	133.3	141.8	NA	Operational	N/A	3
	Walney Extension 4	133.3	141.8	NA	Operational	N/A	3
	West of Duddon Sands	153.2	161.5	NA	Operational	N/A	3
	Walney 2	148.3	156.7	NA	Operational	N/A	3
	Walney 1	153.7	162.0	NA	Operational	N/A	3
	Burbo Bank	173.6	181.3	NA	Operational	N/A	3
	Ormonde	160.7	169.1	NA	Operational	N/A	3

Development Type	Project Name	Distance to array area (km)	Distance to ECC (km)	Distance to the Proposed Development Boundary (km)	Current Status	Planned Programme	Tier
	Barrow	167.7	175.9	NA	Operational	N/A	3
	Robin Rigg East	176.7	184.9	NA	Operational	N/A	3
	Robin Rigg West	176.7	184.9	NA	Operational	N/A	3
	Arklow Bank Phase 1	88.3	91.3	NA	Operational	N/A	3
	Morecambe	138.9	146.5	NA	Concept/ Early Planning	2026-2029	3
	Sceirde Rocks Windfarm	646.7	645.4	NA	Phase 1 (MAC Awarded)	2026 - 2030	3
	Oriel Wind Farm	16.9	21.6	16.9	Phase 1 (MAC Awarded)	2025-2026	2
	Codling Wind Park	50.9	56.9	50.9	Phase 1 (MAC awarded)	2026-2028	2
	Arklow Bank	76.4	80.0	76.4	Phase 1 (MAC awarded)	2025/26-2028/29	2
	Dublin Array	32.9	37.6	32.9	Phase 1 (MAC awarded)	2026-2028	2
Tidal Energy	Minesto	73.3	80.4	NA	Operational	N/A	3
Onshore projects and plans	Broadmeadow Way - Greenway between Malahide Demesne and Newbridge Demesne	NA[3]	NA[2]	0.63	Consented	2024-2026	3

[3] Distance to the array area and the ECC are Not Applicable (NA) for these Tier 3 plans and projects as they are onshore plans and projects and relate to the in-combination assessment for the onshore development area. A distance has not been provided to the onshore development area, however, they have been identified as being located within 300m of the onshore development area, and are therefore screened in for the in-combination assessment.

Development Type	Project Name	Distance to array area (km)	Distance to ECC (km)	Distance to the Proposed Development Boundary (km)	Current Status	Planned Programme	Tier
	DART+	NA[2]	NA[2]	0	Pending Application	Application is expected to be submitted to An Bord Pleanála in 2024.	3
	Fingal Coastal Way	NA[2]	NA[2]	0	Pending Application	No up-to-date information available on construction timelines at time of writing.	3
	Bremore Regional Park Development Project	NA[2]	NA[2]	0	Consented	Granted June 2021. Expiry date June 2026. No up-to-date information available on construction timelines at time of writing.	3

During the breeding bio-season it is considered that potential AEoI on ornithological QIs from designated sites may be attributed more highly to OWFs within areas of sea within foraging distance from the breeding colonies. To assess the potential in-combination effects on ornithological QIs from multiple OWFs and tidal energy projects, information was compiled on the seasonal abundance of species measured at each OWF site (plus 2km buffer). The seasonal abundances were then apportioned to the relevant designated sites (Apportioning Appendix 20).

Outside of the breeding bio-season, when the population contains a mix of birds from Irish breeding colonies and breeding colonies from further away, then a much lower percentage of birds can be apportioned to any particular breeding colony SPA population. This apportionment is based on calculating the proportion of the breeding adults within the defined regional population that can be attributed to the relevant designated sites as defined within the Apportioning Appendix 20.

The assessments provided within this NIS include a number of assumptions that contribute to the predicted impacts and potential effects being considered appropriately precautionary, including:

- The population within each bio-season for all of the OWFs being the mean of the peaks from each survey year. This makes the assumption that such a high population is maintained for each of the months within each bio-season, whilst the actual abundance is likely to be less than this throughout the months making up each bio-season.
- The population within OWF array areas and/or buffers to the south of the proposed development is likely to include non-breeding and migratory auks moving north and south during the months considered as being included in the breeding bio-season for this assessment.
- All sites being considered within the maximum foraging range is very precautionary, considering that many of the OWF array areas and their buffers are beyond a reasonable distance to assume they would be regularly used (if at all) by species during the breeding bio-season from relevant SPAs.
- The maximum extent of displacement considered for each species is likely to be greater than actually experienced within the array area and buffer.
- The maximum of 10% mortality of auks displaced during the non-migratory breeding bio-season is highly unlikely within all the offshore wind farms included within this assessment, as the species assessed in this NIS are not solely dependent upon these area for all their foraging needs; and
- Not accounting for additional non-breeding adults within the Irish Sea that contribute to the population within the OWFs considered within this in-combination assessment throughout the year.

6.4.1 Construction & Decommissioning

6.4.1.1 Offshore Disturbance and Displacement

During the construction and decommissioning phases, the assessment of displacement impacts from the proposed development alone (Section 5.4.1) concluded no AEoI for any of the sites or species assessed.

All QIs that have been assessed for proposed development alone impacts have also been considered for inclusion in the in-combination assessment. Table 6.3 shows which of these QIs have been taken through for in-combination assessment. The majority have only been progressed through to the in-combination assessment for the operational phase for a number of reasons. Firstly, a temporal and spatial overlap with other projects during construction is unlikely. Secondly, the impacts from displacement during construction and decommissioning are considered to be half that of O&M and in all of these cases it has been concluded that there will be no AEoI for the proposed development alone. Therefore, in these cases the in-combination effects for displacement impacts on QIs are only assessed for the scenario that gives rise to the largest impact, which is during the O&M phase.

In the case of the NWIS cSPA, this site is designated to protect important habitat for seabirds and waterbirds and therefore only impacts arising from activities taking place within this SPA are considered in-combination. Within the NWIS cSPA there are no other OWFs and so there is no other collision risk or displacement risk to consider in-combination with the proposed development. The only exception to this is Oriel Wind Farm because the ECC overlaps with the northern edge of the NWIS cSPA.

Therefore, there is some potential for an in-combination impact to the NWIS cSPA to diver and sea duck QIs during construction and decommissioning. These are considered further within the in-combination assessment.

6.4.1.2 Onshore Disturbance and Displacement

A distance of 300m is considered to be a threshold for disturbance and displacement effects on QIs as it is not expected that these effects will extend beyond a distance of c. 300m from construction works, as noise levels associated with general construction activities would attenuate close to background levels at that distance (Cutts *et al*., 2009). As such projects or plans that occur within this ZoI and have potential for construction phase overlap with the onshore construction works of the proposed development were screened in for the in-combination assessment. In-combination disturbance and displacement effects would arise at the landfall site and Malahide Estuary only. Therefore, only those sites occurring within close proximity to these locations have been brought forward in the in-combination assessment for onshore disturbance and displacement effects, and they are, North-West Irish Sea cSPA and Malahide Estuary SPA.

6.4.1.3 Onshore Surface Water Run-off of Suspended Sediment/Deposition and Accidental Pollution

SPAs identified as having hydrologically or hydrogeologically connectivity with the onshore development area, i.e. North-West Irish Sea cSPA, Malahide Estuary SPA, Rogerstown Estuary SPA and Baldoyle Bay SPA, have been considered in the combination assessment for surface water run-off of suspended sediment/deposition and accidental pollution with screened-in onshore plans and projects on the wetland habitats for which QIs rely on.

6.4.2 North-West Irish Sea cSPA

6.4.2.1 Red-throated diver

Red-throated diver has been screened in for the construction and decommissioning phases to assess the potential for an AEoI from disturbance and displacement from vessel movement within the Proposed ECC from the proposed development in-combination with Phase One Projects in relation to the COs for this species as a designated QI of the NWIS cSPA (Table 5.16).

Seasonal and annual red-throated diver population within the North-west Irish Sea cSPA estimated to be at risk of displacement for the proposed development alone and all OWFs considered in the in-combination assessment.

Table 6.5: Seasonal and Annual Red-Throated Diver Displacement Mortalities within the NWIS SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal population at risk of displacement					Tier
	Pre-breeding bio-season	Migration-free breeding bio-season	Post-breeding bio-season	Non-breeding bio-season total	Annual total	
Phase 1 Projects (excluding the proposed development)	N/A	N/A	N/A	0.29	0.29	2
The proposed development	0.25	0.1	0.25	0.6	0.6	N/A
All other projects	No information	No information	No information	No information	No information	-
Total	0.25	0.1	0.25	0.89	0.89	N/A

As shown in Table 6.5, the contribution from the proposed development to disturbance and displacement of red-throated diver from vessel movement within the ECC associated with NWIS cSPA is 0.6 birds during the full non-breeding bio-season.

The in-combination impacts on the wintering red-throated diver population of the North-west Irish Sea cSPA is 0.86 individuals across the full non-breeding bio-season (Table 6.5), using a displacement rate of 100% and a mortality rate of 1%. Based on the 2016 citation colony count of 538 breeding adults and annual background mortality of 124 (124.3) individuals, the addition of less than one (0.89) predicted breeding adult mortality per annum would represent a 0.716% increase in baseline mortality. This level of impact would be indistinguishable from natural fluctuations in the population.

There is, therefore, no potential for an AEoI to the COs of the red-throated diver QI of NWIS cSPA in relation to disturbance and displacement effects as a result of vessel movement/ presence during the construction and decommissioning phases within the Proposed ECC in-combination with other developments and therefore, subject to natural change, the red-throated diver QI will be maintained in the long term with respect to potential for disturbance and displacement.

6.4.2.2 Onshore Disturbance and Displacement

Three onshore projects have been screened in for the in-combination assessment on NWIS cSPA and are the Bremore Regional Park, Dart+ and Fingal Coastal Way. Bremore Regional Park development is south of the landfall site and will involve landscaping for a recreational park. The Dart+ project will involve works at the existing railway lines at the landfall site and the Fingal Coastal Way greenway project is proposed to traverse the coastline at the landfall site. All three projects occur within 300m of the onshore development area where there is potential for cumulative disturbance and displacement effects to arise on wintering waterbirds. Bremore Regional Park was granted permission in 2021 which expires in June 2026, and at the time of writing, there was no up-to-date information on construction timelines. Applications have not been lodged yet for Dart+ or Fingal Coastal Way. Taking a precautionary approach, it is assumed that the likely construction period for Bremore Regional Park, Dart+ and the Fingal Coastal Way greenway would overlap with the planned construction period of the proposed development at the landfall and grid facility area as well as the onshore cable route. Dart+ and the Fingal Coastal Way will be subject to EIA and AA. It is expected that mitigation measures contained in these assessments, and contained within the Bremore Regional Park planning submission, and considering mitigation measures for the proposed development will not result in significant residual effects and therefore would not give rise to any in-combination effect. When considering these projects, and the mitigation measures for the proposed development, the lack of potential adverse effects from the proposed development alone and the considerations of the projects in combination, it is considered that there is no potential for in-combination AEoI on the North-West Irish Sea cSPA.

6.4.2.2.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the North-West Irish Sea cSPA from disturbance and displacement associated with the proposed development when considered in combination with onshore developments.

6.4.2.3 Onshore Surface Water Run-off of Suspended Sediment/Deposition and Accidental Pollution

Increased suspended sediment and accidental pollution arising from onshore works associated with the proposed development reaching the marine environment, for which QIs rely on, via surface water will be localised to the immediate downstream area of the works. Similarly, any suspended sediment contaminants arising from other onshore projects within the same hydrological catchment will enter the cSPA by the same route. However, through the implementation of mitigation measures detailed within the CEMP, the developer has identified best-practice techniques to minimise such inputs into the aquatic environment from all onshore construction activities. All other onshore projects identified for in-combination assessment will be required to implement similar surface water contingency measures detailed in individual CEMPs.

Consequently, inputs of increased suspended sediment and accidental pollution from the proposed development and other onshore projects will be negligible and no significant in-combination effects are predicted from these onshore projects with the proposed development.

6.4.2.3.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the North-West Irish Sea cSPA from surface water run-off suspended sediment/deposition and accidental pollution associated with the proposed development when considered in combination with onshore developments.

6.4.3 Malahide Estuary SPA

6.4.3.1 Onshore Disturbance and Displacement

One onshore project has been screened in for the in-combination assessment on Malahide Estuary SPA which is Dart+. Dart+ will involve works at the existing railway lines at Malahide Estuary along the existing railway embankment where there is potential for cumulative disturbance and displacement effects to arise on wintering waterbirds for which the SPA is designated. An application has not been lodged yet for Dart+, however, taking a precautionary approach, it is assumed that the likely construction period will overlap with the planned construction period of the proposed development of the onshore cable route along Estuary Road. When considering this project, and the mitigation measures for the proposed development, the lack of potential adverse effects from the proposed development alone and the considerations of the projects in combination, it is considered that there is no potential for in-combination AEoI on the Malahide Estuary SPA.

6.4.3.1.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Malahide Estuary SPA from disturbance and displacement associated with the proposed development when considered in combination with onshore developments.

6.4.3.2 Onshore Surface Water Run-off of Suspended Sediment/Deposition and Accidental Pollution

Onshore projects that occur in the same hydrological catchment as the proposed project and that discharge to Malahide Estuary have been considered in the in-combination assessment for onshore surface water run-off of suspended sediment/deposition and accidental pollution on intertidal habitats for which QIs rely on. These impacts are assessed for Malahide Estuary SAC under coastal and marine habitats, for which the SPA, overlaps Section 6.1.1.1 and 6.1.1.2. The assessment on habitats concludes that the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the habitats of Malahide Estuary from Suspended Sediment and Deposition and Accidental Pollution associated with the proposed development when considered in combination with onshore developments.

6.4.3.2.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Malahide Estuary SPA from suspended sediment/deposition and accidental pollution associated with the proposed development when considered in combination with onshore developments.

6.4.4 Rogerstown Estuary SPA

6.4.4.1 Onshore Surface Water Run-off of Suspended Sediment/Deposition and Accidental Pollution

Onshore projects that occur in the same hydrological catchment as the proposed project and that discharge to Rogerstown Estuary have been considered in the in-combination assessment for onshore surface water run-off of suspended sediment/deposition and accidental pollution on intertidal habitats for which QIs rely on. These impacts are assessed for Rogerstown Estuary SAC under coastal and marine habitats, for which the SPA, overlaps Section 6.1.2.1 and 6.1.2.2.

The assessment on habitats concludes that the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the habitats of Rogerstown Estuary from Suspended Sediment and Deposition and Accidental Pollution associated with the proposed development when considered in combination with onshore developments.

6.4.4.1.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Rogerstown Estuary SPA from suspended sediment/deposition and accidental pollution associated with the proposed development when considered in combination with onshore developments.

6.4.5 Baldoyle Bay SPA

6.4.5.1 Onshore Surface Water Run-off of Suspended Sediment/Deposition and Accidental Pollution

Onshore projects that occur in the same hydrological catchment as the proposed project and that discharge to Rogerstown Estuary have been considered in the in-combination assessment for onshore surface water run-off of suspended sediment/deposition and accidental pollution on intertidal habitats for which QIs rely on. These impacts are assessed for Baldoyle Bay SAC under coastal and marine habitats, for which the SPA, overlaps Section 6.1.3.16.1.2.1 and 6.1.3.2. The assessment on habitats concludes that the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the habitats for which QIs rely within Baldoyle Bay from Suspended Sediment and Deposition and Accidental Pollution associated with the proposed development when considered in combination with onshore developments.

6.4.5.1.1 Conclusion of AEoI

Therefore, when factoring in the lack of potential adverse effect from the proposed development alone and the above considerations for the projects considered for in-combination effects, it is considered that there is no potential for AEoI on the QIs of the Baldoyle Bay SPA from suspended sediment/deposition and accidental pollution associated with the proposed development when considered in combination with onshore developments.

6.4.6 Operation and Maintenance

6.4.6.1 Collision Risk and Disturbance and Displacement

All QIs that have been assessed alone have been considered for inclusion in the in-combination assessment. Table 6.3 shows which of these QIs have been taken through for in-combination assessment, during the operational phase, with rationale for those not included.

All breeding SPAs that were assessed in Section 5.4 were considered for an in-combination assessment. All projects with theoretical connectivity to breeding populations at SPAs have been included within the in-combination assessment. Given that the NWIS cSPA is designated to protect important habitat for seabirds and waterbirds, rather than the breeding populations, only activities impacting birds from within the SPA, or with a disturbance range that overlaps with the SPA, have been considered in-combination. There are no other OWFs within the SPA, and consequently there is no additional collision risk or displacement risk to consider in-combination with the proposed development. In addition, there are no other OWFs between the associated SPAs and the NWIS cSPA and therefore there is no possibility of in-combination impacts from barrier effects with the proposed development. The only exception is the ECC for Oriel Windfarm, which intersects with the northern boundary of the SPA. However, given embedded mitigation and the low level of vessel traffic during this phase, no operational impacts from vessel disturbance during O&M to divers and seaducks is expected.

6.4.7 Skerries Islands SPA

6.4.7.1 Herring gull

Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.43). Based on the MMF+1SD of herring gull (58.8+26.8km) (Woodward et al., 2019) Skerries Islands SPA, several OWFs are within foraging range.

6.4.7.1.1 Operational - Collision Risk

Based on the MMF+1SD of herring gull (Woodward et al., 2019) from Skerries Islands SPA numerous OWF projects are within range. The only projects to have apportioned impacts to herring gull from Skerries Islands SPA were the other east coast Irish Phase 1 Projects (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult herring gull of the Skerries Islands SPA at all OWFs included in the in-combination assessment are presented in Table 6.6.

Table 6.6: Seasonal and Annual Herring Gull Collision Mortalities at Skerries Islands SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal Mortality attributed to SPA			Tier
	Migration- free breeding	Non-breeding total	Annual total	
Phase 1 Projects (excluding the proposed development)	0.08	0.01	0.09	2
The proposed development	0.02	0.00	0.03	N/A
All other projects	No information	No information	No information	-
Total	0.10	0.02	0.12	

6.4.7.1.2 Breeding Bio- season

The in-combination predicted collision consequent mortalities of herring gull from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Skerries SPA is less than one (0.10) breeding adult (Table 6.6).

Based on the 1999 citation colony count 600 individuals and an annual background mortality of 100 (99.6) adults, the addition of less than one (0.10) breeding adult mortality during the breeding bio-season would represent a 0.017% increase in baseline mortality, of which the proposed development alone contributes less than one (0.02) breeding adult mortalities equating to an increase of 0.020% in baseline mortality.

Whereas when considering the latest colony count of 20 breeding adults from 2010 and an annual background mortality of 3 (3.3) individuals the addition of less than one (0.105) predicted breeding adult mortality during the breeding bio-season would represent a 0.499% increase in baseline mortality, of which the proposed development alone contributes less than one (0.023) breeding adult mortality equating to an increase of 0.602% in baseline mortality.

6.4.7.1.3 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of herring gull from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Skerries Islands SPA is less than one (0.02) adult during the non-breeding bio-season (Table 6.6).

Based on the 1999 citation colony count of 600 breeding adults and an annual background mortality of 100 (99.6) individuals the addition of less than one (0.02) predicted adult mortality during the non-breeding breeding bio-season would represent a 0.016% increase in baseline mortality, of which the proposed development alone contributes less than one (0.00) breeding adult mortality equating to an increase of 0.004% in baseline mortality.

Whereas when considering the latest colony count 20 individuals and an annual background mortality of 3 (3.3) adults, the addition of less than one (0.02) breeding adult mortality during the breeding bio-season would represent a 0.489% increase in baseline mortality, of which the proposed development alone contributes less than one (0.00) breeding adult mortality equating to an increase of 0.122% in baseline mortality.

6.4.7.1.4 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of herring gull from OWFs and tidal energy projects assessed, including the proposed development, apportioned to the Skerries SPA is less than one (0.12) breeding adults.

The predicted mortality of less than one (0.12) breeding adults from the Skerries Islands SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.116% when considering the 1999 citation colony count (600 birds) and a background mortality of 100 (99.6) individuals. The proposed development alone contributes less than one (0.02) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.024% per annum.

Whereas when considering the latest colony count of 20 individuals and a background mortality of 3 (3.3) individuals the addition of less than one (0.12) breeding adult mortality would represent an increase in baseline mortality of 3.492%. The proposed development alone contributes less than one (0.03 breeding adult mortality per annum which equates to an increase in baseline mortality of 0.777% per annum.

Overall, the level of impact is greater than a 1% increase therefore, further consideration should be given to these impacts below through a PVA. However, given the tiny population size at the SPA, PVA models do not produce robust results and often fail to run for the required timeframe.

The herring gull colony at Skerries Islands SPA is largely unknown with the latest colony estimate being 20 individuals in 2010. Therefore, a colony census during the 2024 breeding season will provide valuable insight into the population at this site. Given the in-combination impact is far smaller than one breeding adult (0.12) it is concluded that there is no potential for an AEoI to the COs of the herring gull QI of Skerries Islands SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects. This is especially true considering there is a larger regional population to buffer the tiny predicted effect of offshore wind developments on this small SPA colony. Therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collisions.

Breeding season census of Skerries Island carried out in 2024 will provide further insight into the population to provide more confidence in the results of this assessment.

6.4.8 Ireland's Eye SPA

6.4.8.1 Guillemot

Guillemot have been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs and tidal energy projects in relation to the COs for this species at Ireland's Eye SPA (Table 5.45). Based on the MMF+1SD of guillemot (73.2+80.5km) (Woodward et al., 2019) from Ireland's Eye SPA, several OWFs and tidal energy projects are within foraging range.

6.4.8.1.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of guillemot (Woodward et al., 2019) from Ireland's Eye SPA numerous OWF projects are within range. The only projects to apportion impacts to Ireland's Eye for guillemot are, east coast Irish Phase 1 Projects, Awel-y-Mor, Morgan and Mona (see Table 6.7).

As per evidence presented in Section 5.4.1, a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on guillemot. However, based on advice from Natural England, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in Table 6.8. Results for annual displacement consequent mortalities are also presented in a matrix in Table 6.8.

Seasonal and annual population estimates of breeding adult guillemot from relevant OWFs apportioned to the Ireland's Eye SPA are presented in Table 6.7.

Table 6.7: Seasonal and Annual Guillemot Population at Ireland's Eye SPA Estimated to Be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal population at risk of displacement			Tier
	Breeding bio-season	Non-breeding bio-season	Annual total	
Awel-y-Mor			8	3
Morgan			30	3
Mona			42	3
Minesto			40	3
Phase 1 Projects (excluding the proposed development)	1,344	95	1,439	2
The proposed development	29	99	128	N/A
All other projects	No information	No information	No information	-
Total	1,372	194	1,687	

6.4.8.1.1.1 Breeding Bio-season

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 1,372 breeding adults (Table 6.7). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be 7 (6.86) breeding adults during the breeding bio-season.

Based on the 2001 citation colony count of 3,950 breeding adults and an annual background mortality of 241 (241.0) individuals the addition of 7 (6.86) predicted breeding adult mortalities during the breeding bio-season would represent a 2.848% increase in baseline mortality, of which the proposed development alone contributes less than one (0.14) breeding adult mortality equating to an increase of 0.060% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.8 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 4,410 individuals and an annual background mortality of 269 (269.0) adults, the addition of 7 (6.86) breeding adult mortalities during the breeding bio-season would represent a 2.551% increase in baseline mortality, of which the proposed development alone contributes less than one (0.14) breeding adult mortality equating to an increase of 0.054% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.8 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, one to 5% mortality).

6.4.8.1.1.2 *Non-breeding Bio-season*

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 194 (194.3). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be less than one (0.97) breeding adults during the non-breeding bio-season.

Based on the 2001 citation colony count of 3,950 breeding adults and an annual background mortality of 241 (241.0) individuals the addition of less than one (0.97) predicted breeding adult mortalities during the non-breeding bio-season would represent a 0.403% increase in baseline mortality, of which the proposed development alone contributes less than half (0.49) a breeding adult mortality equating to an increase of 0.183% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.8 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 4,410 individuals and an annual background mortality of 269 (269.0) adults, the addition of less than one (0.97) predicted breeding adult mortality during the non-breeding bio-season would represent a 0.361% increase in baseline mortality, of which the proposed development alone contributes less than half (0.49) a breeding adult mortality equating to an increase of 0.183% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.8 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.8.1.1.3 *Annual Total*

Throughout all bio-seasons, the in-combination number of guillemot at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 1686.7 individuals (Table 6.7). The total predicted displacement consequent mortality is 9 (8.43) breeding adults.

The predicted mortality of less than 9 (8.43) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 3.500% when considering the 2001 citation colony count (3,950 birds) and a background mortality of 241 (241.0) individuals. The proposed development alone contributes less than one (0.64) breeding adult mortality per annum which equates to a 0.264% increase in baseline mortality per annum.

When considering the latest colony count of 4,410 individuals and a background mortality of 269 (269.0) individuals the addition of 9 (8.43) breeding adult mortalities would represent an increase in baseline mortality of 3.135%. The proposed development alone contributes less than one (0.64) breeding adult mortality per annum which equates to a 0.237% increase in baseline mortality.

Table 6.8: In-Combination Range-Based Displacement Mortalities during the Operation and Maintenance Phases for Guillemot at Ireland's Eye SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[4].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	1372.4	6.86	4.12 - 48.04	2.848	1.709 - 19.936	2.551	1.531 - 17.856
Non-breeding	194.3	0.97	0.58 - 6.80	0.403	0.242 - 2.822	0.361	0.217 - 2.528
Annual Total	1686.7	8.43	5.06 - 59.04	3.500	2.100 - 24.501	3.135	1.881 - 21.946

Overall, the level of impact is greater than a 1% increase and therefore, further consideration is given to these impacts through a PVA.

Table 6.9: PVA Outputs for Breeding Adult Ireland's Eye SPA Guillemot Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario		Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	50%, 1%	0.64	1.000	0.994	0.015%	0.557%
In-combination	50%, 1%	8.43	0.998	0.926	0.212%	7.367%
Proposed development alone	70%, 2%	1.78	1.000	0.983	0.044%	1.653%
In-combination	70%, 2%	23.61	0.994	0.806	0.597%	19.418%

[4] *Note bio-season totals may not equal the annual total exactly in the table due to rounding.*

Assuming an annual mortality of 9 (8.43) breeding adults from Ireland's Eye SPA and 50% displacement and 1% mortality, the CGR and CPS are 0.998 and 0.926, respectively. This represents a median reduction of 0.212% in annual growth rate compared to the baseline scenario and a relative reduction in final population size of 7.367% over the 35-year period. See the PVA Appendix 13 for the results of the PVA as per the range 30% displacement to 70% displacement, 1 to 5% mortality.

The guillemot colony at Ireland's Eye SPA appears to be increasing with the latest colony estimate being 4,410 individuals in 2015 according to the SMP database, representing over a 100% increase since the Seabird 2000 count in 1999. This colony trends equate to an average annual growth rate of 4.47%. Given the In-combination impact is predicted as a 0.212% annual reduction in relative growth rate, the impacts from the proposed development in-combination with other projects would be indistinguishable from natural fluctuations and would not cause the current increasing growth rate to be reversed based on this data. Even based on a realistic worst case scenario of 70% displacement and 2% morality (Table 6.9), the annual reduction in growth rate is 0.597% which would not cause the current increasing population trend to reverse. In addition, these results do not consider that density dependence acts on seabird populations and therefore they can be considered as worst-case.

Additionally, design-based estimates were used to predict the impact on this guillemot population. If the model-based abundance estimates were used to determine the displacement impacts from the proposed development, the effect may be reduced considerably. This coupled with the increasing population at Ireland's Eye adds further confidence in the conclusion.

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

6.4.8.2 Razorbill

Razorbill has been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.45). Based on the MMF+1SD of razorbill (88.7+75.9km) (Woodward et al., 2019) from Ireland's Eye SPA, several OWFs are within foraging range.

6.4.8.2.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of razorbill (Woodward et al., 2019) from Ireland's Eye SPA numerous OWF projects are within range. The only projects to have apportioned impacts to razorbill from Ireland's Eye SPA were the other east coast Irish Phase 1 Projects, Awel-y-Mor, Morgan and Mona (see Table 6.4).

As per evidence presented in Section 5.4.1, the Applicant's approach of a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on razorbill. However, based on advice from Natural England, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in Table 6.11. Results for annual displacement consequent mortalities are also presented in a matrix in Table 6.11.

Seasonal and annual population estimates of breeding adult razorbill of the Ireland's Eye SPA at all OWFs included in the in-combination assessment are presented in Table 6.10.

Table 6.10: Seasonal and Annual Razorbill Population at Ireland's Eye SPA Estimated to Be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal population at risk of displacement						Tier
	Pre-breeding migration	Breeding bio-season	Post-breeding migration	Migration - free winter	Non-breeding total	Annual total	
Awel- y-Mor						4	3
Minesto						8	3

Project	Seasonal population at risk of displacement						Tier
	Pre-breeding migration	Breeding bio-season	Post-breeding migration	Migration - free winter	Non-breeding total	Annual total	
Phase 1 Projects (excluding the proposed development)	6	218	20	8	33	251	2
The proposed development	1	7	8	9	18	26	N/A
All other projects	No information	No information	No information	No information	No information	No informatio n	-
Total	7	225	28	16	52	281	

6.4.8.2.1.1 Breeding Bio- season

The in-combination number of razorbill at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 225 breeding adults (Table 6.10). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be one (1.13) breeding adult during the breeding bio-season.

Based on the 2001 citation colony count of 920 breeding adults and an annual background mortality of 97 (96.6) individuals the addition of one (1.13) predicted breeding adult mortality during the breeding bio-season would represent a 1.165% increase in baseline mortality, of which the proposed development alone contributes less than one (0.04) breeding adult mortality equating to an increase of 0.037% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.11 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 1,600 individuals and an annual background mortality of 168 (168.0) adults, the addition of one (1.13) breeding adult mortality during the breeding bio-season would represent a 0.670% increase in baseline mortality, of which the proposed development alone contributes less than one (0.04) breeding adult mortality equating to an increase of 0.021% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.11 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.8.2.1.2 Non-breeding Bio-season

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 64 individuals during the non-breeding bio-season (Table 6.10). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be less than one (0.26) breeding adult during the non-breeding bio-season.

Based on the 2001 citation colony count of 920 breeding adults and an annual background mortality of 97 (96.6) individuals the additions of less than one (0.26) predicted breeding adult mortalities during the non-breeding bio-season would represent a 0.267% increase in baseline mortality, of which the proposed development alone contributes less than one (0.09) breeding adult mortality equating to an increase of 0.095% in baseline mortality (based on 50% displacement and 1% mortality rates).

See Table 6.11 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 1,600 individuals and an annual background mortality of 168 (168.0) adults, the addition of less than one (0.26) breeding adult mortality during the non-breeding bio-season would represent a 0.154% increase in baseline mortality, of which the proposed development alone contributes less than one (0.09) breeding adult mortality equating to an increase of 0.055% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.11 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.8.2.1.3 Annual Total

Throughout all bio-seasons, the in-combination number of razorbill at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 290 individuals. The total predicted displacement consequent mortality is 1 (1.40) breeding adults.

The predicted mortality of 1 (1.40) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 1.453% when considering the 2001 citation colony count (920 birds) and a background mortality of 97 (96.6) individuals. The proposed development alone contributes less than one (0.13) breeding adult mortality per annum which equates to a 0.132% increase in baseline mortality per annum.

Whereas when considering the latest colony count of 1,600 individuals and a background mortality of 168 (168.0) individuals the addition of one (1.40) breeding adult mortalities would represent an increase in baseline mortality of 0.835%. The proposed development alone contributes less than one (0.13) breeding adult mortality per annum which equates to a 0.076 increase in baseline mortality per annum.

Table 6.11: In-Combination Range-Based Displacement Mortalities during the Construction and Decommissioning Phases for Razorbill at Ireland's Eye SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[5].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	225.1	1.13	0.68 - 7.88	1.165	0.699 – 8.157	0.670	0.402 - 4.690
Post-breeding migration	28.3	0.14	0.08 – 0.99	0.146	0.088 – 1.025	0.084	0.051 – 0.589
Return-breeding migration	6.9	0.03	0.02 - 0.24	0.035	0.021 - 0.248	0.020	0.012 - 0.143
Migration-free winter	16.4	0.08	0.05 - 0.58	0.085	0.051 – 0.596	0.049	0.029 – 0.343
Total Non-breeding	51.6	0.26	0.2 -1.8	0.267	0.160 – 1.869	0.154	0.092 -1.075
Annual Total	280.7	1.40	0.84 – 9.83	1.453	0.872 -10.171	0.835	0.501 – 5.848

[5] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Overall, the level of impact is greater than a 1% increase and therefore requires further consideration through a PVA.

Table 6.12: PVA Outputs for Breeding Adult Ireland's Eye SPA Razorbill Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario		Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	50%, 1%	0.13	1.000	0.995	0.016%	0.480%
In-combination	50%, 1%	1.40	0.999	0.966	0.097%	3.384%
Proposed development alone	70%, 2%	0.36	1.000	0.990	0.026%	0.984%
In-combination	70%, 2%	3.93	0.997	0.901	0.289%	9.879%

Assuming an annual mortality of 1 (1.40) breeding adults from Ireland's Eye SPA and 50% displacement and 1% mortality has been applied (the Applicant's approach), the GPGR and CPS are 0.999 and 0.966, respectively. This represents a 0.097% reduction in growth rate and a reduction in final population size of 3.384% over the 35-year period. See the PVA Appendix 13 for the results of the PVA as per the range 50% displacement to 70% displacement, 1 to 5% mortality.

The razorbill colony at Ireland's Eye SPA appears to be increasing with the latest colony estimate being 1,248 individuals in 2015 according to the SMP database, over a 200% increase since the Seabird 2000 count of 522 in 1999. This colony trends equate to an average annual growth rate of 7.25%. Given the In-combination impact is predicted as a 0.097% annual reduction in growth rate, the impacts from the proposed development in-combination with other projects would be indistinguishable from natural fluctuations and would not cause the colony to stop its growth rate based on this data. Even based on a realistic worst case scenario of 70% displacement and 2% morality (Table 6.12), the annual reduction in growth rate is 0.289% which would not cause the increasing population trend to reverse.

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Ireland's Eye SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

6.4.8.3 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.45). Based on the MMF+1SD of kittiwake (156.1+144.5km) (Woodward et al., 2019) from Ireland's Eye SPA, several OWFs are within foraging range.

6.4.8.3.1 Operation - Collision risk

Based on the MMF+1SD of kittiwake (Woodward et al., 2019) from Ireland's Eye SPA numerous OWF projects are within range. The only projects to have apportioned impacts to razorbill from Ireland's Eye SPA were the other east coast Irish Phase 1 Projects namely, Arklow Bank Wind Park, Codling Wind Park; Oriel Wind Farm and Dublin Array, and Awel-y-Mor, Morgan and Mona from the west coast of the UK (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult kittiwake of the Ireland's Eye SPA at all OWFs included in the in-combination assessment are presented in Table 6.13.

Table 6.13: Seasonal and Annual Kittiwake Collision Mortalities at Ireland's Eye SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal mortality attributed to SPA					Tier
	Pre-breeding migration	Breeding	Post-breeding migration	Non-breeding total	Annual total	
Awel-y-Mor					0.07	3
Erebus					0.00	3
Morgan					0.60	3
Mona					0.60	3
Phase 1 Projects (excluding the proposed development)	0.22	0.91	0.11	0.33	1.24	2
The proposed development	0.01	0.09	0.01	0.02	0.10	N/A
All other projects	No information	No information	No information	No information	No information	-
Total	0.23	1.00	0.12	0.35	2.62	

6.4.8.3.1.1 Breeding Bio- season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 1 (1.00) breeding adults (Table 6.13).

Based on the 2001 citation colony count of 2,058 breeding adults and an annual background mortality of 299 (299.0) individuals the addition of 1 (1.00) predicted breeding adult mortalities during the breeding bio-season would represent a 0.334% increase in baseline mortality, of which the proposed development alone contributes less than one (0.09) breeding adult mortality equating to an increase of 0.030% in baseline mortality.

Whereas when considering the latest colony count 3,320 individuals and an annual background mortality of 470 (470.1) adults, the addition of 1 (1.00) breeding adult mortality during the breeding bio-season would represent a 0.212% increase in baseline mortality, of which the proposed development alone contributes less than one (0.09) breeding adult mortality equating to an increase of 0.019% in baseline mortality.

6.4.8.3.1.2 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is less than one (0.35) adult during the non-breeding bio-season (Table 6.13).

Based on the 2001 citation colony count of 2,058 breeding adults and an annual background mortality of 299 (299.0) individuals the addition of less than one (0.35) predicted adult mortality during the non-breeding breeding bio-season would represent a 0.117% increase in baseline mortality, of which the proposed development alone contributes less than one (0.02) breeding adult mortality equating to an increase of 0.007% in baseline mortality.

Whereas when considering the latest colony count 3,320 individuals and an annual background mortality of 470 (470.1) adults, the addition of less than one (0.35) breeding adult mortality during the breeding bio-season would represent a 0.074% increase in baseline mortality, of which the proposed development alone contributes less than one (0.02) breeding adult mortality equating to an increase of 0.004% in baseline mortality.

6.4.8.3.1.3 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of kittiwake from OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is 3 (2.62) breeding adults.

The predicted mortality of 3 (2.62) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.879% when considering the 2001 citation colony count (2,058 birds) and a background mortality of 299 (299.0) individuals. The proposed development alone contributes less than one (0.11) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.037%.

Whereas when considering the latest colony count of 3,320 individuals and a background mortality of 470 (470.1) individuals the addition of 3 (2.62) breeding adult mortalities would represent an increase in baseline mortality of 0.559%. The proposed development contributes less than one (0.11) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.023%. This level of impact is below a 1% increase in baseline mortality for this population, and therefore likely to be undetectable.

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Ireland's Eye SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

6.4.8.4 Herring gull

Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.45). Based on the MMF+1SD of herring gull (58.8+26.8km) (Woodward et al., 2019) from Ireland's Eye SPA, several OWFs are within foraging range.

6.4.8.4.1 Operation - Collision Risk

Based on the MMF+1SD of herring gull (Woodward et al., 2019) from Ireland's Eye SPA numerous OWF projects are within range. The only projects to have apportioned impacts to herring gull from Ireland's Eye SPA were the other east coast Irish Phase 1 Projects (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult herring gull of the Ireland's Eye SPA at all OWFs included in the in-combination assessment are presented in Table 6.14.

Table 6.14: Seasonal and Annual Herring Gull Collision Mortalities at Ireland's Eye SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal Mortality attributed to SPA			Tier
	Migration- free breeding	Non-breeding total	Annual total	
Phase 1 Projects (excluding the proposed development)	2.63	0.26	2.89	2
The proposed development	0.20	0.13	0.34	N/A
All other projects	No information	No information	No information	-
Total	2.83	0.39	3.23	

6.4.8.4.2 Breeding Bio- season

The in-combination predicted collision consequent mortalities of herring gull, including those from the proposed development, apportioned to Ireland's Eye SPA is 3 (2.83) breeding adult (Table 6.14).

Based on the 1999 citation colony count of 492 breeding adults and an annual background mortality of 82 (81.7) individuals the addition of 3 (2.83) predicted breeding adult mortalities during the breeding bio-season would represent a 3.465% increase in baseline mortality, of which the proposed development alone contributes less than one (0.20) breeding adult mortality equating to an increase of 0.245% in baseline mortality.

Whereas when considering the latest colony count 662 individuals and an annual background mortality of 110 (109.9) adults, the addition of 3 (2.83) breeding adult mortalities during the breeding bio-season would represent a 2.575% increase in baseline mortality, of which the proposed development alone contributes less than one (0.20) breeding adult mortality equating to an increase of 0.182% in baseline mortality.

6.4.8.4.3 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of herring gull, including those from the proposed development, apportioned to Ireland's Eye SPA is less than one (0.39) adult during the non-breeding bio-season (Table 6.14).

Based on the 1999 citation colony count of 492 breeding adults and an annual background mortality of 82 (81.7) individuals the addition of less than one (0.39) predicted adult mortality during the non-breeding breeding bio-season would represent a 0.478% increase in baseline mortality, of which the proposed development alone contributes less than one (0.13) breeding adult mortality equating to an increase of 0.159% in baseline mortality.

Whereas when considering the latest colony count 662 individuals and an annual background mortality of 110 (109.9) adults, the addition of less than one (0.39) breeding adult mortality during the breeding bio-season would represent a 0.355% increase in baseline mortality, of which the proposed development alone contributes less than one (0.13) breeding adult mortality equating to an increase of 0.118% in baseline mortality.

6.4.8.4.4 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of herring gull, including those from the proposed development, apportioned to Ireland's Eye SPA is 3 (3.23) breeding adults.

The predicted mortality of 3 (3.23) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 3.955% when considering the 2001 citation colony count (492 birds) and a background mortality of 82 (81.7) individuals. The proposed development alone contributes less than one (0.34) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.415% per annum.

Whereas when considering the latest colony count of 662 individuals and a background mortality of 110 (109.9) individuals the addition of 3 (3.23) breeding adult mortalities would represent an increase in baseline mortality of 2.939%. The proposed development alone contributes less than one (0.34) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.321% per annum.

Overall, the level of impact is greater than a 1% increase in baseline mortality, therefore, further consideration is given to these impacts below through a PVA.

Table 6.15: PVA Outputs for Breeding Adult Ireland's Eye SPA Herring Gull Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	0.34	0.999	0.969	0.078%	3.080%
In-combination	3.23	0.994	0.804	0.601%	19.632%

Assuming an annual mortality of 3 (3.23) breeding adults from Ireland's Eye SPA, the CGR and CPS are 0.994 and 0.804, respectively. This represents a 0.601% reduction in growth rate, when assessing against the latest robust colony count, and a reduction in final population size of 19.632% over the 35-year period. Further details regarding the PVA are presented in the PVA Appendix 13.

The herring gull colony at Ireland's Eye SPA appears to be stable/increasing. The latest colony count of 636 individuals in 2015 represents a 29.3% increase since the Seabird 2000 count of 492 in 1999. This trend represents an annual population growth rate of 1.62%. Given the In-combination impact is predicted as a 0.601% annual reduction in growth rate, the impacts from the proposed development in-combination with other projects would not cause the current growth of the colony to reverse based on this data.

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Ireland's Eye SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collisions.

Colony monitoring of Ireland's Eye during the 2024 breeding season will provide more confidence in the results of this assessment.

6.4.9 Saltee Islands SPA

6.4.9.1 Guillemot

Guillemot has been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.56). Based on the MMF+1SD of guillemot (73.2+80.5km) (Woodward et al., 2019) from Saltee Islands SPA, several OWFs are within foraging range.

The proposed development is located 169.3km from the Saltee Island SPA which is outside MMF+1SD for guillemot (73.2+80.5km) (Woodward et al., 2019) and therefore this species has been screened out for the breeding bio-season in the alone assessment above. However, guillemot will disperse throughout the bio-geographical region outside of the breeding season and a proportion of individuals from Saltee Islands SPA are likely to be present within the array area; therefore, guillemot have been screened in for the non-breeding bio-season for the alone assessment (above) and in-combination presented here.

6.4.9.1.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of guillemot (Woodward et al., 2019) from the Saltee Islands SPA numerous OWF projects are within range. The only projects to have apportioned impacts to guillemot from the Saltee Islands SPA were the other east coast Irish Phase 1 Projects (see Table 6.4).

As per evidence presented in Section 4.12, the Applicant's approach of a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on guillemot. However, following the assessment approach proposed by Phase One Projects, which corresponds to the latest guidance published by Natural England, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in Table 6.17.

Seasonal and annual population estimates of breeding adult guillemot of the Saltee Islands SPA at all OWFs included in the in-combination assessment are presented in Table 6.16.

Table 6.16: Seasonal and Annual Guillemot Population at Saltee Islands SPA Estimated to be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal population at risk of displacement			Tier
	Breeding bio-season	Non-breeding bio-season	Annual total	
Phase 1 Projects (excluding the proposed development)	396	691	1,087	2
The proposed development		391	391	N/A
All other projects	No information	No information	No information	-
Total	396	1,082	1,478	

6.4.9.1.2 Non-breeding Bio-season

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to the Saltee Islands SPA is 1,082 individuals during the non-breeding bio-season (Table 6.17). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be 5 (5.41) breeding adults during the non-breeding bio-season.

Based on the 1998-2000 citation colony count of 28,734 breeding adults and an annual background mortality of 1,752 (1,752.2) individuals the additions of 5 (5.41) predicted breeding adult mortalities during the non-breeding bio-season would represent a 0.309% increase in baseline mortality, of which the proposed development alone contributes 2 (1.95) breeding adult mortalities equating to an increase of 0.112% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.17 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 17,501 individuals and an annual background mortality of 1,068 (1,067.6) adults, the addition of 5 (5.41) breeding adult mortalities during the non-breeding bio-season would represent a 0.507% increase in baseline mortality, of which the proposed development alone contributes 2 (1.95) breeding adult mortality equating to an increase of 0.183% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.17 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.9.1.3 Annual Total

Throughout all bio-seasons, the in-combination number of guillemot at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development apportioned to the Saltee Islands SPA is 800 individuals. The total predicted displacement consequent mortality is four (4.0) breeding adults.

The predicted mortality of 8 (7.39) breeding adults from the Saltee Islands SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.422% when considering the 2001 citation colony count (28,724 birds) and a background mortality of 1,752 (1,757.2) individuals. The proposed development alone contributes 2 (1.95) breeding adult mortalities per annum which equates to a 0.183% increase in baseline mortality per annum.

Whereas when considering the latest colony count of 17,501 individuals and a background mortality of 1,068 (1,067.6) individuals the addition of 8 (7.39) breeding adult mortalities would represent an increase in baseline mortality of 0.692%. The proposed development alone contributes 2 (1.95) breeding adult mortality per annum which equates to a 0.183% increase in baseline mortality per annum. This level of impact would be indistinguishable from natural fluctuation in the population.

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Saltee Islands SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Table 6.17: In-Combination Range Based Displacement Mortalities During the Operational and Maintenance Phase for Guillemot at Saltee Islands Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and 2001 Citation Colony Count[6].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	396.3	1.98	1.19 - 13.87	0.113	0.068 - 0.792	0.186	0.111 - 1.299
Non-breeding	1081.8	5.41	3.25 - 37.86	0.309	0.185 - 2.161	0.507	0.304 - 3.547
Annual Total	1478.1	7.39	4.43 - 51.73	0.422	0.253 - 2.953	0.692	0.415 - 4.846

[6] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

6.4.9.2 Razorbill

Razorbill has been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.56). Based on the MMF+1SD of razorbill (88.7+75.9km) (Woodward et al., 2019) from Saltee Islands SPA, several OWFs are within foraging range.

The proposed development is located 169.3km from the Saltee Island SPA which is outside MMF+1SD for razorbill (88.7+75.9km) (Woodward et al., 2019) and therefore this species has been screened out for the breeding bio-season in the alone assessment above. However, razorbill will disperse throughout the bio-geographical region outside of the breeding season and a proportion of individuals from Saltee Islands SPA are likely to be present within the array area; therefore, razorbill have been screened in for the non-breeding bio-season for the alone assessment (above) and in-combination presented here.

6.4.9.2.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of razorbill (Woodward et al., 2019) from the Saltee Islands SPA numerous OWF projects are within range. The only projects to have apportioned impacts to razorbill from the Saltee Islands SPA were the other east coast Irish Phase 1 Projects (see Table 6.4).

As per evidence presented in Section 5.4.1, the Applicant's approach of a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on razorbill. However, based on advice from Natural England, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in. Results for annual displacement consequent mortalities are also presented in a matrix in Table 6.18.

Seasonal and annual population estimates of breeding adult razorbill of the Saltee Islands SPA at all OWFs included in the in-combination assessment are presented in Table 6.18.

Table 6.18: Seasonal and Annual Razorbill Population at Saltee Islands SPA Estimated to Be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal Mortality attributed to SPA						Tier
	Pre-breeding migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Non-breeding total	Annual total	
Phase 1 Projects (excluding the proposed development)	16	46	68	23	106	153	2
The proposed development	2		15	16	34	34	N/A
All other projects	No information	No information	No information	No information	No information	No information	-
Total	18	46	83	39	140	186	

6.4.9.2.2 Non-breeding Bio-season

The in-combination number of razorbill at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to the Saltee Islands SPA is 46.2 individuals during the non-breeding bio-season (Table 6.19). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be less than one (0.23) breeding adults during the non-breeding bio-season.

Based on the 1998-2000 citation colony count of 5,010 breeding adults and an annual background mortality of 526 (526.1) individuals the additions of less than one (0.23) predicted breeding adult mortalities during the non- breeding bio-season would represent a 0.044% increase in baseline mortality, of which the proposed development alone contributes less than one (0.17) breeding adult mortalities equating to an increase of 0.032% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.18 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 2,931 individuals and an annual background mortality of 308 (307.8) adults, the addition of less than one (0.23) breeding adult mortalities during the non-breeding bio-season would represent a 0.075% increase in baseline mortality, of which the proposed development alone contributes less than one (0.17) breeding adult mortality equating to an increase of 0.055% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.8 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.9.2.3 Annual Total

Throughout all bio-seasons, the in-combination number of razorbill at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development, apportioned to the Saltee Islands SPA is 141 individuals. The total predicted displacement consequent mortality is less than one (0.93) breeding adult.

The predicted mortality of less than one (0.93) breeding adults from the Saltee Islands SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.177% when considering the 1998-2000 citation colony count (5,010 birds) and a background mortality of 526 (526.1) individuals. The proposed development alone contributes less than one (0.17) breeding adult mortalities per annum which equates to a 0.032% increase in baseline mortality per annum.

Whereas when considering the latest colony count of 2,931 individuals and a background mortality of 308 (307.8) individuals the addition of less than one (0.93) breeding adult mortalities would represent an increase in baseline mortality of 0.303%. The proposed development alone contributes less than one (0.17) breeding adult mortality per annum which equates to a 0.055% increase in baseline mortality per annum. This level of impact would be indistinguishable from natural fluctuations in the population.

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Saltee Islands SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Table 6.19: In-Combination Range-Based Displacement Mortalities during the Construction and Decommissioning Phases for Razorbill at Saltee Islands SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[7].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	50-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	46.2	0.23	0.14 – 1.62	0.044	0.026 – 0.308	0.075	0.045 – 0426
Post-breeding migration	83.4	0.42	0.25 – 2.92	0.079	0.048 – 0.555	0.135	0.081 – 0.948
Return-breeding migration	18.1	0.09	0.05 – 0.63	0.017	0.010 – 0.120	0.029	0.018 – 0.206
Migration-free winter	38.7	0.19	0.12 - 1.36	0.037	0.022 – 0.248	0.063	0.038 – 0.440

[7] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	50-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Total Non-breeding	140.2	0.70	0.42 - 4.91	0.133	0.106– 0.933	0.228	0.182 – 1.594
Annual Total	186.4	0.93	0.56- 6.52	0.177	0.080 – 1.240	0.303	0.137 – 2.120

6.4.10 Howth Head Coast SPA

6.4.10.1 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.69). Based on the MMF+1SD of kittiwake (156.1+144.5km) (Woodward et al., 2019) from Howth Head Coast SPA, several OWFs are within foraging range.

6.4.10.1.1 Operation- Collision Risk

Based on the MMF+1SD of kittiwake (Woodward et al., 2019) from Howth Head Coast SPA numerous OWF projects are within range. Only east coast Irish Phase 1 Projects, Awel-y-Mor and Erebus have apportioned impacts to kittiwake from Howth Head Coast SPA (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult kittiwake of the Howth Head Coast SPA at all OWFs included in the in-combination assessment are presented in Table 6.20.

Table 6.20: Seasonal and Annual Herring Gull Collision Mortalities at Skerries Islands SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment Seasonal and Annual Kittiwake Collision Mortalities at Howth Head Coast SPA for the Proposed Development Alone and All OWFs Considered in the In combination Assessment.

Project	Seasonal Mortality attributed to SPA					Tier
	Pre-breeding migration	Migration-free breeding	Post-breeding migration	Non-breeding total	Annual total	
Awel-y-Mor					0.10	3
Erebus					0.01	3
Morgan					1.20	3
Mona					1.20	3
Phase 1 Projects (excluding the proposed development)	0.94	4.97	0.48	1.41	6.38	2
The proposed development	0.05	0.30	0.02	0.07	0.37	N/A
All other projects	No information	No information	No information	No information	No information	-
Total	0.99	5.27	0.50	1.48	9.26	

6.4.10.1.2 Breeding Bio- season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Howth Head and Coast SPA is 5 (5.27) breeding adults (Table 6.20).

Based on the 1999 citation colony count 3,546 individuals and an annual background mortality of 518 (517.7) adults, the addition of 5 (5.27) breeding adult mortalities during the breeding bio-season would represent a 1.017% increase in baseline mortality, of which the proposed development alone contributes less than one (0.30) breeding adult mortalities equating to an increase of 0.057% in baseline mortality.

Whereas when considering the latest colony count of 4,538 breeding adults and an annual background mortality of 663 (662.5) individuals the addition of 5 (5.27) predicted breeding adult mortalities during the breeding bio-season would represent a 0.795% increase in baseline mortality, of which the proposed development alone contributes less than one (0.30) breeding adult mortality equating to an increase of 0.045% in baseline mortality.

6.4.10.1.3 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Howth Head and Coast SPA is less than two (1.48) adults during the non-breeding bio-season (Table 6.20).

Based on the 1999 citation colony count of 3,546 breeding adults and an annual background mortality of 518 (517.7) individuals the addition of less than two (1.48) predicted adult mortalities during the non-breeding breeding bio-season would represent a 0.286% increase in baseline mortality, of which the proposed development alone contributes less than one (0.07) breeding adult mortality equating to an increase of 0.014% in baseline mortality.

Whereas when considering the latest colony count 4,538 individuals and an annual background mortality of 663 (662.5) adults, the addition of two (1.48) breeding adult mortalities during the breeding bio-season would represent a 0.224% increase in baseline mortality, of which the proposed development alone contributes less than one (0.07) breeding adult mortality equating to an increase of 0.011% in baseline mortality.

6.4.10.1.4 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of kittiwake from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Howth Head and Coast SPA is nine (9.26) breeding adults.

The predicted mortality of nine (9.26) breeding adults from Howth Head and Coast SPA per annum across all bio-seasons represents an increase in baseline mortality of 1.788% when considering the 1999 citation colony count (3,546 birds) and a background mortality of 518 (517.7) individuals. The proposed development alone contributes less than one (0.37) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.071% per annum.

Whereas when considering the latest colony count of 4,538 individuals and a background mortality of 663 (662.5) individuals the addition of nine (9.26) breeding adult mortality would represent an increase in baseline mortality of 1.397%. The proposed development alone contributes less than one (0.37) breeding adult mortality per annum which equates to an increase in baseline mortality of 0.055% per annum.

Overall, the level of impact is greater than a 1% increase and therefore, further consideration is given to these impacts below through a PVA.

Table 6.21: Seasonal and Annual Herring Gull Collision Mortalities at Skerries Islands SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	0.37	1.000	0.995	0.014%	0.463%
In-combination	9.26	0.997	0.894	0.309%	10.551%

Assuming an annual mortality of nine (9.26) breeding adults from Howth Head Coast SPA, the GPGR and CPS are 0.99 and 0.921, respectively. This represents a 0.309% reduction in growth rate and a reduction in final population size of 10.551% over the 35-year period. For further details regarding the PVA presented here see the PVA Appendix 13.

The kittiwake colony at Howth Head Coast SPA is has shown a slight decrease, with the 2015 population count of 3,546 representing a 23.9% decline since the Seabird 2000 count of 4,658 individuals. This corresponds to an annual decline of 1.69%. Notably, between 2000 and 2024 there are only three colony counts available on the SMP database (3,812 individuals in 2001; 5,224 individuals in 2007 and 3,568 in 2015), suggesting the population may be in short-term decline but stable long-term based on the 2007 count. Despite the slight population decline, the in-combination impact is expected to be indistinguishable from natural fluctuations, with the CGR of 0.997. This level of impact is above the threshold of 0.995, and therefore likely to be undetectable and not impact populations that are not robust to change (Section 5.4.8).

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Howth Head and Coast SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collision.

Colony counts during the 2024 breeding season will add further insight into the potential impacts on this SPA population.

6.4.11 Lambay Island SPA

6.4.11.1 Guillemot

Guillemot has been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.71). Based on the MMF+1SD of guillemot (73.2+80.5km) (Woodward et al., 2019) from Lambay Island SPA, several OWFs are within foraging range.

6.4.11.1.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of guillemot (Woodward et al., 2019) from Lambay Island SPA numerous OWF projects are within range. The only projects, except for the other east coast Irish Phase 1 Projects namely, Arklow Bank Wind Park, Codling Wind Park; Oriel Wind Farm and Dublin Array, and Awel-y-Mor, Morgan and Mona have apportioned impacts to guillemot from Lambay Island SPA (see Table 6.4).

As per evidence presented in Section 5.4.1, the Applicant's approach of a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on guillemot. However, based on published Natural England guidance, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in

Table 6.24. Results for annual displacement consequent mortalities are also presented in a matrix in Table 6.22.

Seasonal and annual population estimates of breeding adult guillemot of the Lambay Island SPA at all OWFs included in the in-combination assessment are presented in Table 6.22.

Table 6.22: Seasonal and Annual Guillemot Population at Lambay Island SPA Estimated to Be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal population at risk of displacement			Tier
	Breeding bio-season	Non-breeding bio-season	Annual total	
Awel-y-Mor			120	3
Morgan			466	3
Mona			634	3
Minesto			1,280	3
Phase 1 Projects (excluding the proposed development)	10,332	1,858	12,191	2
The proposed development	826	1,340	2,165	N/A
All other projects	No Information	No Information	No Information	-
Total	11,158	3,198	16,856	

It should be noted that the abundance of birds used to predict the impacts to Lambay Island SPA were derived from design-based abundance estimates. Model-based abundance estimates predicted a peak-seasonal abundance of 14,000 fewer guillemots in the array plus 2km buffer compared with design-based estimates. Therefore, the results presented are more precautionary as they give rise to high estimated mortalities and predicted impacts on the population.

6.4.11.1.2 Breeding Bio-season

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 11,158 breeding adults (Table 6.23). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be 56 (55.79) breeding adults during the breeding bio-season.

Based on the 2004 citation colony count of 77,998 breeding adults and an annual background mortality of 4,758 (4,757.9) individuals the addition of 56 (55.79) predicted breeding adult mortality during the breeding bio-season would represent a 1.173% increase in baseline mortality, of which the proposed development alone contributes 4 (4.13) breeding adult mortalities equating to an increase of 0.087% in baseline mortality (based on 50% displacement and 1% mortality rates).

See Table 6.23 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 59,983 individuals and an annual background mortality of 3,659 (3659.0) adults, the addition of 56 (55.79) breeding adult mortality during the breeding bio-season would represent a 1.525% increase in baseline mortality, of which the proposed development alone contributes 4 (4.13) breeding adult mortality equating to an increase of 0.113% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.23 the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.11.1.3 *Non-breeding Bio-season*

The in-combination number of guillemot at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 3,198 individuals during the non-breeding bio-season (Table 6.23). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be 16 (15.99) breeding adults during the non-breeding bio-season.

Based on the 2004 citation colony count of 77,998 breeding adults and an annual background mortality of 4,798 (4,757.9) individuals the addition of 16 (15.99) predicted breeding adult mortalities during the non-breeding bio-season would represent a 0.336% increase in baseline mortality, of which the proposed development alone contributes seven (6.70) breeding adult mortalities equating to an increase of 0.141% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.23 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 59,983 individuals and an annual background mortality of 3,659 (3,659.0) adults, the addition of 16 (15.99) breeding adult mortalities during the non-breeding bio-season would represent a 0.437% increase in baseline mortality, of which the proposed development alone contributes seven (6.70) breeding adult mortalities equating to an increase of 0.183% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.23 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.11.1.4 *Annual Total*

Throughout all bio-seasons, the in-combination number of guillemot at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 16,856 individuals. The total predicted displacement consequent mortality is 84 (84.28) breeding adults.

The predicted mortality 84 (84.28) of breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 1.771% when considering the 2001 citation colony count (77,998 birds) and a background mortality of 4,798 (4,797.9) individuals. The proposed development alone contributes 11 (10.83) breeding adult mortalities per annum which equates to a 0.228% increase in baseline mortality per annum.

Whereas when considering the latest colony count of 59,983 individuals and a background mortality of 3,659 (3,659) individuals the addition of 84 (84.28) breeding adult mortalities would represent an increase in baseline mortality of 2.303%. The proposed development alone contributes 11 (10.83) breeding adult mortality per annum which equates to a 0.296% increase in baseline mortality per annum.

Table 6.23: In-Combination Range-Based Displacement Mortalities during the Construction and Decommissioning Phases for Guillemot at Lambay Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[8].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	11158.1	55.79	33.47 - 390.53	1.173	0.704 - 8.208	1.525	0.915 - 10.673
Non-breeding	3198.1	15.99	9.59 - 111.93	0.336	0.202 - 2.353	0.437	0.262 - 3.059
Annual Total	16856.2	84.28	50.57 - 589.97	1.771	1.063 - 12.400	2.303	1.382 - 16.124

This level of impact is greater than a 1% increase and therefore, further consideration is given to these impacts below through a PVA.

Table 6.24: PVA Outputs for Breeding Adult Lambay Island SPA Guillemot Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario		Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	50%, 1%	10.83	1.000	0.993	0.020%	0.727%
In-combination	50%, 1%	84.28	0.998	0.945	0.156%	5.461%
Proposed development alone	70%, 2%	30.31	0.999	0.980	0.056%	2.017%
In-combination	70%, 2%	235.99	0.996	0.854	0.437%	14.603%

[8] *Note bio-season totals may not equal the annual total exactly in the table due to rounding*

Assuming an annual mortality of 84 (84.28) breeding adults from Lambay Island SPA and 50% displacement and 1% mortality has been applied (the Applicant's approach), the GGR and CPS are 0.998 and 0.945, respectively. This represents a 0.156% reduction in growth rate and a reduction in final population size of 5.461% over the 35-year period. See the PVA Appendix 13 for the results of the PVA as per the range 50% displacement to 70% displacement, 1 to 5% mortality.

The guillemot colony at Lambay Island SPA appears to be relatively stable with the latest colony estimate being 59,983 individuals in 2015, only a 1.3% reduction since the Seabird 2000 count in 1999 (60,754 individuals). This trend represents an annual reduction in the population of 0.08%. The in-combination impact based on 50% displacement and 1% mortality represents an annual reduction in population growth of 0.156%. Though greater than the current annual rate of change of 0.08%, this impact is still considered to be negligible, and well within the range arising from natural fluctuations in the population. The same is also true when considering the realistic worst-case scenario of 70% displacement and 2% mortality, which shows less than 0.5% reduction in growth rate between the impacts and baseline scenarios.

In addition, these decreases in growth rate are far more precautionary than what would be considered realistic within natural systems because density dependence was not incorporated into models. This population has currently been modelled as a closed population, however in reality density dependence would act on a population of this size (Horswill and Robinson, 2015). If density dependence were to be included in models, then the predicted CGR would be close to zero because non-breeders from the wider region will be recruited into the Lambay Island population to replace the few mortalities predicted from displacement impacts. Please see the Assessment Criteria section 5.4 and the PVA Appendix 13 for further justification.

There is, therefore, no potential for an AEoI to the COs of the guillemot QI of Lambay Island SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the guillemot QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

6.4.11.2 Razorbill

Razorbill has been screened in for the operational phase to assess the potential for an AEoI from disturbance and displacement from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.71). Based on the MMF+1SD of razorbill (88.7+75.9km) (Woodward et al., 2019) from Lambay Island SPA, several OWFs are within foraging range.

6.4.11.2.1 Operation - Disturbance and Displacement

Based on the MMF+1SD of razorbill (Woodward et al., 2019) from Lambay Island SPA numerous OWF projects are within range. The only project to apportion impacts to razorbill from Lambay Island SPA, except for the other east coast Irish Phase 1 Projects, is Awel-y-Mor (see Table 6.4).

As per evidence presented in Section 5.4.1, the Applicant's approach of a displacement rate of 50% and a mortality rate of 1% were applied for the assessment of in-combination effects on razorbill. However, based on advice from Natural England, a displacement range of 30% to 70% and a mortality range of 1% to 5% is also presented in Table 6.26. Results for annual displacement consequent mortalities are also presented in a matrix in Table 6.25.

Seasonal and annual population estimates of breeding adult razorbill of the Lambay Island SPA at all OWFs included in the in-combination assessment are presented in Table 6.25.

Table 6.25: Seasonal and Annual Razorbill Population at Lambay Island SPA Estimated to Be at Risk of Displacement for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project		Seasonal mortality attributed to SPA					Tier
	Pre-breeding migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Non-breeding total	Annual total	
Awel-y-Mor						18	3
Minesto						74	3
Phase 1 Projects (excluding the proposed development)	26	617	92	35	153	770	2
The proposed development	6	72	39	42	87	158	N/A
All other projects	No information	No information	No information	No information	No information	No information	-
Total	32	689	131	77	239	1020	

6.4.11.2.2 Breeding Bio-season

The in-combination number of razorbill at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 689 breeding adults (Table 6.26). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be 4 (3.45) breeding adults during the breeding bio-season.

Based on the 2001 citation colony count of 7,610 breeding adults and an annual background mortality of 799 (799.1) individuals the addition of four (3.45) predicted breeding adult mortalities during the breeding bio-season would represent a 0.431% increase in baseline mortality, of which the proposed development alone contributes less than one (0.36) breeding adult mortality equating to an increase of 0.045% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.26 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 7,353 individuals and an annual background mortality of 772 (772.1) adults, the addition of 4 (3.45) breeding adult mortality during the breeding bio-season would represent a 0.460% increase in baseline mortality, of which the proposed development alone contributes less than one (0.36) breeding adult mortality equating to an increase of 0.046% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.26 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.11.2.3 Non-breeding Bio-season

The in-combination number of razorbill at risk of disturbance and displacement from the OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 239 individuals during the non-breeding bio-season (Table 6.26). Provided a displacement rate of 50% and a mortality rate of 1% have been applied, the predicted consequent mortality from displacement is estimated to be one (1.20) breeding adult during the non-breeding bio-season.

Based on the 2001 citation colony count of 7,610 breeding adults and an annual background mortality of 799 (799.1) individuals the additions of less than two (1.20) predicted breeding adult mortalities during the non-breeding bio-season would represent a 0.150% increase in baseline mortality, of which the proposed development alone contributes less than one (0.43) breeding adult mortality equating to an increase of 0.054% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.26 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

Whereas when considering the latest colony count 7,353 individuals and an annual background mortality of 772 (772.1) adults, the addition of one (1.20) breeding adult mortality during the non-breeding bio-season would represent a 0.155% increase in baseline mortality, of which the proposed development alone contributes less than one (0.43) breeding adult mortality equating to an increase of 0.056% in baseline mortality (based on 50% displacement and 1% mortality rates). See Table 6.26 for the in-combination displacement consequent mortalities from the OWFs and tidal energy projects, including the proposed development, as per the range recommended within the SNCBs guidance (MIG-Birds, 2022) (30% displacement to 70% displacement, 1 to 5% mortality).

6.4.11.2.4 Annual Total

Throughout all bio-seasons, the in-combination number of razorbill at risk of displacement from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 1,020 individuals. The total predicted displacement consequent mortality is 5 (5.10) breeding adults.

The predicted mortality of 5 (5.10) breeding adults from Lambay Island SPA per annum across all bio-seasons represents an increase in baseline mortality of 0.639% when considering the 2001 citation colony count (7,610 birds) and a background mortality of 799 (799.1) individuals. The proposed development alone contributes less than one (0.79) breeding adult mortality per annum which equates to a 0.099% increase in baseline mortality per annum.

Whereas when considering the latest colony count of 7,535 individuals and a background mortality of 772 (772.1) individuals the addition of 5 (5.10) breeding adult mortalities would represent an increase in baseline mortality of 0.661%. The proposed development alone contributes less than one (0.79) breeding adult mortality per annum which equates to a 0.102% increase in baseline mortality per annum. This level of impact would be indistinguishable from natural fluctuations in the population.

There is, therefore, no potential for an AEoI to the COs of the razorbill QI of Lambay Island SPA in relation to disturbance and displacement effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the razorbill QI will be maintained in the long term with respect to potential for adverse effects from disturbance and displacement.

Table 6.26: In-Combination Range-Based Displacement Mortalities during the Operation and Maintenance Phases for Razorbill at Lambay Island SPA Based on a Range of Displacement Impacts and the Latest NPWS Colony Count and the 2001 Citation Colony Count[9].

Bio-season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	50-70% displacement, 1 - 5% mortality	50% displacement, 1% mortality	30-70% displacement, 1 - 5% mortality
Breeding	689.1	3.45	2.07 - 24.12	0.431	0.259 - 3.018	0.446	0.268 - 3.124
Post-breeding migration	130.9	0.65	0.39 - 4.58	0.082	0.049 - 0.573	0.085	0.051 - 0.593
Return-breeding migration	31.7	0.16	0.10 - 1.11	0.020	0.012 - 0.139	0.021	0.012 - 0.144
Migration-free winter	76.8	0.38	0.23 - 2.69	0.048	0.029 - 0.337	0.050	0.030 - 0.348
Total Non-breeding	239.4	1.20	0.72 - 8.38	0.150	0.090 - 1.048	0.155	0.093 - 1.085
Annual Total	1020.4	5.10	3.06 - 35.71	0.639	0.383 - 4.470	0.661	0.396 - 4.626

[9] *Note bio-season totals may not equal the annual total exactly in the table due to rounding.*

6.4.11.3 Kittiwake

Kittiwake has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.71). Based on the MMF+1SD of kittiwake (156.1+144.5km) (Woodward et al., 2019) from Lambay Island SPA, several OWFs are within foraging range.

6.4.11.3.1 Operation - Collision Risk

Based on the MMF+1SD of kittiwake (Woodward et al., 2019) from Lambay Island SPA numerous OWF projects are within range. The only projects to have apportioned impacts to kittiwake from Lambay Island SPA were the other east coast Irish Phase 1 Projects namely, Arklow Bank Wind Park, Codling Wind Park; Oriel Wind Farm and Dublin Array, and Awel-y-Mor, Erebus, Morgan, and Mona (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult kittiwake of the Lambay Island SPA at all OWFs included in the in-combination assessment are presented in Table 6.27.

Table 6.27: Seasonal and Annual Kittiwake Collision Mortalities at Ireland's Eye SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal Mortality attributed to SPA					Tier
	Pre- breeding migration	Breeding bio-season	Post-breeding migration	Non-breeding bio-season total	Annual total	
Awel-y-Mor					0.15	3
Erebus					<0.01	3
Morgan					1.50	3
Mona					1.40	3
Phase 1 Projects (excluding the proposed development)	1.79	5.20	0.91	2.70	7.90	2
The proposed development	0.09	1.57	0.05	0.14	1.71	N/A
All other projects	No information	No information	No information	No information	No information	-
Total	1.88	6.77	0.96	2.84	12.67	

6.4.11.3.2 Breeding Bio- season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 7 (6.77) breeding adults (Table 6.27).

Based on the 2004 citation colony count of 7,894 breeding adults and an annual background mortality of 1,153 (1,152.5) individuals the addition of 7 (6.77) predicted breeding adult mortalities during the breeding bio-season would represent a 0.588% increase in baseline mortality, of which the proposed development alone contributes less than two (1.57) breeding adult mortalities equating to an increase of 0.136% in baseline mortality.

Whereas when considering the latest colony count 6,640 individuals and an annual background mortality of 936 (936.4) adults, the addition of 7 (6.77) breeding adult mortalities during the breeding bio-season would represent a 0.699% increase in baseline mortality, of which the proposed development alone contributes less than two (1.57) breeding adult mortalities equating to an increase of 0.162% in baseline mortality.

6.4.11.3.3 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of kittiwake from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is four (4.0) adults during the non-breeding bio-season (Table 6.27).

Based on the 2004 citation colony count of 7,894 breeding adults and an annual background mortality of 1,153 (1,152.5) individuals the addition of 3 (2.84) predicted adult mortalities during the non-breeding breeding bio-season would represent a 0.246% increase in baseline mortality, of which the proposed development alone contributes less than one (0.14) breeding adult mortality equating to an increase of 0.012% in baseline mortality.

Whereas when considering the latest colony count 6,640 individuals and an annual background mortality of 936 (936.4) adults, the addition of 3 (2.84) breeding adult mortalities during the breeding bio-season would represent a 0.293% increase in baseline mortality, of which the proposed development alone contributes less than one (0.14) breeding adult mortality equating to an increase of 0.015% in baseline mortality.

6.4.11.3.4 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of kittiwake from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 13 (12.67) breeding adults.

The predicted mortality of 13 (12.67) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 1.100% when considering the 2004 citation colony count (7,894 birds) and a background mortality of 1,153 (1,152.5) individuals. The proposed development alone contributes two (1.71) breeding adult mortalities per annum which equates to an increase in baseline mortality of 0.155% per annum.

Whereas when considering the latest colony count of 6,640 individuals and a background mortality of 936 (936.4) individuals the addition of 12 (13.67) breeding adult mortalities would represent an increase in baseline mortality of 1.307%. The proposed development alone contributes two (1.71) breeding adult mortalities per annum which equates to an increase in baseline mortality of 0.176% per annum.

Overall, the level of impact is greater than a 1% increase and therefore, further consideration is given to these impacts below through a PVA.

Table 6.28: PVA Outputs for Breeding Adult Lambay Island SPA Kittiwake Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	1.71	1.000	0.988	0.031%	1.187%
In-combination	12.67	0.998	0.921	0.228%	7.828%

Assuming an annual mortality of 13 (12.67) breeding adults from Lambay Island SPA, the GPGR and CPS are 0.998 and 0.921, respectively. This represents a 0.228% reduction in growth rate and a reduction in final population size of 7.828% over the 35-year period. For further details regarding the PVA presented here see the PVA Appendix 13.

The kittiwake colony at Lambay Island SPA has shown a slight decrease, with the recent 2015 count of 6,640 individuals representing an 18.8% decline since the Seabird 2000 count of 8,182 individuals in 1999. This trend corresponds to an annual rate of decrease of 1.30%. Though the current population trend is slightly declining, an annual counterfactual reduction in population growth rate of 0.228% is expected to be indistinguishable from natural fluctuations in the population at Lambay Island and not contribute materially to the natural mortality rate (Section 5.4.6). There are other ecosystem drivers that are contributing to the declining population trend in the region, for example insufficient prey availability, however, based on this analysis, the minimal impact from offshore wind developments will not exacerbate the current trend.

In addition, these decreases in growth rate are far more precautionary than what would be considered realistic within natural systems because density dependence was not incorporated into models. Please see the Assessment Criteria section 5.4, and the PVA Appendix 13 for further justification.

There is, therefore, no potential for an AEoI to the COs of the kittiwake QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the kittiwake QI will be maintained in the long term with respect to potential for adverse effects from collisions.

6.4.11.4 Herring gull

Herring gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species (Table 5.71). Based on the MMF+1SD of herring gull (58.8+26.8km) (Woodward et al., 2019) from Lambay Island SPA, several OWFs are within foraging range.

6.4.11.4.1 Operation - Collision Risk

Based on the MMF+1SD of herring gull (Woodward et al., 2019) from Lambay Island SPA numerous OWF projects are within range. The only projects to have apportioned impacts to herring gull from Lambay Island SPA were the other east coast Irish Phase 1 Projects (see Table 6.4).

Seasonal and annual mortality estimates of breeding adult herring gull of the Lambay Island SPA at all OWFs included in the in-combination assessment are presented in Table 6.29.

Table 6.29: Seasonal and Annual Herring Gull Collision Mortalities at Lambay Island SPA for the Proposed Development Alone and All OWFs Considered in the In-Combination Assessment.

Project	Seasonal Mortality attributed to SPA			Tier
	Migration- free breeding	Non-breeding total	Annual total	
Phase 1 Projects (excluding the proposed development)	4.25	0.69	4.93	2
The proposed development	1.25	0.38	1.64	N/A
All other projects	No information	No information	No information	-
Total	5.50	1.07	6.57	

Breeding Bio- season

The in-combination predicted collision consequent mortalities of herring gull from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 6 (5.50) breeding adults (Table 6.29).

Based on the 2004 citation colony count of 622 breeding adults and an annual background mortality of 103 (103.3) individuals the addition of 6 (5.50) predicted breeding adult mortalities during the breeding bio-season would represent a 5.322% increase in baseline mortality, of which the proposed development alone contributes less than two (1.25) breeding adult mortalities equating to an increase of 1.211% in baseline mortality.

Whereas when considering the latest colony count 1,812 individuals and an annual background mortality of 301 (300.8) adults, the addition of 6 (5.50) breeding adult mortalities during the breeding bio-season would represent a 1.827% increase in baseline mortality, of which the proposed development alone contributes less than two (1.25) breeding adult mortalities equating to an increase of 0.416% in baseline mortality.

6.4.11.4.2 Non-breeding Bio-season

The in-combination predicted collision consequent mortalities of herring gull from the OWFs, and tidal energy projects assessed, including the proposed development, apportioned to Lambay Island SPA is 1 (1.06) adult during the non-breeding bio-season (Table 6.29).

Based on the 2004 citation colony count of 622 breeding adults and an annual background mortality of 103 (103.3) individuals the addition of 1 (1.07) predicted adult mortalities during the non-breeding breeding bio-season would represent a 1.034% increase in baseline mortality, of which the proposed development alone contributes less than one (0.38) breeding adult mortality equating to an increase of 0.354% in baseline mortality.

Whereas when considering the latest colony count 1,812 individuals and an annual background mortality of 301 (300.8) adults, the addition of one (1.07) breeding adult mortalities during the breeding bio-season would represent a 0.355% increase in baseline mortality, of which the proposed development alone contributes less than one (0.38) breeding adult mortality equating to an increase of 0.122% in baseline mortality.

6.4.11.4.3 Annual Total

Throughout all bio-seasons, the in-combination predicted collision consequent mortalities of kittiwake from OWFs and tidal energy projects assessed, including the proposed development, apportioned to Ireland's Eye SPA is seven (6.56) breeding adults.

The predicted mortality of seven (6.57) breeding adults from Ireland's Eye SPA per annum across all bio-seasons represents an increase in baseline mortality of 6.361% when considering the 2004 citation colony count (662 birds) and a background mortality of 103 (103.3) individuals. The proposed development alone contributes 2 (1.64) breeding adult mortalities per annum which equates to an increase in baseline mortality of 1.584% per annum.

Whereas when considering the latest colony count of 1,812 individuals and a background mortality of 301 (300.8) individuals the addition of 6 (6.57) breeding adult mortalities would represent an increase in baseline mortality of 2.183%. The proposed development alone contributes 2 (1.64) breeding adult mortalities per annum which equates to an increase in baseline mortality of 0.544% per annum.

This level of impact is greater than a 1% increase and therefore, further consideration is given to these impacts below through a PVA.

Table 6.30: PVA Outputs for Breeding Adult Lambay Island SPA Herring Gull Incorporating Mean Displacement Impacts of the Proposed Development Alone and In-Combination with Other Projects.

Scenario	Mortalities	CGR	CPS	Difference in GR	Difference in PS
Proposed development alone	1.64	0.999	0.965	0.099%	3.502%
In-combination	6.57	0.996	0.857	0.433%	14.344%

Assuming an annual mortality of 7 (6.57) breeding adults from Lambay Island SPA, the GGR and CPS are 0.996 and 0.857, respectively. This represents a 0.433% reduction in growth rate and a reduction in final population size of 14.344% over the 35-year period. For further details regarding the PVA presented here see the PVA Appendix 13.

The herring gull colony at Lambay Island SPA appears to be decreasing, with the recent 2015 count of 1,812 individuals representing a 49.8% decline since the Seabird 2000 count of 3,612 in 1999. This corresponds to an annual decline of 4.22%. The latest official colony count at this site is 1,812 individuals as of 2015, however there is anecdotal evidence that the herring gull population has increased significantly at Lambay Island SPA since this count (S Newton, BirdWatch Ireland, pers.comms.). As such, this assessment has been carried out using a drastically smaller colony count than is likely to be present at the site. Based on the 2015 count, though the population has decreased since 1999, the CGR value of 0.996 corresponds to a relative decrease in less than 0.5% compared to an unimpacted population.

Given the number of other environmental factors acting on these populations, and the absence of density dependence within the models used to predict this impact, this level of impact is considered to be indistinguishable from natural fluctuations in the population (Section 5.4.6). The annual reduction in population growth is also expected to be further reduced in reality when considering that the population has increased since the 2015 count used in the assessment.

In addition, these decreases in growth rate are far more precautionary than what would be considered realistic within natural systems because density dependence was not incorporated into models. Please see the Assessment Criteria section and the PVA Appendix 13 for further justification.

There is, therefore, no potential for an AEoI to the COs of the herring gull QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development in-combination with other plans and projects and therefore, subject to natural change, the herring gull QI will be maintained in the long term with respect to potential for adverse effects from collisions.

Colony monitoring of Lambay Island SPA during the 2024 breeding season will help to provide more confidence in the results of this assessment.

6.4.11.5 Lesser black-backed gull

Lesser black-backed gull has been screened in for the operational phase to assess the potential for an AEoI from collision risk from the proposed development in-combination with other OWFs in relation to the COs for this species as a designated QI of Lambay Island SPA (Table 5.71). Based on the MMF+1SD of lesser black-backed gull (127+109km) (Woodward et al., 2019), several OWFs are within foraging range.

6.4.11.5.1 Operation - Collision Risk

No other OWFs or tidal energy projects considered in-combination with the proposed development for lesser black-backed gull assessed and apportioned impacts to Lambay Island SPA, therefore no potential impacts to this species could be quantified in-combination with the proposed development.

This species has been screened in for the operational phase to assess the potential for an AEoI from collision from the proposed development alone in relation to COs for this species, as a QI at the Lambay Island SPA is presented in Section 5.4.6. Less than one (0.4) breeding adult mortalities were estimated annually. Based in the 2004 citation colony count of 266 breeding adults and annual adult background mortality of 31 (30.6) individuals, the addition of less than one breeding adult mortality would represent a 1.197% increase in baseline mortality during the breeding bio-season. Whereas, considering the latest colony count of 690 individuals and an annual background mortality of 79 (79.4) adults, this would represent a 0.461% increase in baseline mortality during the breeding bio-season. This level of impact would be indistinguishable from natural fluctuations in the population, when assessed against the latest colony count.

There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull QI of Lambay Island SPA in relation to collision risk effects during the operational phase from the proposed development alone and therefore, subject to natural change, the lesser black-backed gull QI will be maintained in the long term with respect to potential for adverse effects from collision.

6.5 Stage 2 Appropriate Assessment In-combination Conclusion

It was concluded for all sites considered within this assessment that there is no AEoI of the sites or their COs resulting from in-combination interactions with the proposed development. These conclusions are listed in Table 8.1 below for each site considered.

7. Transboundary Statement

Transboundary effects are defined as those effects upon the receiving environment of other states, whether occurring from the proposed development alone, or in-combination with other projects in the area. Transboundary effects are only relevant to ornithological and marine mammal QIs.

7.1 Marine Mammals

The screening process identified the following transboundary sites (and species) for assessment:

- Abers – Côtes des légendes SAC (Harbour porpoise);
- Anse de Vauville SAC (Harbour porpoise);
- Archipel de Saint Malo et Dinard SAC (Harbour porpoise);
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC (Harbour porpoise);
- Baie de Morlaix SAC (Harbour porpoise);
- Baie de Saint-Brieuc – Est SAC (Harbour porpoise);
- Baie du Mont Saint-Michel SAC (Harbour porpoise);
- Banc et récifs de Surtainville SAC (Harbour porpoise);
- Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC (Harbour porpoise);
- Cardigan Bay/ Bae Ceredigion SAC (Bottlenose dolphin);
- Chausey SAC (Harbour porpoise);
- Chaussée de Sein SAC (Harbour porpoise);
- Côtes de Crozon SAC (Harbour porpoise);
- Glannau Ynys Gybi/ Holy Island Coast SAC (Grey seal);
- Mers Celtiques – Talus du golfe de Gascogne SAC (Harbour porpoise);
- Nord Bretagne DH SAC (Harbour Porpoise);
- North Anglesey Marine/ Gogledd Môn Forol SAC (Harbour porpoise);
- Ouessant-Molène SAC (Harbour porpoise);
- Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC (Bottlenose dolphin);
- Récifs et landes de la Hague SAC (Harbour porpoise);
- Tregor Goëlo SAC (Harbour porpoise);
- West Wales Marine/ Gorllewin Cymru Forol SAC (Harbour porpoise);

Consideration of the potential for AEoI been addressed in Section 5.3 for marine mammals, including in relation to the above sites, with all conclusions being no AEoI for Project Option 1 and Project Option 2. The assessment in-combination with other plans and projects has been addressed in Section 7.3 for marine mammals with all conclusions similarly being no AEoI for Project Option 1 and Project Option 2.

It can therefore be concluded that no AEoI exists for a transboundary effect from the proposed development for Project Option 1 and Project Option 2, alone and/or in-combination.

7.2 Ornithology

For ornithological receptors which often have wide foraging and migratory ranges, there is potential for transboundary effects to occur. During the breeding season, connectivity with other sites is determined based on mean-maximum foraging ranges presented in Woodward et al., (2019), representing a standard approach to determining connectivity across Irish and UK projects and as agreed among Phase 1 projects. Even for species which have particularly large mean-maximum foraging ranges (e.g., Manx shearwater) it is unlikely that these receptors will travel beyond the Irish and Celtic Seas. During the breeding season the majority of impacts are therefore concentrated at local SPA colonies along the Irish East Coast with some small impacts apportioned to UK SPAs in Wales, England and the west coast of Scotland.

During the non-breeding season, ornithological receptors are able to travel more widely and therefore receptors that disperse widely or undertake migrations have the potential to be impacted by the proposed development even if they originate from SPAs outside of Ireland and the UK. Impacts on these distant SPAs are not considered within the assessment unless there is some evidence of connectivity (e.g. from tracking studies), because the likelihood of connectivity is extremely low, and impacts would be immaterially small once they have been apportioned to all SPAs in the regional population.

The screening process identified six transboundary sites for assessment, including:

- Rathlin Island SPA;
- Ailsa Craig SPA;
- North Colonsay and Western Cliffs SPA;
- Grassholm SPA;
- Skomar, Skokholm and the Seas off Pembrokeshire SPA; and
- Ribble & Alt Estuaries SPA.

Consideration of the potential for AEoI has been addressed in Section 5.4 for Ornithology, including in relation to the above sites, with all conclusions being no AEoI for Project Option 1 and Project Option 2. The assessment in-combination with other plans and projects has been addressed in Section 5.4 for Ornithology with all conclusions similarly being no AEoI for Project Option 1 and Project Option 2.

8. Appropriate Assessment Conclusion

This NIS presents the information required for a Stage 2 AA to be carried out by the competent authority to determine whether or not the proposed development, either alone or in-combination, in view of best scientific knowledge, will adversely affect the integrity of European Sites.

The potential impacts have been considered collectively with each other across receptor groups and based on the assessment of the proposed development alone and in-combination, it is concluded that there is no potential for AEoI of the QIs of any European site.

Table 8.1: Conclusions of the Assessment for AEoI for All Coastal and Offshore Receptor Groups

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
Coastal and Marine Habitats					
Malahide Estuary SAC	Annex I habitats: Mudflats and sandflats not covered by seawater at low tide; Salicornia and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.	Onshore and offshore suspended sediment / deposition; Onshore and offshore accidental pollution; Marine INNS; and Onshore Dust deposition.	Offshore suspended sediment / deposition; Offshore accidental pollution; Marine INNS; Offshore changes to physical processes.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Rogerstown Estuary SAC	Annex I habitats: Estuaries; Mudflats and sandflats not covered by seawater at low tide; Salicornia and other annuals colonising mud and sand; Atlantic salt meadows; and Mediterranean salt meadows.	Onshore and offshore suspended sediment / deposition; Onshore and offshore accidental pollution; Marine INNS; and Onshore Dust deposition	Offshore suspended sediment / deposition; Offshore accidental pollution; Marine INNS; Offshore changes to physical processes;	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Baldoyle Bay SAC	Annex I habitats: Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; Atlantic salt meadows; and	Onshore and offshore suspended sediment / deposition; and Onshore and offshore accidental pollution.	None	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Mediterranean salt meadows.				
Rockabill to Dalkey Island SAC	Annex I habitats: Reefs.	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Offshore changes to physical processes; and Marine INNS.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Boyne Coast and Estuary SAC	Annex I habitats: Estuaries; Mudflats and sandflats not covered by seawater at low tide; Salicornia and other annuals colonising mud and sand; and Atlantic salt meadows	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Marine INNS; Offshore changes to physical processes.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Lambay Island SAC	Annex I habitats: Reefs.	Offshore suspended sediment / deposition; Offshore accidental pollution; and Marine INNS.	Offshore suspended sediment / deposition; Offshore accidental pollution; Marine INNS; Offshore changes to physical processes.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
Migratory Fish					
River Boyne and River Blackwater SAC	Annex II species: River lamprey; and Atlantic salmon.	Underwater noise from piling, UXO clearance and other noise sources; Offshore suspended sediment /deposition; and Offshore accidental pollution.	Offshore suspended sediment/deposition; Offshore accidental pollution; Electro-magnetic fields (EMF).	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Marine Mammals					
Rockabill to Dalkey Island SAC	Annex II species: Harbour porpoise.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Lambay Island SAC	Annex II species: Harbour porpoise; Grey seal and Harbour seal.	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Hook Head SAC	Annex II species: Bottlenose dolphin	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Codling Fault Zone SAC	Annex II species: Harbour porpoise	Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
North Anglesey Marine/ Gogledd Môn Forol SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Murlough SAC	Annex II species: Harbour seal.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
North Channel SAC	Annex II species Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Glannau Ynys Gybi/ Holy Island Coast SAC	Annex II species: Grey seal	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
West Wales Marine/ Gorllewin Cymru Forol SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
		Accidental pollution.	Accidental pollution		
Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC	Annex II species: Bottlenose dolphin.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Blackwater Bank SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Carnsore Point SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Cardigan Bay/ Bae Ceredigion SAC	Annex II species: Bottlenose dolphin.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision;	Offshore development area only Vessel disturbance; Vessel collision;	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
		Changes to prey; and Accidental pollution.	Changes to prey; and Accidental pollution		
Roaringwater Bay and Islands SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Blasket Islands SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Kenmare River SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combinationv
Bunduff Lough and Machair/Trawalua/Mullaghmore SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Nord Bretagne DH SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance;	Offshore development area only Vessel disturbance;	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
		Vessel collision; Changes to prey; and Accidental pollution	Vessel collision; Changes to prey; and Accidental pollution		
West Connacht Coast SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Mers Celtiques – Talus du golfe de Gascogne SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Récifs et landes de la Hague SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Anse de Vauville SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Banc et récifs de Surtainville SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise;	Offshore development area only	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
		Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution		
Tregor Goëlo SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Belgica Mound SAC	Annex II species: Harbour porpoise	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Abers - Côtes des légendes SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Ouessant-Molène SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
Chausey SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Baie de Saint-Brieuc – Est SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Côtes de Crozon SAC,	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Baie du Mont Saint-Michel SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
		Accidental pollution.	Accidental pollution		
Kilkieran Bay and Islands SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Chaussée de Sein SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Inishmore Island SAC	Annex II species: Harbour porpoise.	Offshore development area only Underwater noise; Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution.	Offshore development area only Vessel disturbance; Vessel collision; Changes to prey; and Accidental pollution	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Ornithology					
North-West Irish Sea cSPA	Common scoter; Red-throated diver; and Great northern diver.	Offshore and onshore disturbance and displacement; Spatial distribution; Dust deposition; Suspended sediment; Accidental pollution; and Indirect effects via impacts on prey.	Migratory collision risk; Barrier effects; Offshore disturbance and displacement, Indirect effects via impacts on prey; and Spatial distribution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Fulmar; Kittiwake;	Spatial distribution and disturbance; Indirect effects via impacts on prey;	Collision risk;	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Lesser black-backed gull; and Herring Gull	Dust deposition; Surface water run-off of suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and displacement.	Spatial distribution and disturbance; Indirect effects via impacts on prey; and Barrier effects		
	Shag; and Cormorant	Dust deposition; Suspended sediment; Accidental pollution; and Onshore disturbance and displacement.	N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Great black-back gull; Manx shearwater; Little gull; Little tern; Roseate tern; Common tern; and Arctic tern.	Indirect effects via impacts on prey; and Spatial distribution.	Collision risk; Spatial distribution; Indirect effects via impacts on prey; and Barrier effects.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Manx shearwater	Offshore disturbance and displacement.	Offshore disturbance and displacement.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Razorbill; and Guillemot.	Offshore and onshore disturbance and displacement; Spatial distribution; Dust deposition; Suspended sediment; Accidental pollution; and Indirect effects via impacts on prey.	Barrier effects; Offshore disturbance and displacement, Indirect effects via impacts on prey; and Spatial distribution.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Malahide Estuary SPA	Bar-tailed godwit; Black-tailed godwit; Dunlin;	Dust deposition; Surface water run-off of suspended sediment/ deposition;	Migratory collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Golden plover; Goldeneye; Great crested grebe; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Pintail; Red-breasted merganser; Redshank; and Shelduck.	Accidental pollution; and Onshore Disturbance and displacement.			
	Wetlands and waterbirds		N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Rockabill SPA	Common tern; Roseate tern; and Arctic tern.	N/A	Collision risk; Barrier effects; and Indirect effects via impacts on prey.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Purple sandpiper.	Offshore and onshore disturbance and displacement.	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Rogerstown Estuary SPA	Black-tailed godwit; Dunlin; Grey plover; Greylag goose; Knot;	Dust deposition; Surface water run-off of suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Light-bellied brent goose; Oystercatcher; Redshank; Ringed plover; Shelduck; and Shoveler.	displacement			
	Wetlands and waterbirds		N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Baldoyle Bay SPA	Bar-tailed godwit; Golden plover; Grey plover; Light-bellied brent goose; Ringed plover; and Shelduck.	Suspended sediment/ deposition; Accidental pollution; and Onshore Disturbance and displacement	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Wetlands and waterbirds		N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
North Bull Island SPA	Bar-tailed godwit; Black-tailed godwit; Curlew; Dunlin; Golden plover; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Pintail;	Onshore Disturbance and displacement.	N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Redshank; Sanderling; Shelduck; Shoveler; Teal; Turnstone; and Black-headed gull.				
River Nanny Estuary and Shore SPA	Golden plover; Knot; Oystercatcher; Ringed plover; and Sanderling.	Onshore Disturbance and displacement	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
South Dublin Bay and River Tolka Estuary SPA	Black-headed gull; Bar-tailed godwit; Dunlin; Grey plover; Knot; Light-bellied brent goose; Oystercatcher; Redshank; Ringed plover; and Sanderling.	Onshore Disturbance and displacement	N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Skerries Islands SPA	Herring gull.	Onshore Disturbance and displacement	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Light-bellied Brent Goose; Purple Sandpiper; and Turnstone;	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Cormorant; and Shag.	Onshore Disturbance and displacement	N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Ireland's Eye SPA	Guillemot; and Razorbill.	Offshore disturbance & displacement.	Offshore disturbance & displacement.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Herring gull; and Kittiwake.	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Saltee Islands SPA	Kittiwake; and Lesser black-backed gull;	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Gannet;	Offshore disturbance and displacement.	Collision risk; and offshore disturbance and displacement	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Razorbill; and Guillemot.		Offshore disturbance and displacement	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Howth Head Coast SPA	Kittiwake	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Lambay Island SPA	Guillemot; and Razorbill.	Offshore and onshore disturbance & displacement.	Offshore disturbance & displacement.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Cormorant; and Shag.	Onshore Disturbance and displacement	N/A	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Herring gull; Kittiwake; and Lesser black-backed gull.		Collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Fulmar.	N/A		No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
	Greylag goose.	N/A	Migratory collision risk;.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Boyne Estuary SPA	Black-tailed godwit; Golden plover; Grey plover; Knot; Lapwing; Oystercatcher; Redshank; Sanderling; Shelduck; and Turnstone.	Onshore Disturbance and displacement	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Poulaphouca Reservoir SPA	Greylag goose	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Wicklow Head SPA	Kittiwake	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Morecambe Bay & Duddon Estuary SPA	Lesser black-backed gull	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Rathlin Island SPA	Kittiwake; Lesser black-backed gull.	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Ailsa Craig SPA	Gannet	Offshore disturbance & displacement	Offshore disturbance & displacement; and Collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Lesser black-backed gull; and Kittiwake	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Helvick Head to Ballyquin SPA	Kittiwake	N/A	Collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Ribble & Alt Estuaries SPA	Lesser black-backed gull	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Skomer, Skokholm & the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA	Lesser black-backed gull; and kittiwake.	N/A	Collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Grassholm SPA	Gannet	Offshore disturbance and displacement.	Offshore disturbance and displacement; and Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Blackwater Callows SPA	Whooper swan; Bewick's swan; Wigeon; Teal; Mallard; Shoveler; Black-tailed godwit; Lapwing; Curlew.	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Horn Head to Fanad Head SPA	Kittiwake	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Cork Harbour SPA	Shelduck; Wigeon; Teal;	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
	Mallard; Pintail; Shoveler; Red-breasted merganser; Little grebe; Great crested grebe; Grey heron; Oystercatcher; Black-tailed godwit; Bar-tailed godwit; Redshank; Golden plover; Grey plover; Lapwing; Dunlin; and Curlew.				
Courtmacsherry SPA	Shelduck; Wigeon; Red-breasted merganser; Black-tailed godwit; Bar-tailed godwit; Golden plover; Lapwing; Dunlin; Curlew; and Great northern diver.	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

European site name	Qualifying interest assessed in the NIS	Impacts screened in for construction and decommissioning	Impacts screened in for operation and maintenance	Conclusion on Adverse Effect – Project Option 1 Construction /Operation /Decommissioning	Conclusion on Adverse Effect Project Option 2 - Construction/ Operation /Decommissioning
North Colonsay & Western Cliffs SPA & Assemblage	Kittiwake	N/A	Collision risk.	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination
Clonakilty SPA	Shelduck; Black-tailed godwit; Curlew; Dunlin.	N/A	Migratory collision risk	No potential for AEoI alone or in-combination	No potential for AEoI alone or in-combination

9. References

Aarts, G., Brasseur, S. and Kirkwood, R. (2017) 'Response of grey seals to pile-driving'. Wageningen, Wageningen Marine Research (University & Research Centre), Wageningen Marine Research report C006/18. 54 pp.

Ainley, D. G.; Nettleship, D. N.; Storey, A. E. (2021). 'Common Murre (Uria aalge), version 2.0'. In Birds of the World (S. M. Billerman, P. G. Rodewald, and B. K. Keeney, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

Alerstam, T., Rosén, M., Bäckman, J., Ericson, P.G.P. and Hellgren, O. (2007). 'Flight speeds among Bird Species Allometric and Phylogenetic Effects'. PLoS Biology, 5 (8): 1656-1662.

Allbrook, D.; Dunne, S.; Fink, A.; Newton, S. (2022), 'Rockabill Tern Report, 2022', BirdWatch Ireland Seabird Conservation Report to NPWS

Anderwald, P., A. Brandecker, M. Coleman, C. Collins, H. Denniston, M. D. Haberlin, M. O'Donovan, R. Pinfield, F. Visser, and L. Walshe. 2013. Displacement responses of a mysticete, an odontocete, and a phocid seal to construction-related vessel traffic. Endangered Species Research 21.

APEM (2014), Assessing Northern Gannet Avoidance of Offshore Windfarms, APEM Report to East Anglia Offshore Wind Ltd. APEM, Stockport.

APEM (2016) Assessment of displacement impacts of offshore wind farms and other human activities on red-throated divers and alcids. Natural England Commissioned Report NECR227

APEM (2017), Mainstream Kittiwake and Auk Displacement Report, APEM Scientific Report P000001836. Neart na Gaoithe Offshore Wind Limited, 04/12/17, v2.0 Final, 55.

APEM (2019). Gwynt y Môr Offshore Wind Farm Post-construction Aerial Surveys Annual Report 2018/2019 (APEM Ref P00002798). APEM Ltd., Stockport.

APEM (2022). Review of evidence to support auk displacement and mortality rates in relation to offshore wind farms. APEM Scientific Report P00007416. Ørsted, January 2022, Final, 49.

Aquatic Services Unit, 2020. Dublin Port Maintenance Dredging 2022 - 2029 Benthic and Fisheries Assessment. Available at: https://epawebapp.epa.ie/licences/lic_eDMS/090151b2807a46b2.pdf Accessed: August 2023.

Arnold, J.M., Oswald, S.A., Nisbet, I.C.T., Pyle, P., Patten, M.A. (2020), 'Common Tern', Birds of the World, Available at: https://birdsoftheworld.org/bow/species/comter/cur/introduction, Accessed [March 2024].

Baer, J. and Newton, S. (2012). Integrating Irish Marine Protected Areas: the FAME Seabird Tracking Project. Unpublished BirdWatch Ireland report.

Ballantine, B., (2014). Fifty years on: Lessons from marine reserves in New Zealand and principles for worldwide network. Biological Conservation, 176, pp.297-307.

Barry, J., Kennedy, R.J., Rosell, R. and Roche, W.K., 2020. Atlantic salmon smolts in the Irish Sea: first evidence of a northerly migration trajectory. Fisheries Management and Ecology 27(5): 517-522.

Basran, C. J., Woelfing, B., Neumann, C. and Rasmussen, M. H. (2020), 'Behavioural Responses of Humpback Whales (Megaptera novaeangliae) to Two Acoustic Deterrent Devices in a Northern Feeding Ground off Iceland', Aquatic mammals, 46/6.

Bejder, L., Samuels, A., Whitehead, H., Finn, H., and Allen, S.J. (2009). 'Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli'. Marine Ecology Progress Series, 395, 177-185.

Bellebaum, J., Diederichs, A., Kube, J., Schulz, A. and Nehls, G., (2006). Flucht-und Meidedistanzen überwinternder Seetaucher und Meeresenten gegenüber Schiffen auf See. Ornithologischer Rundbrief Mecklenburg-Vorpommern, 45: 86-90.

Benhemma-Le Gall, A., Graham, I.M., Merchant, N.D. and Thompson, P.M. (2021), ‘Broad-scale responses of harbour porpoises to pile-driving and vessel activities during offshore windfarm construction’, Frontiers in Marine Science, 8.

Benhemma-Le Gall, A., P. Thompson, N. Merchant, and I. Graham. 2023. Vessel noise prior to pile driving at offshore windfarm sites deters harbour porpoises from potential injury zones. Environmental Impact Assessment Review 103:107271.

Berrow, S. D., & Rogan, E. (1995). Stomach contents of harbour porpoises and dolphins in Irish waters. European Research on Cetaceans, 9, 179-181.

Berrow, S., Cummins, F., Kane, G., Keogh, H, and Wall, D. (2021). Harbour porpoise surveys in Rockabill to Dalkey Island SAC, 2021. Report to the National Parks and Wildlife Service, Department Housing, Local Government & Heritage, Ireland.

Berrow, S., F. Cummins, G. Kane, H. Keogh, and D. Wall. 2021. Harbour porpoise surveys in Rockabill to Dalkey Island SAC, 2021. Report to the National Parks and Wildlife Service, Department Housing, Local Government & Heritage, Ireland.

Berrow, S.D. and O’Brien, J. (2013). Harbour porpoise SAC survey 2013. Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Irish Whale and Dolphin Group. pp. 37.

Berrow, S.D., Hickey, R., O’Brien, J. O’Connor, I. and McGrath, D. (2008) Habour Porpoise Survey 2008. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group. pp.33

Berrow, S.D., O'Brien, J., Ryan, C., McKeogh, E. and O'Connor, I. (2011). 'Inshore boat-based surveys for cetaceans - Irish Sea'. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group, pp.24.

BirdLife International. (2004), ‘Birds in Europe: population estimates, trends and conservation status. (Birdlife Conservation Series No. 12)’, BirdLife, Cambridge.

Bishop, A., Pomeroy, P. and Twiss, S.D. (2015). 'Breeding male grey seals exhibit similar activity budgets across varying exposures to human activity'. Marine Ecology Progress Series, 527, pp.247-259.

Bodznick D. and Preston, D.G., 1983. Physiological characterization of electroreceptors in the lampreys Ichthyomyzon unicuspis and Petromyzon marinus. Journal of Comparative Physiology 152: 209-217.

Bodznick, D. and Northcutt, R.G., 1981. Electroreception in lampreys: Evidence that the earliest vertebrates were electroreceptive. Science 212(4493): 465-467.

Booth, C. and Heinis, F. (2018). Updating the Interim PCoD Model: Workshop Report -New transfer functions for the effects of permanent threshold shifts on vital rates in marine mammal species. 10.13140/RG.2.2.12135.32162.

Booth, C. G., F. Heinis, and H. J. 2019. Updating the Interim PCoD Model: Workshop Report - New transfer functions for the effects of disturbance on vital rates in marine mammal species. Report Code SMRUC-BEI-2018-011, submitted to the Department for Business, Energy and Industrial Strategy (BEIS), February 2019 (unpublished)

Bradbury, G., Trinder, M., Furness, B., Banks, A. N., Caldow, R. W. and Hume, D. (2014). Mapping seabird sensitivity to offshore wind farms. PloS one, 9(9): 106366.

Brandt, M. J., A. Diederichs, K. Betke, and G. Nehls. 2011. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Marine Ecology Progress Series 421:205-216.

Brandt, M. J., A. Dragon, A. Diederichs, A. Schubert, V. Kosarev, G. Nehls, V. Wahl, A. Michalik, A. Braasch, C. Hinz, C. Katzer, D. Todeskino, M. Gauger, M. Laczny, and W. Piper. 2016. Effects of offshore pile driving on harbour porpoise abundance in the German Bight. Report prepared for Offshore Forum Windenergie.

Brandt, M. J., A.-C. Dragon, A. Diederichs, M. A. Bellmann, V. Wahl, W. Piper, J. Nabe-Nielsen, and G. Nehls. 2018. Disturbance of harbour porpoises during construction of the first seven offshore wind farms in Germany. Marine Ecology Progress Series 596:213-232.

Brooke, M. (1990). The Manx Shearwater. Poyser, London.

BTO. (2023), Avian Influenza, Available at: https://www.bto.org/understanding-birds/avian-influenza, [Accessed August 2023].

Buckingham, L., Bogdanova, M.I., Green, J.A., Dunn, R.E., Wanless, S., Bennett, S., Bevan, R.M., Call, A., Canham, M., Corse, C.J. and Harris, M.P., (2022). Interspecific variation in non-breeding aggregation: a multi-colony tracking study of two sympatric seabirds. Marine Ecology Progress Series, 684, 181-197.

Burger, J., Gochfeld, M., Kirwan, G. M., Christie, D. and Garcia, E. (2020). Black-headed gull (Chroicocephalus ridibundus), version 1.0. In Birds of the Worlds. Cornell Lab of Ornithology, Ithaca, NY, USA.

Carroll, M.J., Wakefield, E.D., Scragg, E.S., Owen, E., Pinder, S., Bolton, M., Waggitt, J.J. and Evans, P.G., (2019). Matches and mismatches between seabird distributions estimated from at-sea surveys and concurrent individual-level tracking. Frontiers in Ecology and Evolution, .333.

Carter, M. I. D., L. Boehme, M. A. Cronin, C. D. Duck, W. J. Grecian, G. D. Hastie, M. Jessopp, J. Matthiopoulos, B. J. McConnell, D. L. Miller, C. D. Morris, S. E. W. Moss, D. Thompson, P. M. Thompson, and D. J. F. Russell. 2022. Sympatric Seals, Satellite Tracking and Protected Areas: Habitat-Based Distribution Estimates for Conservation and Management. Frontiers in Marine Science 9.

Carter, M. I. D., L. Boehme, M. A. Cronin, C. D. Duck, W. J. Grecian, G. D. Hastie, M. Jessopp, J. Matthiopoulos, B. J. McConnell, D. L. Miller, C. D. Morris, S. E. W. Moss, D. Thompson, P. M. Thompson, and D. J. F. Russell. 2022. Sympatric Seals, Satellite Tracking and Protected Areas: Habitat-Based Distribution Estimates for Conservation and Management. Frontiers in Marine Science 9.

Carter, M., L. Boehme, C. Duck, W. Grecian, G. Hastie, B. McConnell, D. Miller, C. Morris, S. Moss, D. Thompson, P. Thompson, and D. Russell. 2020. Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal Research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78.

Carter, M., L. Boehme, C. Duck, W. Grecian, G. Hastie, B. McConnell, D. Miller, C. Morris, S. Moss, D. Thompson, P. Thompson, and D. Russell. 2020. Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal Research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78.

Cefas (2002a). Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (2nd edition). Marine Aggregate Levy Sustainability Fund, 80 pp. Available at: http://www.marbef.org/qa/documents/ConductofsurveysatMAEsites.pdf

Cefas (2004), Guidance note for Environmental Impact Assessment In respect of FEPA and CPA requirements – Version 2, Available at: https://www.ctc-n.org/sites/www.ctc-n.org/files/resources/windfarm-guidance.pdf [Accessed: February 2022]

Cefas, 2000b. Irish Sea Annual Egg Production Method (AEPM) Plankton Survey. Available online: https://data.cefas.co.uk/view/2641

Celtic Sea Trout Project (CSTP), 2016. (Milner, N., McGinnity, P. and Roche, W. Eds) Celtic Sea Trout Project - Technical Report to Ireland Wales Territorial Co-operation Programme 2007-2013

(INTERREG 4A). Dublin, Inland Fisheries Ireland. Available at: http://celticseatrout.com/downloads/technical-report/

Centre for Marine and Coastal Studies (CMACS). (2003). A baseline assessment of electromagnetic fields generated by offshore windfarm cables. COWRIE Report5 EMF – 01-2002 66.

Change in text to 2021

Chudzińska, M., K. Klementisová, C. Booth, and J. Harwood. (2024). 'Combining bioenergetics and movement models to improve understanding of the population consequences of disturbance'. Oikos:e10123.

Chudzińska, M., Klementisová, K., Booth, C., and Harwood. J. (2024). ‘Combining bioenergetics and movement models to improve understanding of the population consequences of disturbance’. Oikos:e10123.

Chung-Davidson Y.W., Bryan, M.B., Teeter, J., Bedore, C.N. and Li, W., 2008. Neuroendocrine and behavioural responses to weak electric fields in adult sea lampreys (Petromyzon marinus). Hormones and Behaviour 54(1): 34-40.

Chung-Davidson, Y.-W., Yun, S.-S., Teeter, J. and Li, W., 2004. Brain Pathways and Behavioral Responses to Weak Electric Fields in Parasitic Sea Lampreys (Petromyzon marinus). Behavioral Neuroscience 118(3), 611–619.

CMACS. (2006). Pre-construction Sub-tidal Benthic Ecology Investigation. Document: J3034 Sub-tidal Benthic Ecology v1.0.

Codling Wind Park Limited (2020). Codling Wind Park CWP-CWP-02-REP-00023 Offshore Scoping Report

Collaborative Offshore Wind Research into the Environment (COWRIE). (2005). COWRIE 1.5 The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms - A Review. (Report No. COWRIE-EM FIELD 2-06-2004).

Constantine, R., D. H. Brunton, and T. Dennis. (2004), ‘Dolphin-watching tour boats change bottlenose dolphin (Tursiops truncatus) behaviour’. Biological Conservation 117:299-307.

Cook, A. S., Humphreys, E. M., Bennet, F., Masden, E. A. and Burton, N. H. (2018). Quantifying avian avoidance of offshore wind turbines: current evidence and key knowledge gaps. Marine environmental research, 140: 278-288.

Cook, A.S. and Robinson, R.A., 2017. Towards a framework for quantifying the population-level consequences of anthropogenic pressures on the environment: the case of seabirds and windfarms. Journal of Environmental Management, 190, pp.113-121.

Cook, A.S.C.P., Humphries, E.M., Masden, E.A., and Burton, N.H.K. (2014), ‘The avoidance rates of collision between birds and offshore turbines’, BTO research Report No 656 to Marine Scotland Science

Cook, A.S.C.P., Johnston, A., Wright, L.J. and Burton, N.H. (2012). Strategic Ornithological Support Services Project SOSS-02: A review of flight heights and avoidance rates of birds in relation to offshore wind farms. British Trust for Ornithology.

Coull, K.A., Johnstone, R., and Rogers, S.I. (1998). Fisheries Sensitivity Maps in British Waters. Available online: https://www.cefas.co.uk/media/o0fgfobd/sensi_maps.pdf

Cramp S. and Simmons K.E.L. (Eds.) (1977 – 1994), ‘The Birds of the Western Palearctic’, Oxford University Press, Oxford.

Crocker, S. E., and F. D. Fratantonio. 2016. Characteristics of sounds emitted during high-resolution marine geophysical surveys. OCS Study, BOEM 2016-44, NUWC-NPT Technical Report 12.marley

Cronin M, Gerritsen H, Reid D, Jessopp M (2016). 'Spatial Overlap of Grey Seals and Fisheries in Irish Waters, Some New Insights Using Telemetry Technology and VMS'. PLOS ONE 11(9): e0160564. https://doi.org/10.1371/journal.pone.0160564

CSA Ocean Sciences Inc. 2020. Application for incidental harassment authorization for the non-lethal taking of marine mammals: site characterization surveys Lease OCS-A 0486, 0517, 0487, 0500 and Associated Export Cable Routes. Submitted to Orsted. July 2020. 89 pp.

Cudahy, E.A., & Parvin, S. (2001). The Effects of Underwater Blast on Divers.

Culloch, R. M., P. Anderwald, A. Brandecker, D. Haberlin, B. McGovern, R. Pinfield, F. Visser, M. Jessopp, and M. Cronin. 2016. Effect of construction-related activities and vessel traffic on marine mammals. Marine Ecology Progress Series 549:231-242.

Cummins, S., Lauder, C., Lauder, A. & Tierney, T. D. (2019). The Status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018. Irish Wildlife Manuals, No. 114. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Cutts, N., Hemingway, K. & Spencer, J. (2013). Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning & Construction Projects. Institute of Estuarine & Coastal Studies (IECS), University of Hull.

Cutts, N., Phelps, A. & Burdon, D. (2009) Construction and waterfowl: defining sensitivity, response impacts and guidance. Institute of Estuarine & Coastal Studies (IECS) The University of Hull.

Dahl, P.H., Keith Jenkins, A., Casper, B., Kotecki, S.E., Bowman, V., Boerger, C., Dall'Osto, D.R., Babina, M.A. and Popper, A.N., 2020. Physical effects of sound exposure from underwater explosions on Pacific sardines (Sardinops sagax). The Journal of the Acoustical Society of America, 147(4), pp.2383-2395.

Dähne, M., A. Gilles, K. Lucke, V. Peschko, S. Adler, K. Krugel, J. Sundermeyer, and U. Siebert. 2013. Effects of pile-driving on harbour porpoises (Phocoena phocoena) at the first offshore wind farm in Germany. Environmental Research Letters 8:025002.

Dalkin, M. (2008). Mid Irish Sea reefs habitat mapping report. JNCC Report, No. 411.

Davidsen, J.G., Rikardsen, A.H., Thorstad, E.B., Halttunen, E., Mitamura, H., Præbel, K., Skarðhamar, J. and Næsje, T.F., 2013. Homing behaviour of Atlantic salmon (Salmo salar) during final phase of marine migration and river entry. Canadian Journal of Fisheries and Aquatic Sciences 70(5), 794–802. https://doi.org/10.1139/cjfas-2012-0352

Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. and Vincent, M., (eds) 2001. Marine Monitoring Handbook. Joint Nature Conservation Committee, Peterborough. 405pp. https://data.jncc.gov.uk/data/ed51e7cc-3ef2-4d4f-bd3c-3d82ba87ad95/marine-monitoring-handbook.pdf

Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull., C., Vincent, M., (2001). Marine Monitoring Handbook. JNCC. Available at: http://jncc.defra.gov.uk/MarineMonitoringHandbook

DCCAE, 2017. Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects. Prepared for the Environmental Working Group of the Offshore Renewable Energy Steering Group and the Department of Communications, Climate Action and Environment. Available at: https://www.gov.ie/en/publication/3d6efb-guidance-documents-for-offshore-renewable-energy-developers/ Accessed: November 2023.

Dean, B., Freeman, R., Kirk, H., Leonard, K., Phillips, R.A., Perrins, C.M. and Guilford, T., (2013). Behavioural mapping of a pelagic seabird: combining multiple sensors and a hidden Markov model reveals the distribution of at-sea behaviour. Journal of the Royal Society Interface, 10(78): .20120570.

Deecke, V. B., Slater, P. J. and Ford, J. K. (2002), 'Selective habituation shapes acoustic predator recognition in harbour seals', Nature, 420/6912: 171-173.

Degraer, S., Brabant, R., Rumes, B., Vigin, L., Braeckman, U., Buyse, J., Courtens, W., De Backer, A., Hostens, K., Lefaible, N. And Moens, T., Attraction, Avoidance And Habitat Use At Various Spatial Scales.

Dehnhardt, G., Mauck, B., Hanke, W. and Bleckmann, H. (2001), 'Hydrodynamic trail-following in harbor seals (Phoca vitulina)', Science, 293/5527: 102-104.

Del Hoyo, J., Elliott, A. and Sargatal, J. (Eds.) (1992 – 2011), 'Handbook of the Birds of the World', Lynx Editions, Madrid.

Department of Agriculture, Environment and Rural Affairs (DAERA) (2022). 'Marine Environment: unxploded ordance clearance joint interim position statement'. Available from: https://www.gov.uk/government/publications/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement Accessed: 13th May 2024

Department of Arts, Heritage and the Gaelacht (DAHG). (2012). Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document.

Department of Arts, Heritage and the Gaelacht (DAHG). (2014). Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters.

Department of the Environment, Climate and Communications (DECC). (2017). Guidance on EIS and NIS preparation for Offshore Renewable Energy Projects.

Department of the Environment, Heritage and Local Government (DEHLG). (2009, revised 11/02/10). Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. Department of the Environment Heritage and Local Government (Ireland).

Department of the Environment, Heritage and Local Government (DEHLG). (2010). NPW 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive – Guidance for Planning Authorities.

Diederichs, A., Brandt, M. and Nehls, G. (2010). 'Does sand extraction near Sylt affect harbour porpoises?'. In book: Science for Nature Conservation and Management: The Wadden Sea Ecosystem and EU Directives. Proceedings of the 12th International Scientific Wadden Sea Symposium in Wilhelmshaven, Germany, 30 March - 3 April 2009. (pp.199-203)Edition: Wadden Sea Ecosystem No. 26. Publisher: Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Editors: Harald Marnecic, Kai Eskildsen, Hubert Farke, Stefanie Hedtkamp

Dierschke, V., Furness, R.W. and Garthe, S. (2016), Seabirds and offshore wind farms in European waters: Avoidance and attraction, Biological Conservation, 202: 59-68.

Dierschke, V., Furness, R.W., Gray, C.E., Petersen, I.K., Schmutz, J., Zydelis, R and Daunt, F., (2017) Possible behavioural, energetic and demographic effects of displacement of red-throated divers, JNCC Report 605, ISSN 0963-8901.

Dierschke, V., Garthe, S. and Mendel, B., 2006. Possible conflicts between offshore wind farms and seabirds in the German sectors of North Sea and Baltic Sea. Offshore wind energy: Research on environmental impacts, pp.121-143.

Doksæter, L., Rune Godø, O., Olav Handegard, N., Kvadsheim, P.H., Lam, F.P.A., Donovan, C. and Miller, P.J., 2009. Behavioral responses of herring (Clupea harengus) to 1-2 and 6-7kHz sonar signals and killer whale feeding sounds. The Journal of the Acoustical Society of America, 125(1), 554-564.

Drewitt, A.L. and Langston, R.H.W. (2006), 'Assessing the impacts of wind farms on birds', Ibis, 148 (Suppl. 1), 4-7.

Dublin Port (2022). About Dublin Port. Dublin: Dublin Port Company. https://www.dublinport.ie/wpcontent/uploads/2018/07/DPC_Masterplan_2040_Reviewed_2018.pdf (Accessed August 2023).

Dunlop, R. A. (2016), 'The effect of vessel noise on humpback whale, Megaptera novaeangliae, communication behaviour', Animal Behaviour, 111: 13-21.

Dunlop, R. A., M. J. Noad, R. D. McCauley, L. Scott-Hayward, E. Kniest, R. Slade, D. Paton, and D. H. Cato. 2017. Determining the behavioural dose–response relationship of marine mammals to air gun noise and source proximity. Journal of Experimental Biology 220:2878-2886.

Dunn, R.E., Wanless, S., Daunt, F. et al. A year in the life of a North Atlantic seabird: behavioural and energetic adjustments during the annual cycle. Sci Rep 10, 5993 (2020). https://doi.org/10.1038/s41598-020-62842-x

Ellis, J.R., Milligan, S., Readdy, L., South, A., Taylor, N. and Brown, M. (2010). Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones). CEFAS. MB5301, Report No 1.

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N., and Brown, M.J. (2012). Spawning and nursery grounds of selected fish species in UK waters. Science Series Technical Report. No. 147. Available online: https://www.cefas.co.uk/publications/techrep/techrep147.pdf

EMODnet. (2021). 'EMODnet Human Activities, Vessel Density Map, funded by the European Commission'. Available from: https://ows.emodnet-humanactivities.eu/geonetwork/srv/api/records/0f2f3ff1-30ef-49e1-96e7-8ca78d58a07c. Accessed: 18 October 2023.

Erbe, C., Reichmuth, C., Cunningham, K., Lucke, K. and Dooling, R. (2016), 'Communication masking in marine mammals: A review and research strategy', Marine pollution bulletin, 103/1-2: 15-38.

Erbe, C., S. A. Marley, R. P. Schoeman, J. N. Smith, L. E. Trigg, and C. B. Embling. 2019. The Effects of Ship Noise on Marine Mammals—A Review. Frontiers in Marine Science 6.

European Commission (2012) Guidelines on the implementation of the birds and habitats directives in estuaries and coastal zones – With particular attention to port development and dredging, Directorate-General for Environment, Publications Officehttps://data.europa.eu/doi/10.2779/44024

European Commission (2021) Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (2021/C 437/01) https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=uriserv:OJ.C_.2021.437.01.0001.01.ENG

European Commission. (2011), Wind Energy Developments and Natura 2000, EU guidance on wind energy development in accordance with the EU nature legislation.

EUSeaMap (2021). EMODnet broad-scale seabed habitat map of Europe. Available at: https://www.emodnet-seabedhabitats.eu/European Environment Agency (EEA) (2013), Interpretation Manual of European Union Habitats, version EUR 28, Available at: https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf [Accessed: February 2022]

Evans, P. G. H. (1990), 'Marine Mammals in the English Channel in relation to proposed dredging scheme'. Sea Watch Foundation, Oxford.

Evans, P., and J. Waggitt. 2023. Modelled Distributions and Abundance of Cetaceans and Seabirds in Wales and Surrounding Waters. NRW Evidence Report, Report No: 646, 354 pp. Natural Resources Wales, Bangor

Finneran, J. J. 2015. Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015. The Journal of the Acoustical Society of America 138:1702-1726.

Finstad, A.G., Økland, F., Thorstad, E.B. and Heggberget, T.G., 2005. Comparing upriver spawning migration of Atlantic salmon Salmo salar and sea trout Salmo trutta. Journal of Fish Biology 67(4), 919–930.

Fox, A.D., Desholm, M., Kahlert, J., Christensen, T.K. and Krag Petersen, I.B., 2006. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis, 148, pp.129-144.

Frost, M. and Diele, K., 2022. Essential spawning grounds of Scottish herring: current knowledge and future challenges. Reviews in Fish Biology and Fisheries, 32(3), 721-744.

Fugro, 2021. 'Fugro - WPM1, WPM2 & WPM3 - Main Array & ECR - Benthic Ecology Monitoring Report', Dublin Array Offshore Site Investigation, Ireland, Irish Sea.

Furness, R. W. (2015), Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS), Natural England Commissioned Reports, Number 164.

Furness, R.W. and Wade, H. (2012), Vulnerability of Scottish seabirds to offshore wind turbines, The Scottish Government, Edinburgh. Available at: http://www.scotland.gov.uk/Resource/0040/00401641.pdf [Accessed: July 2023].

Furness, R.W., Wade, H.M. and Masden, E.A., (2013). Assessing vulnerability of marine bird populations to offshore wind farms. Journal of environmental management, 119: 56-66.

Garthe, S and Hüppop, O. (2004), Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index, Journal of Applied Ecology, 41: 724-734.

Genesis. (2011), 'Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements under the Marine Strategy Framework Directive. Report for the Department of Energy and Climate Change'.

Gilbey, J., Utne, K.R., Wennevik, V., Beck, A.C., Kausrud, K., Hindar K, de Leaniz, C.G., Cherbonnel, C., Coughlan, J., Cross, T.F., Dillane, E., Ensing, D., García- Vázquez, E., Hole, L.R., Holm, M., Holst, J.C., Jacobsen, J.A., Jensen, A.J., Karlsson, S., Ó Maoiléidigh, N., Mork, K.A., Nielsen, E.E., Nøttestad, L., Primmer, C.R., Prodöhl, P., Prusov, S., Stevens, J.R., Thomas, K., Whelan, K., McGinnity, P. and Verspoor, E.2021. The early marine distribution of Atlantic salmon in the North-east Atlantic: A genetically informed stock-specific synthesis. Fish and Fisheries 22(6): 1274-1306.

Gill, A. B., Gloyne-Phillips, I., Neal, K. J. and Kimber, J. A., 2005. The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms - A Review. COWRIE 1.5 Electromagnetic Fields Review.

Gill, A.B. and Bartlett, M., 2010. Literature review on the potential effects of electromagnetic fields and subsea noise from marine renewable energy developments on Atlantic salmon, sea trout and European eel. Scottish Natural Heritage Commissioned Report No. 401.

Gilles, A., M. Authier, N. Ramirez-Martinez, H. Araújo, A. Blanchard, J. Carlström, C. Eira, G. Dorémus, C. FernándezMaldonado, S. Geelhoed, L. Kyhn, S. Laran, D. Nachtsheim, S. Panigada, R. Pigeault, M. Sequeira, S. Sveegaard, N. Taylor, K. Owen, C. Saavedra, J. Vázquez-Bonales, B. Unger, and P. Hammond. 2023. Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys.

Gillson, J.P., Bašić, T., Davison, P.I., Riley, W.D., Talks, L., Walker, A.M. and Russell, I.C., 2022. A review of marine stressors impacting Atlantic salmon Salmo salar, with an assessment of the major threats to English stocks. Reviews in Fish Biology and Fisheries, 32(3), pp.879-919.

Gittings, T., Peppiatt, C. and Troake, P., (2015). Disturbance response of Great Northern Divers Gavia immer to boat traffic in Inner Galway Bay. Irish Birds, 10(2): 163-166.

GoBe (2023). ARKLOW ENVIRONMENTAL IMPACT ASSESSMENT SCOPING REPORT. SSE Renewables. 00189. Available from: https://www.sserenewables.com/media/hlrh3zef/00189_arklow_scoping.pdf

Good, T. P., (2020). Great Black-backed Gull (Larus marinus), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

Goodship, N.M. and Furness, R.W. (2022). 'Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species'. NatureScot Research Report 1283 (MacArthur Green).

Gosch, M., G. Hernandez-Milian, E. Rogan, M. Jessopp, and M. Cronin. 2014. Grey seal diet analysis in Ireland highlights the importance of using multiple diagnostic features. Aquatic Biology 20:155-167.

Government of Ireland, 2023. DRAFT Offshore Renewable Energy Development Plan II. A National Spatial Strategy for the transition to the Enduring Regime. Department of the Environment, Climate and Communications. https://www.gov.ie/en/publication/71e36-offshore-renewable-energy-development-plan-ii-oredp-ii/ Accessed: August 2023.

Graham, I. M., E. Pirotta, N. D. Merchant, A. Farcas, T. R. Barton, B. Cheney, G. D. Hastie, and P. M. Thompson. (2017), 'Responses of bottlenose dolphins and harbor porpoises to impact and vibration piling noise during harbor construction'. Ecosphere 8.[HS1]

Graham, I. M., N. D. Merchant, A. Farcas, T. R. C. Barton, B. Cheney, S. Bono, and P. M. Thompson. 2019. Harbour porpoise responses to pile-driving diminish over time. Royal Society Open Science 6:190335.

Green, E., 2017. A literature review of the lesser (Raitt's) sandeel Ammodytes marinus in European waters. Technical Report by RSPB funded through LIFE14 NAT/UK/00394 Roseate Tern.

Greenore Port. (2023), Greenore Port, Available at: https://greenore.ie/ [Accessed: September 2023].

Guilford, T., Meade, J., Freeman, R., Biro, D., Evans, T., Bonadonna, F., Boyle, D., Roberts, S. and Perrins, C.M., 2008. GPS tracking of the foraging movements of Manx Shearwaters Puffinus puffinus breeding on Skomer Island, Wales. Ibis, 150(3), pp.462-473.

Hammond, P. S., K. MacLeod, P. Berggren, D. L. Borchers, L. Burt, A. Cañadas, G. Desportes, G. P. Donovan, A. Gilles, D. Gillespie, J. Gordon, L. Hiby, I. Kuklik, R. Leaper, K. Lehnert, M. Leopold, P. Lovell, N. Øien, C. G. M. Paxton, V. Ridoux, E. Rogan, F. Samarra, M. Scheidat, M. Sequeira, U. Siebert, H. Skov, R. Swift, M. L. Tasker, J. Teilmann, O. Van Canneyt, and J. A. Vázquez. 2013. Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation 164:107-122.

Hammond, P., C. Lacey, A. Gilles, S. Viquerat, P. Börjesson, H. Herr, K. Macleod, V. Ridoux, M. Santos, M. Scheidat, J. Teilmann, J. Vingada, and N. Øie. 2021. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys - revised June 2021.

Harding, H., Bruintjes, R., Radford, A.N. and Simpson, S.D., 2016. Measurement of Hearing in the Atlantic salmon (Salmo salar) using Auditory Evoked Potentials, and effects of Pile Driving Playback on salmon Behaviour and Physiology. Scottish Marine and Freshwater Science Vol 7 No 11.

Harris, M.P., Wanless, S., Ballesteros, M., Moe, B., Daunt, F. & Erikstad, K.E.(2015): Geolocators reveal an unsuspected moulting area for Isle of May Common Guillemots Uria aalge , Bird Study, DOI:10.1080/00063657.2015.1006164

Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. (2014), 'A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal populations'. Report Number SMRUL-TCE-2013-014. Scottish Marine And Freshwater Science, 5(2).

Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. 2014. A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal populations. Report Number SMRUL-TCE-2013-014. Scottish Marine And Freshwater Science, 5(2).

Hastings, M.C. and Popper, A.N., 2005. Effects of Sound on Fish. Final Report # CA05-0537. Project P476 Noise Thresholds for Endangered Fish. State of California Department of Transportation, Sacramento, California.

Hatch, S. A., Robertson, G. J., and Baird, P. H. (2020). Black-legged Kittiwake (Rissa tridactyla). Version 1.0, In Birds of the World. Cornell Lab of Ornithology, Ithaca, NY, USA.

Hawkins, A.D. and Johnstone, A.D.F., 1978. The hearing of the Atlantic salmon, Salmo salar. Journal of Fish Biology, 13(6), pp.655-673.

Hawkins, A.D. and Johnstone, A.D.F., 1978. The hearing of the Atlantic salmon, Salmo salar. Journal of Fish Biology, 13(6), pp.655-673.

Hawkins, A.D., Roberts, L. and Cheesman, S. (2014). Responses of free-living coastal pelagic fish to impulsive sounds. The Journal of the Acoustical Society of America 135(5): 3101-3116.

Heiler, J., Elwen, S. H., Kriesell, H. J. and Gridley, T. (2016), ‘Changes in bottlenose dolphin whistle parameters related to vessel presence, surface behaviour and group composition’, Animal behaviour, 117: 167-177.

Henry, E. and Hammill, M.O. (2001). 'Impact of small boats on the haulout activity of harbour seals (Phoca vitulina) in Metis Bay, Saint Lawrence Estuary, Quebec, Canada'. Aquatic Mammals, 27.2, 140-148.

Hermans, A. (2022). Electromagnetic fields and the Marine Strategy Framework Directive Descriptor 11 – Energy.

Hernandez-Milian, G., Santos, M. and Rogan, E. (2011). Harbour porpoise and bottlenose dolphin in Ireland: diet and interaction with fisheries. Conference: ICES Annual Science Conference At: Gdansk, Poland

HiDef Aerial Surveying Ltd. (2024). mCRM: Avian Migration Collision Risk Model. R package version 0.4.1. Available at: https://github.com/hiDef-Aerial-Surveying/mCRM.

Hildebrand, J., 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395, 5–20. https://doi.org/10.3354/meps08353

Holm, M., Holst, J.C. and Hansen, L.P., 2000. Spatial and temporal distribution of post-smolts of Atlantic salmon (Salmo salar L.) in the Norwegian Sea and adjacent areas. ICES Journal of Marine Science 57(4), 955–964. https://doi.org/10.1006/jmsc.2000.0700

Horswill, C. and Robinson R. A. (2015), ‘Review of seabird demographic rates and density dependence’, JNCC Report No. 552.

Humphreys, E. M., Cook, A. S. C. P. and Burton, N. H. (2015), ‘Collision, displacement and barrier effect concept note’, BTO Research Report, 669.

Hutchinson, C. (2010), ‘Birds in Ireland’, A& C Black.

Hutchison, Z., Secor, D. and Gill, A., 2020. The Interaction Between Resource Species and Electromagnetic Fields Associated with Electricity Production by Offshore Wind Farms. Oceanography 33(4), 96–107. https://doi.org/10.5670/oceanog.2020.409

ICES, 2022a. ICES Ecosystem Overviews. Celtic Seas ecoregion - Ecosystem Overview.

ICES, 2022b. ICES Fisheries Overviews. Celtic Seas ecoregion - fisheries overview.

ICES, 2023a. Fish trawl survey: Northern Irish Ground Fish Trawl Survey. ICES Database on Trawl Surveys (DATRAS). The International Council for the Exploration of the Sea, Copenhagen. Available at: https://datras.ices.dk Accessed: August 2023.

ICES, 2023b. Fish trawl survey: Beam Trawl Survey. ICES Database on Trawl Surveys (DATRAS). The International Council for the Exploration of the Sea, Copenhagen. Available at: https://datras.ices.dk Accessed: August 2023.

IFI, 2018. The Status of Irish Salmon Stocks in 2017 with Catch Advice for 2018. A Report of the Technical Expert Group on Salmon to the Inland Fisheries Ireland.

INFOMAR (2021). Integrated Mapping for the Sustainable Development of Ireland's Marine Resources. Available at: https://www.marine.ie/Home/site-area/areas-activity/seabed-mapping/infomar

INFOMAR, 2023. Seabed sediment particle size analysis data. Available at: https://www.marine.ie Accessed: 2023.

Iorio-Merlo, V., Fernandez-Betelu, O., Benhemma-Le Gall, A., Graham, I. M., Thompson, P.M. (2023). Task 4.2. Work Package 4 – Changes in the occurrence of harbour porpoises following the construction of Moray Firth offshore windfarms. PrePARED Report, No. 002. March 2024.

Jansen, J.K., Boveng, P.L., Ver Hoef, J.M., Dahle, S.P. and Bengtson, J.L. (2015), Natural and human effects on harbor seal abundance and spatial distribution in an Alaskan glacial fjord. Mar Mam Sci, 31: 66-89. https://doi.org/10.1111/mms.12140

Jarrett, D., Calladine, J., Cook, A.S., Upton, A., Williams, J., Williams, S., Wilson, J.M., Wilson, M.W., Woodward, I. and Humphreys, E.M., (2022). Behavioural responses of non-breeding waterbirds to marine traffic in the near-shore environment. Bird Study, 68(4): 443-454.

Jarrett, D., Cook, A.S.C.P., Woodward, I., Ross, K., Horswill, C., Dadam, D. and Humphreys, E.M., (2018). Short-term behavioural responses of wintering waterbirds to marine activity. Scottish Marine and Freshwater Science, 9(7).

Jessopp, M., Mackey, M., Luck, C., Critchley, E., Bennison, A, and Rogan, E. (2018) The seasonal distribution and abundance of seabirds in the western Irish Sea. Department of Communications, Climate Action and Environment, and National Parks & Wildlife Service, Department of Culture, Heritage & the Gaeltacht, Ireland. 90.

Jessopp, M., Mackey, M., Luck, C., Critchley, E., Bennison, A, and Rogan, E. (2018), 'The seasonal distribution and abundance of seabirds in the western Irish Sea. Department of Communications',Climate Action and Environment, and National Parks & Wildlife Service, Department of Culture, Heritage & the Gaeltacht, Ireland. 90pp

JNCC (2010). JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. JNCC, Aberdeen.

JNCC. 2020. Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). Report No. 654, JNCC, Peterborough.

Johnston, A., Cook, A. S. C. P., Wright, L. J., Humphreys, E. M. and Burton, E. H. K. (2014), 'Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines', Journal of Applied Ecology, 51, 31-41

Jones, E., G. Hastie, S. Smout, J. Onoufriou, N. D. Merchant, K. Brookes, and D. Thompson. 2017. Seals and shipping: quantifying population risk and individual exposure to vessel noise. Journal of Applied Ecology 54:1930-1940.

Kaiser, M.J., Galanidi, M., Showler, D.A., Elliot, A.J., Caldow, R.W.G., Rees, E.I.S., Stillman, R.A. & Sutherland, W.J. (2006). Distribution and behaviour of Common Scoter Melanitta nigra relative to prey resources and environmental parameters. Ibis, 148, 110-128.

Kaiser, M.J., Galanidi, M., Showler, D.A., Elliot, A.J., Caldow, R.W.G., Rees, E.I.S., Stillman, R.A. & Sutherland, W.J. (2006). Distribution and behaviour of Common Scoter Melanitta nigra relative to prey resources and environmental parameters. Ibis, 148, 110-128.

Karpovich, S., Skinner, J., Mondragon, J. and Blundell, G. (2015). 'Combined physiological and behavioral observations to assess the influence of vessel encounters on harbor seals in glacial fjords of southeast Alaska'. Journal of Experimental Marine Biology and Ecology. 473. 110-120. 10.1016/j.jembe.2015.07.016.

Kastelein, R. A., L. Helder-Hoek, J. Covi, and R. Gransier. 2016. Pile driving playback sounds and temporary threshold shift in harbour porpoises (Phocoena phocoena): Effect of exposure duration. The Journal of the Acoustical Society of America 139:2842-2851.

Kastelein, R. A., L. Helder-Hoek, S. Van de Voorde, A. M. von Benda-Beckmann, F.-P. A. Lam, E. Jansen, C. A. de Jong, and M. A. Ainslie. 2017. Temporary hearing threshold shift in a harbour porpoise (Phocoena phocoena) after exposure to multiple airgun sounds. The Journal of the Acoustical Society of America 142:2430-2442.

Kastelein, R. A., R. Gransier, and L. Hoek. 2013a. Comparative temporary threshold shifts in a harbour porpoise and harbour seal, and severe shift in a seal (L). Journal of the Acoustical Society of America 134:13-16.

Kastelein, R. A., R. Gransier, L. Hoek, A. Macleod, and J. M. Terhune. 2012b. Hearing threshold shifts and recovery in harbour seals (Phoca vitulina) after octave-band noise exposure at 4 kHz. Journal of the Acoustical Society of America 132:2745-2761.

Kastelein, R. A., R. Gransier, L. Hoek, and C. A. de Jong. 2012a. The hearing threshold of a harbour porpoise (Phocoena phocoena) for impulsive sounds (L). Journal of the Acoustical Society of America 132:607-610.

Kastelein, R. A., R. Gransier, L. Hoek, and M. Rambags. 2013b. Hearing frequency thresholds of a harbour porpoise (Phocoena phocoena) temporarily affected by a continuous 1.5 kHz tone. Journal of the Acoustical Society of America 134:2286-2292.

Kastelein, R. A., R. Gransier, M. A. T. Marijt, and L. Hoek. 2015a. Hearing frequency thresholds of harbour porpoises (Phocoena phocoena) temporarily affected by played back offshore pile driving sounds. The Journal of the Acoustical Society of America 137:556-564.

Kastelein, R. A., S. Van de Voorde, and N. Jennings. (2018), 'Swimming Speed of a Harbor Porpoise (Phocoena phocoena) During Playbacks of Offshore Pile Driving Sounds'. Aquatic Mammals 44:92-99.

Kavanagh, A. S., M. A. Cronin, M. Walton, and E. Rogan. 2010. Diet of the harbour seal (Phoca vitulina vitulina) in the west and south-west of Ireland. Journal of the Marine Biological Association of the United Kingdom 90:1517-1527.

Kavanagh, A. S., M. A. Cronin, M. Walton, and E. Rogan. 2010. Diet of the harbour seal (Phoca vitulina vitulina) in the west and south-west of Ireland. Journal of the Marine Biological Association of the United Kingdom 90:1517-1527.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. and Cassidy, D., 2011. Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beuker, D. & Dirksen, S. (2011), 'Effect Studies Offshore Wind Farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds', Bureau Waardenburg Report No 10-219.

La Manna, G., Manghi, M., Pavan, G., Lo Mascolo, F. and Sarà, G. (2013), Behavioural strategy of common bottlenose dolphins (Tursiops truncatus) in response to different kinds of boats in the waters of Lampedusa Island (Italy). Aquatic Conserv: Mar. Freshw. Ecosyst., 23: 745-757. https://doi.org/10.1002/aqc.2355

Lacey, C., A. Gilles, P. Börjesson, H. Herr, K. Macleod, V. Ridoux, M. Santos, M. Scheidat, J. Teilmann, S. Sveegaard, J. Vingada, S. Viquerat, N. Øien, and P. Hammond. 2022. Modelled density surfaces of cetaceans in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. (2001). Collisions between ships and whales. Marine Mammal Science 17: 35-75.

Langston, R.H.W. (2010), ‘Offshore wind farms and birds: Round 3 zones, extensions to Round 1 and Round 2 sites and Scottish Territorial Waters’, RSPB Research Report No. 39. RSPB, Sandy.

Lavers, J.; Hipfner, J. M.; G. Chapdelaine, G. (2020). Razorbill (Alca torda), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA

Leopold, M. F., R. S. A. van Bemmelen & A. Zuur, (2013). Responses of local birds to the offshore wind farms PAWP and OWEZ off the Dutch mainland coast. Report C151/12, Imares, Texel.

Leopold, M.F. and Verdaat, H.J.P. (2018), ‘Pilot field study: observations from a fixed platform on occurrence and behaviour of common guillemots and other seabirds in offshore wind farm Luchterduinen (WOZEP Birds-2)’, Wageningen Marine Research Report C068/18.

Lester, S.E., Halpern, B., Grorud-Colvert, K., Lubchenco, J., (2009). Biological effects within no-time marine reserves: A global synthesis. Marine Ecology Progress Series, 384, pp33-46.

Lusseau, D. 2003. Male and female bottlenose dolphins Tursiops spp. have different strategies to avoid interactions with tour boats in Doubtful Sound, New Zealand. Marine Ecology Progress Series 257:267-274.

Lusseau, D. 2006. The short - term behavioural reactions of bottlenose dolphins to interactions with boats in Doubtful Sound, New Zealand. Marine Mammal Science 22:802-818.

MacArthur Green and Royal Haskoning DHV. (2021), Displacement of red throated divers in the Outer Thames Estuary SPA –Deadline 6 Update, MacArthur Green and Royal Haskoning DHV report for East Anglia ONE North Limited and East Anglia TWO Limited.

MacArthur Green. (2019), Norfolk Vanguard Offshore Wind Farm Offshore Ornithology Environmental Statement Volume 1, MacArthur Green report for Norfolk Vanguard Limited.

MacArthur Green. (2021), Beatrice Offshore Wind Farm- Year 2 Post-construction Ornithological Monitoring Report. MacArthur Green report for Beatrice Offshore Wind Farm.

Mackie, A. S. Y. (1990). Offshore Benthic Communities of the Irish Sea. The Irish Sea: An Environmental Review. Part 1, 169-218.

Maclean, I. M. D., Wright, L. J., Showler, D. A. and Rehfisch, M. M. (2009), A Review of Assessment Methodologies for Offshore Windfarms, (Thetford: British Trust for Ornithology).

Maitland, P.S., 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

Malme, C., P. Miles, C. Clark, P. Tyack, and J. Bird. 1984. Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior—Phase II. U-S. Department of the Interior Minerals Management Service.

Marine Institute (2019). Distribution of Coastal Habitats in Ireland 2013-2018. Available at: https://data.marine.ie/geonetwork/srv/eng/catalog.search#/metadata/ie.marine.data:dataset.3993

Marine Institute, 2009. Cruise Report, Irish Sea Marine Assessment ISMA. Available at: https://www.ucc.ie/en/media/research/marinegeo/mgpdfs/CruiseReport_Final_ISMA.pdf

Marine Institute, 2013. Article 6 Assessment of Fisheries, including a Fishery Natura Plan for Seed Mussel (2013-2017), in the Irish Sea.

Marine Institute, 2016. Ireland’s Marine Atlas. Available at: https://atlas.marine.ie/ Accessed: July 2023.

Marine Institute, 2022. The Stock Book 2022: Annual Review of Fish Stocks in 2022 with Management Advice for 2022. Marine Institute, Galway, Ireland.

Marley, S.A., Salgado Kent, C.P., Erbe, C. and Parnum, I. (2017). 'Effects of vessel traffic and underwater noise on the movement, behaviour and vocalisations of bottlenose dolphins in an urbanised estuary'. Sci Rep 7, 13437. https://doi.org/10.1038/s41598-017-13252-z

Masden, E.A., 2015. Developing an avian collision risk model to incorporate variability and uncertainty, Edinburgh.

McGregor R.M., King S., Donovan C. R., Caneco B., Webb A. (2018). A Stochastic Collision Risk Model for Seabirds in Flight. Report to Marine Scotland, https://www.gov.scot/publications/stochastic-collision-risk-model-for-seabirds-in-flight/ [Accessed: July 2023]

McHuron, E.A., Costa, D.P., Schwarz, L. and Mangel, M. (2017), State-dependent behavioural theory for assessing the fitness consequences of anthropogenic disturbance on capital and income breeders. Methods Ecol Evol, 8: 552-560. https://doi.org/10.1111/2041-210X.12701

McQueen, A. D., B. C. Suedel, C. de Jong, and F. Thomsen. (2020), 'Ecological risk assessment of underwater sounds from dredging operations'. Integrated environmental assessment and management 16:481-493.

Meade, R., O'Brien, J. and Berrow, S.D. (2017). 'Greater Dublin Drainage Project, Co. Dublin. Report on Marine Mammal Surveys. Available from: https://www.water.ie/planning-sites/greater-dublin-drainage/docs/environmental-documents/volume-3b/Appendix%20A9.2%20Marine%20Mammal%20Survey%20Investigation.pdf

Mendel, B., Kotzerka, J., Sommerfeld, J., Schwemmer, H., Sonntag, N., Garthe, S. (2014). Effects of the alpha ventus offshore test site on distribution patterns, behaviour and flight heights of seabirds. In: Ecological Research at the Offshore Windfarm Alpha Ventus. Springer Fachmedien, Wiesbaden, pp. 95–110.

Mendel, B., Schwemmer, P., Peschko, V., Müller, S., Schwemmer, H., Mercker, M. and Garthe, S., (2019). Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of environmental management, 231: 429-438.

Mickle, M.F., Miehls, S.M., Johnson, N.S. and Higgs, D.M., 2019. Hearing capabilities and behavioural response of sea lamprey (Petromyzon marinus) to low-frequency sounds. Canadian Journal of Fisheries and Aquatic Sciences, 76(9), pp.1541-1548.

MIG-Birds, (2022). Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm (OWF) developments. Marine Industry Group for ornithology.

Millane, M., Fitzgerald, C., Kennedy, R., Maxwell, H., McLean, S., Barry J. and Gargan, P., 2023. The Status of Irish Salmon Stocks in 2022 with Catch Advice for 2023. Report of the Technical Expert Group on Salmon (TEGOS) to the North-South Standing Scientific Committee for Inland Fisheries. 55 pp.

MMO (2014). Review of post-consent offshore wind farm monitoring data associated with licence conditions. A report produced for the Marine Management Organisation, pp 194. MMO Project No: 1031. ISBN: 978-1-909452-24-4.

Morris, C., and C. Duck. 2019. Aerial thermal-imaging survey of seals in Ireland 2017 to 2018. National Parks and Wildlife Service. Department of Culture, Heritage and the Gaeltacht, 2019-10, Irish wildlife manuals, No.111, 2019.

Moskoff, W., Bevier, L. R.; Rasmussen, P. C. (2021). Common Gull (Larus canus), version 1.1. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

Natural England and JNCC., (2012). Joint Natural England and JNCC Interim Advice Note – Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation of Offshore Wind farm Developments.

Natural England. (2020), 'Natural England's comments in relation to the Norfolk Boreas updated ornithological assessment', submitted at Deadline 2 [REP2-035]. The Inspectorate Ref REP4-040.

Natural England. (2022), Natural England interim advice on updated Collision Risk Modelling parameters (July 2022).

Natural Power Consultants Ltd. (2022) NISA Benthic Ecology Baseline Cable Route Benthic Survey Report.

Natural Power Consultants Ltd. (2023) NISA Benthic Ecology Baseline Array Area Benthic Survey Report.

NatureScot (2023a), Guidance Note 11: Guidance to support Offshore Wind Applications: Marine Ornithology - Recommendations for Seabird Population Viability Analysis (PVA), January 2023.

NatureScot. (2023c), Guidance Note 8: Guidance to support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds, January 2023.

Nedwell, J. and Edwards, B., 2004. A review of the measurements of underwater manmade noise carried out by Subacoustech Ltd 1993-2003. Southampton; Subacoustech 134.

Nedwell, J. and Howell. D. (2004) A review of offshore windfarm related underwater noise sources. (Report No. 544 R 0308). Report by Subacoustech Ltd. Report for The Crown Estate.

Nedwell, J., J. Langworthy, and D. Howell. 2003. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Subacoustech Report ref: 544R0423, published by COWRIE.

New, L. F., J. Harwood, L. Thomas, C. Donovan, J. S. Clark, G. Hastie, P. M. Thompson, B. Cheney, L. Scott‐Hayward, and D. Lusseau. (2013), 'Modelling the biological significance of behavioural change in coastal bottlenose dolphins in response to disturbance'. Functional Ecology 27:314-322.

Newton, S.F. and Crowe, O., (2000). Roseate terns-the natural connection.

Nilsson, L. and Green, M., (2011). Birds in southern Öresund in relation to the windfarm at.

NMFS. 2018. Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. Page 167. U.S. Department of Commerce, NOAA, Silver Spring.

NMPF, 2019. National Marine Planning Framework SEA Environmental Report. Available at: https://assets.gov.ie/109184/f1b35f41-3cf9-44e1-931a-481f22641821.pdf Accessed: 2023.

NOAA. 2005. Endangered Fish and Wildlife; Notice of Intent to Prepare an Environmental Impact Statement., Federal Register 70: 1871-1875.

Norfolk Vanguard Ltd (2019) The Applicant Responses to First Written Questions Appendix 3.3 Operational Auk and Gannet Displacement: update and clarificationhttps://infrastructure.planninginspectorate.gov.uk/wpcontent/ipc/uploads/projects/EN010079/EN010079-002249-Womble%20Bond%20Dickinson%20on%20Behalf%20of%20Norfolk%20Vanguard%20-%20Appendices%20to%20written%20Questions-%20Email%204.pdf

Normandeau Associates, Exponent, Tricas, T. and Gill A, 2011. Effects of EMFs From Undersea Power Cables On Elasmobranchs and Other Marine Species. U.S. Department of Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

North Irish Sea Array Windfarm Limited. 2024. Screening for Appropriate Assessment.

Nowacek, S. M., R. S. Wells, and A. R. Solow. 2001. Short‐term effects of boat traffic on bottlenose dolphins, Tursiops truncatus, in Sarasota Bay, Florida. Marine Mammal Science 17:673-688.

NPWS (2012a). Conservation objectives supporting document - Marine Habitats: Baldoyle Bay SAC (site code: 199). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2012b) Conservation objectives for Boyne Coast and Estuary SAC (site code: 1957). Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013a). Conservation objectives supporting document - Marine Habitats and Species: Rockabill to Dalkey Island SAC (site code: 3000). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013b) Conservation objectives for Rockabill to Dalkey Island SAC (site code: 3000) Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013c) Rockabill to Dalkey Island SAC Site Synopsis (site code:3000). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013d) Rockabill to Dalkey Island SAC Standard Data Form [003000]. [Online] URL: https://www.npws.ie/sites/default/files/protected-sites/natura2000/NF003000.pdf [Accessed May 2023]

NPWS (2013e) Conservation objectives for North Dublin Bay SAC (site code: 206). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013f). Conservation objectives supporting document - Marine Habitats: North Dublin Bay SAC (site code: 0206). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013g). Conservation objectives supporting document - Marine Habitats: Malahide Estuary SAC (site code: 0205). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013h) Conservation objectives for Malahide Estuary SAC (site code: 0205). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013i) Conservation objectives supporting document Malahide Estuary SPA (site code: 4025). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013j) Conservation objectives for Rogerstown Estuary SAC (site code: 0208). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013k) Conservation objectives for Lambay Island SAC (site code: 0204) Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2014) Lambay Island SPA Site Synopsis (site code:4069). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht .

NPWS (2015a) Conservation objectives for South Dublin Bay and River Tolka Estuary SPA (site code: 4024). Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015b) South Dublin Bay SAC Standard Data Form [000210]. [online] URL: https://www.npws.ie/sites/default/files/protected-sites/natura2000/NF000210.pdf. [Accessed May 2023]

NPWS (2015c) South Dublin Bay and River Tolka Estuary SPA Site Synopsis (site code: 4024). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2015d) South Dublin Bay and River Tolka Estuary Data Form[004024]. [online] URL: https://www.npws.ie/sites/default/files/protected-sites/natura2000/

Ó Cadhla, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Lyons, D. & Hiby, A.R. (2007). An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. Irish Wildlife Manuals No. 34. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

O'Brien, J. and Berrow, S.D. (2016). Harbour porpoise surveys in Rockabill to Dalkey Island SAC, 2016. Report to the National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Irish Whale and Dolphin Group. pp. 23.

O'Sullivan, D., O'Keefe, E., Berry, A., Tully, O., and Clarke, M., 2013. An Inventory of Irish Herring Spawning Grounds. Irish Fisheries Bulletin No. 42: Marine Institute.

Oakley, J. A., A. T. Williams, and T. Thomas. (2017), 'Reactions of harbour porpoise (Phocoena phocoena) to vessel traffic in the coastal waters of South West Wales, UK'. Ocean & Coastal Management 138:158-169.

Office of the Planning Regulator (OPR) (2021), 'Appropriate Assessment Screening for Development Management'. https://www.opr.ie/wp-content/uploads/2021/03/9729-Office-of-the-Planning-Regulator-Appropriate-Assessment-Screening-booklet-15.pdf [Accessed: January 2024]

Öhman, M.C., Sigray, P. and Westerberg, H., 2007. Offshore Windmills and the Effects of Electromagnetic Fields on Fish. AMBIO: A Journal of the Human Environment 36(8), 630–633.

Orsted. (2018), 'Hornsea Three Offshore Wind Farm Environmental Statement', Volume 2 Chapter 5 Offshore Ornithology.

OSPAR. 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment. Report 441:2009.

Ozsanlav-Harris, L., Inger, R. & Sherley, R. (2023). Review of data used to calculate avoidance rates for collision risk modelling of seabirds. JNCC Report 732, JNCC, Peterborough, ISSN 0963-8091.

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022c), Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications, Natural England. Version 1.2., 140.

Paruk, J. D., Evers, D. C.; McIntyre, J. W.; Barr, J. F.; Mager, J.; Piper, W. H. (2021), 'Common Loon (Gavia immer)', version 2.0. In Birds of the World (P. G. Rodewald and B. K. Keeney, Editors), Cornell Lab of Ornithology, Ithaca, NY, USA

Pena, H. Handegard, N.O. and Ona, E., 2013. Feeding herring schools do not react to seismic air gun surveys. ICES Journal of Marine Science, 70(6), 1174-1180.

Pennycuick, C.J (1987). Flight of auks (Alcidae) and other northern seabirds compared with southern Procellariiformes: ornithodolite observations. Journal of Experimental Biology 128: 335-347.

Percival, S. and Ford, J., (2018). Kentish Flats Offshore Wind Farm Extension: Ornithological Survey Annual Report, October 2016–March 2017 (Post-Construction).

Percival, S., 2013. Thanet Offshore Wind Farm Ornithological Monitoring 2012–2013. Vattenfall & Royal Haskoning.

Perrow, M., Harwood, A., Berridge, R., Burke, B., Newton, S. and Piec, D., (2019). Foraging and chick-provisioning ecology of Roseate Terns breeding at Rockabill. British Birds, 112(9): 496-516.

Perrow, M.R., Skeate, E.R., Gilroy, J.J. (2011), 'Visual tracking from a rigid-hulled inflatable boat to determine foraging movements of breeding terns', Journal of Field Ornithology 82: 68-79.

Peschko, V., Mendel, B., Mueller, S., Markones, N., Mercker, M. and Garthe, S. (2020), Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season, Marine Environmental Research, 162.

Petersen, I.K., Christensen, T.K., Kahlert, J., Desholm, M. and Fox, A.D., (2006). Final results of bird studies at the offshore wind farms at Nysted and Horns Rev. Denmark. Commissioned by DONG energy and Vattenfall A/S NERI/ministry of environment NERI Report, (161).

Petersen, I.K., Nielsen, R.D., Mackenzie, M.L., (2014). Post-Construction Evaluation of Bird Abundances and Distributions in the Horns Rev 2 offshore Wind Farm Area, 2011 and 2012. Aarhus University, Aarhus.

Peterson, I.K. and Fox, A.D. (2007), 'Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter', Report, Vattenfall A/S, National Environmental Research Institute

Phillips, R.A., Petersen, M.K., Lilliendahl, K., Solmundsson, J., Hamer, K.C., Camphuysen, C.J. and Zonfrillo, B., (1999). Diet of the northern fulmar Fulmarus glacialis: reliance on commercial fisheries?. Marine Biology, 135: 159-170.

Pine, M. K., Schmitt, P., Culloch, R. M., Lieber, L. and Kregting, L. T. (2019), ‘Providing ecological context to anthropogenic subsea noise: Assessing listening space reductions of marine mammals from tidal energy devices’, Renewable and Sustainable Energy Reviews, 103: 49-57.

Pirotta, E., B. E. Laesser, A. Hardaker, N. Riddoch, M. Marcoux, and D. Lusseau. 2013. Dredging displaces bottlenose dolphins from an urbanised foraging patch. Marine Pollution Bulletin 74:396-402

Pirotta, E., C. G. Booth, D. P. Costa, E. Fleishman, S. D. Kraus, D. Lusseau, D. Moretti, L. F. New, R. S. Schick, and L. K. Schwarz. (2018). 'Understanding the population consequences of disturbance'. Ecology and Evolution.

Pirotta, E., Merchant, N. D., Thompson, P. M., Barton, T. R. and Lusseau, D. (2015), ‘Quantifying the effect of boat disturbance on bottlenose dolphin foraging activity’, Biological Conservation, 181: 82-89.

Pirotta, E., R. S. Schick, P. K. Hamilton, C. M. Harris, J. Hewitt, A. R. Knowlton, S. D. Kraus, E. Meyer‐Gutbrod, M. J. Moore, and H. M. Pettis. (2023). 'Estimating the effects of stressors on the health, survival and reproduction of a critically endangered, long‐lived species'. Oikos:e09801.

Piwetz, S. (2019), ‘Common bottlenose dolphin (Tursiops truncatus) behavior in an active narrow seaport’. PLoS ONE.

Plantalech Manel‐La, N., Thorstad, E.B., Davidsen, J.G., Økland, F., Sivertsgård, R., Mckinley, R.S. and Finstad, B., 2009. Vertical movements of Atlantic salmon post‐smolts relative to measures of salinity and water temperature during the first phase of the marine migration. Fisheries Management and Ecology 16(2), 147–154.

Pollock, C.M., Reid, J.B., Webb, A. &and Tasker, M.L. (1997), ‘The distribution of seabirds and cetaceans in the waters around Ireland’, JNCC Report, No. 267

Popper, A.N. and Fay, R.R., 2011. Rethinking sound detection by fishes. Hearing research, 273(1-2), pp.25-36.

Popper, A.N. and Hawkins, A.D., (2019). An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology 94: 692-713.

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T, Gentry, R.I., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N., 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. New York, Springer. [Online] URL: https://www.researchgate.net/publication/279347068_Sound_Exposure_Guidelines [Accessed February 2024].

Power, A.; O’Connor, I.; Tierney, T.D., (2022). Spatial utilisation of marine areas as foraging resources for Roseate and Common Terns at Rockabill SPA. Unpublished report by NPWS and ATU.

Putland, R.L., Montgomery, J.C. and Radford, C.A., 2019. Ecology of fish hearing. Journal of Fish Biology 95(1), 39–52.

Ridge, K., Jones, C., Jones, G. & Kean, G. (2019). Norfolk Vanguard Offshore Wind Farm Examing Authority’s Report of Findings and Conclusions and Recommendations to the Secretary of State for Business, Energy and Industrial Strategy

Robinson, R.A. (2005), ‘Bird Facts: profiles of birds occurring in Britain and Ireland’, BTO Research Report 407, BTO, Thetford.

Robinson, S. P., L. Wang, S.-H. Cheong, P. A. Lepper, J. P. Hartley, P. M. Thompson, E. Edwards, and M. Bellmann. (2022), ‘Acoustic characterisation of unexploded ordnance disposal in the North Sea using high order detonations’. Marine Pollution Bulletin 184:114178.

Rogan, E., P. Breen, M. Mackey, A. Cañadas, M. Scheidat, S. Geelhoed, and M. Jessopp. 2018. Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp.

Rojano-Doñate, L., B. I. McDonald, D. M. Wisniewska, M. Johnson, J. Teilmann, M. Wahlberg, J. Højer-Kristensen, and P. T. Madsen. 2018. High field metabolic rates of wild harbour porpoises. Journal of Experimental Biology 221:jeb185827.

Rojano-Donate, L., McDonald, B.I., Wisniewska, D.M., Johnson, M., Teilmann J., Wahlberg, M., Hojer-Kristensen, J. and Madsen, P. (2018). 'High field metabolic rates of harbour porpoises'. Journal of Experimental Biology, 221. doi: 10.1242/jeb.185827 **note this references contains special characters that excel won't show

RoyalHaskoningDHV, (2020). Review of Kittiwake Flight Speed for use in Collision Risk Modelling. Document Reference: ExA.AS-5.D5.V1

Russell, D. J., G. D. Hastie, D. Thompson, V. M. Janik, P. S. Hammond, L. A. Scott ‐ Hayward, J. Matthiopoulos, E. L. Jones, and B. J. McConnell. 2016. Avoidance of wind farms by harbour seals is limited to pile driving activities. Journal of Applied Ecology 53:1642-1652.

Salomons, E. M., B. Binnerts, K. Betke, and A. M. v. Benda-Beckmann. 2021. Noise of underwater explosions in the North Sea. A comparison of experimental data and model predictions. The Journal of the Acoustical Society of America 149:1878-1888.

Schaffeld, T., Ruser, A., Woelfing, B., Baltzer, J., Kristensen, J. H., Larsson, J., Schnitzler, J. G. and Siebert, U. (2019), ‘The use of seal scarers as a protective mitigation measure can induce hearing impairment in harbour porpoises’, The Journal of the Acoustical Society of America, 146/6: 4288-4298.

Schulte-Pelkum, N., Wieskotten, S., Hanke, W., Dehnhardt, G. and Mauck, B. (2007), ‘Tracking of biogenic hydrodynamic trails in harbour seals (Phoca vitulina)’, Journal of Experimental Biology, 210/5: 781-787.

Schwemmer, P., Mendel, B., Sonntag, N., Dierschke, V. and Garthe, S., (2011). Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications, 21(5), pp.1851-1860.

SEAI, 2010. Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDP) in the Republic of Ireland, Environmental Report Volume 4: Appendices. https://www.gov.ie/en/publication/e13f49-offshore-renewable-energy-development-plan/ Accessed: August 2023.

SEAMARCO (2011), ‘Temporary hearing threshold shifts and recovery in a harbor porpoise and two harbor seals after exposure to continuous noise and playbacks of pile driving sounds’ SEAMARCO Ref: 2011/01.

Skaret, G., Axelsen, B.E., Nøttestad, L., Fernö, A. and Johannessen, A., 2005. The behaviour of spawning herring in relation to a survey vessel. ICES Journal of Marine Science 62(6): 1061-1064.

Skaret, G., Axelsen, B.E., Nøttestad, L., Fernö, A. and Johannessen, A., 2005. The behaviour of spawning herring in relation to a survey vessel. ICES Journal of Marine Science, 62(6), 1061-1064.

Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S. & Ellis, I. (2018). ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust. 247.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. J. Greene, D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33:411-414.

Southall, B., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. Nowacek, and P. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45:125-232.

Spivey, R.J., Stansfield, S. and Bishop, C.M., (2014). Analysing the intermittent flapping flight of a Manx Shearwater, Puffinus puffinus, and its sporadic use of a wave-meandering wing-sailing flight strategy. Progress in Oceanography, 125, 62-73.

SPR (Scottish Power Renewables) (2019). East Anglia ONE North Offshore Windfarm. Chapter 12 Ornithology. Preliminary Environmental Information Volume 1. Document Reference: EA1N-DEVWF-ENV-REP-IBR-000281.SPR, 2019;

Stenberg, C., Støttrup, J.G., van Deurs, M., Berg, C.W., Dinesen, G.E., Mosegaard, H., Grome, T.M. and Leonhard, S.B., (2015). Long-term effects of an offshore wind farm in the North Sea on fish communities. Marine Ecology Progress Series, 528, 257-265.

Stone, C. J., K. Hall, S. Mendes, and M. L. Tasker. (2017), ‘The effects of seismic operations in UK waters: analysis of Marine Mammal Observer data’. Journal of Cetacean Research and Management 16:71-85.

Stone, C.J. Webb, A., Barton, C., Ratcliffe, N., Reed, T.C. Tasker, M.L. Camphuysen, C.J. and Pienkowski, M.W. (1995), ‘An atlas of seabird distribution in north-west European waters’, JNCC, Peterborough.

Tech Works Marine (2013). Greater Dublin Drainage Scheme: Hydrographic Survey Report GEO13_GDD. Available at: https://assets.gov.ie/109918/2501a74e-c4af-48a9-a598-44d9026d7355.pdf

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. and Burton, N.H.K. (2012), ‘Seabird foraging ranges as a preliminary tool for identifying Marine Protected Areas’,Biological Conservation, 156, 53-61.

The Marine Management Organisation (MMO) (2015). Modelled Mapping of Continuous Underwater Noise Generated by Activities. A report produced for the Marine Management Organisation, pp 50. MMO Project No: 1097. ISBN: 978-1-909452-87-9

Thompson, D.L., Duckworth, J., Ruffino, L., Johnson, L., Lehikoinen, P., Okill, D., Petersen, A., Petersen, I.K., Väisänen, R., Williams, J., William, S., Green, J., Daunt, F. & O’Brien, S. 2023. Red-Throated Diver Energetics Project: Final Report. JNCC Report 736, JNCC Peterborough, ISSN 0963-8091.

Thompson, F., S. R. McCully, D. Wood, F. Pace, and P. White. (2009), ‘A generic investigation into noise profiles of marine dredging in relation to the acoustic sensitivity of the marine fauna in UK waters with particular emphasis on aggregate dredging: PHASE 1 Scoping and review of key issues., MALSF’.

Tillin, H. & Tyler-Walters, H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 2 Report – Literature review and sensitivity assessments for ecological groups for circalittoral and offshore Level 5 biotopes. JNCC Report No. 512B, 260 pp.

Tillin, H.M. 2015. Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the

United Kingdom. [cited 11-02-2022]. Available from: https://www.marlin.ac.uk/habitat/detail/1026.

Todd, N. R. E., M. Cronin, C. Luck, A. Bennison, M. Jessopp, and A. S. Kavanagh. (2020), 'Using passive acoustic monitoring to investigate the occurrence of cetaceans in a protected marine area in northwest Ireland'. Estuarine, Coastal and Shelf Science 232:106509.

Todd, V. L., I. B. Todd, J. C. Gardiner, E. C. Morrin, N. A. MacPherson, N. A. DiMarzio, and F. Thomsen. 2015. A review of impacts of marine dredging activities on marine mammals. ICES Journal of Marine Science: Journal du Conseil 72:328-340.

Topping, C., and Petersen, I.K., (2011). Report on a Red-throated Diver Agent-Based Model to assess the cumulative impact.

Trigg, L., F. Chen, G. Shapiro, S. Ingram, C. Vincent, D. Thompson, D. Russell, M. I. D. Carter, and C. Embling. (2020), 'Predicting the exposure of diving grey seals to shipping noise'. The Journal of the Acoustical Society of America 148.

Trinder M, O'Brien SH and Deimel J (2024) A new method for quantifying redistribution of seabirds within operational offshore wind farms finds no evidence of within-wind farm displacement. Front. Mar. Sci. 11:1235061. doi: 10.3389/fmars.2024.1235061

Tully, O. 2017. Atlas of Commercial Fisheries for Shellfish around Ireland, Marine Institute, March 2017. ISBN 9781902895611, 58 pp.

Vabø, R., Olsen, K. and Huse, I., 2002. The effect of vessel avoidance of wintering Norwegian spring spawning herring. Fisheries Research, 58(1), 59-77.

Vanermen, N., Courtens, W., Van de walle, M., Verstraete, H. & Stienen, E.W.M. (2016). Seabird monitoring at offshore windfarms in the Belgian part of the North Sea – updated results for the Bligh Bank & first results for the Thornton bank. Report INBO.R.2016.11861538. Brussels: Research Institute for Nature and Forest.

Vanermen, N., Courtens, W., Van de walle, M., Verstraete, H. & Stienen, E.W.M. (2017). Seabird monitoring at the Thornton bank offshore wind farm – Updated seabird displacement results & an explorative assessment of large gull behaviour inside the wind farm area. Reports of the Research Institute for Nature and Forest 2017 (31). Brussels: Research Institute for Nature and Forest.

Vanermen, N., Courtens, W., Van De Walle, M., Verstraete, H., and Stienen, E. (2019), Seabird monitoring at the Thornton Bank offshore wind farm: Final displacement results after 6 years of post-construction monitoring and an explorative Bayesian analysis of common guillemot displacement using INLA, In Environmental impacts of offshore wind farms in the Belgian part of the North Sea: Marking a decade of monitoring, research and innovation, 85-116.

Vanermen, N., Stienen, E.W., Courtens, W., Onkelinx, T., Van De Walle, M. and Verstraete, H., 2013. Bird monitoring at offshore wind farms in the Belgian Part of the North Sea: assessing seabird displacement effects. Instituut voor Natuur-en Bosonderzoek.

Verboom, W. (2014), 'Preliminary information on dredging and harbour porpoises'. JunoBioacoustics.

von Benda-Beckmann, A. M., G. Aarts, H. Ö. Sertlek, K. Lucke, W. C. Verboom, R. A. Kastelein, D. R. Ketten, R. van Bemmelen, F.-P. A. Lam, and R. J. Kirkwood. 2015. Assessing the impact of underwater clearance of unexploded ordnance on harbour porpoises (Phocoena phocoena) in the southern North Sea. Aquatic Mammals 41:503.

Wade, H.M., Masden, E.A., Jackson, A.C. and Furness, R.W. (2016), 'Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments', Mar. Policy 70 108–13.

Waggitt, J.J., Evans, P.G.H., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J., Felce, T., Fijn, R.C., Garcia-Baron, I., Garthe, S., Geelhoed, S.C.V., Gilles, A., Goodall, M., Haelters, J., Hamilton, S., Hartny-Mills, L., Hodgins, N., James, K., Jessopp, M., Kavanagh, A.S., Leopold, M., Lohrengel, K., Louzao, M., Markones, M., Martinez-Cedeira, J., O Cadhla, O., Perry, S.L., Pierce, G.J., Ridoux, V., Robinson, K.P., Begona Santos, M., Saavedra, C., Skov, H., Stienen, E.W.M., Sveegaard, S., Thompson, P., Vanermen, N., Wall, D., Webb, A., Wilsonn, J., Wanless, S. and Hiddink, J.G. (2020). 'Distribution maps of cetacean and seabird populations in the North-East Atlantic'. J Appl Ecol.; 57: 253–269. https://doi.org/10.1111/1365-2664.13525

Wall, D., C. Murray, J. O'Brien, L. Kavanagh, C. Wilson, C. Ryan, B. Glanville, D. Williams, I. Enlander, I. O'Connor, and M. D. 2013. Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters: Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters: 2005 -2011. Irish whale and Dolphin Group, Merchants Quay, Kilrish, Co Clare.

Wardle, C.S., Carter, T.J., Urquhart, G.G., Johnstone, A.D.F., Ziolkowski, A.M., Hampson, G. and Mackie, D., 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21: 1005-1027.

Ware, S.J. & Kenny, A.J. 2011. Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (2nd Edition). Marine Aggregate Levy Sustainability Fund, 80pp. Available at: Guidelines for the Conduct of Benthic Studies at Marine Aggregate https://www.yumpu.com/en/document/view/15696156/guidelines-for-the-conduct-of-benthic-studies-at-marine-aggregate-

Webb, A., Irwin, C., Mackenzie, M., Scott-Hayward, L., Caneco, B., & Donovan, C. (2017), 'Lincs wind farm: third annual post-construction aerial ornithological monitoring report', Unpublished report, HiDef Aerial Surveying Limited for Centrica Renewable Energy Limited. CREL LN-E-EV-013-0006- 400013-007.

Welcker, J. and Nehls, G., (2016). Displacement of seabirds by an offshore wind farm in the North Sea. Marine Ecology Progress Series, 554: 173-182.

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. and Baillie, S.R. (eds). (2002), 'The Migration Atlas: Movements of the birds of Britain and Ireland',. T. and A.D. Poyser, London.

Weseloh, D. V.; Hebert, C. E.; Mallory, M. L.; Poole, A. F.; Ellis, J. C.; Pyle, P.; Patten, M. A. (2020). Herring Gull (Larus argentatus), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

Wilhelmsson, D. and Malm, T. (2008) Fouling Assemblages on Offshore Wind Power Plants and Adjacent Substrata. Estuarine, Coastal and Shelf Science, 79, 459-466.

Wilhelmsson, D., Malm, T. and Öhman, M. (2006). The influence of offshore wind power on demersal fish. ICES Journal of Marine Science, 63: 775e784

Wisniewska, D. M., M. Johnson, J. Teilmann, L. Rojano‐Doñate, J. Shearer, S. Sveegaard, L. A. Miller, U. Siebert, and P. T. Madsen. 2018. Response to "Resilience of harbor porpoises to anthropogenic disturbance: Must they really feed continuously?". Marine Mammal Science 34:265-270.

Woodward, I., Thaxter, C. B., Owen, E., and Cook, A. S. C. P. (2019), Desk-based revision of seabird foraging ranges used for HRA screening, BTO research report number 724.

Wright, L. and Austin, G. (2012), 'SOSS Migration Assessment Tool. BTO and the Crown Estate', SOSS Website.

Wright, P.J., Jensen, H. and Tuck, I., 2000. The influence of sediment type on the distribution of the lesser sandeel, Ammodytes marinus. Journal of Sea Research, 44(3-4), 243-256.

Wyman, M.T., Peter Klimley, A., Battleson, R.D., Agosta, T.V., Chapman, E.D., Haverkamp, P.J., Pagel, M.D. and Kavet, R., 2018. Behavioral responses by migrating juvenile salmonids to a subsea high-voltage DC power cable. Marine Biology 165(8), 134. https://doi.org/10.1007/s00227-018-3385-0

Young, C., S. Gende, and J. Harvey. (2014), ‘Effects of Vessels on Harbor Seals in Glacier Bay National Park’. Tourism in Marine Environments 10.

.