Dublin Array
Generation for generations

Part 4: Habitats Directive Assessment
Volume 4: Applicant's Natura Impact Statement

Kish Offshore Wind Ltd.

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

Dublin Array Offshore Wind Farm

Habitats Directive Assessment

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Glossary

Term	Definition
Alternative Design Option	The alternative design options which would result in the least impact (for instance, the smallest footprint, shortest exposure or smallest dimensions inter alia)
An Bord Pleanála (ABP)	An Bord Pleanála is the authority that decides major strategic infrastructural projects under the provisions of the Planning and Development (Strategic Infrastructure) Act 2006 and the Planning and Development Act 2000.
Annex I Birds	The 194 wild bird species and sub-species listed on Annex I of the Birds Directive (2009/147/EC) that are particularly threatened and for which, European Union (EU) Member States (MS) must designate Special Protection Areas (SPAs) for their protection.
Annex I Habitat	One of the 169 Natural Habitat types listed on Annex I of the Habitats Directive as a habitat of community interest for which EU MS must consider the designation of Special Areas of Conservation to protect the habitat (or Qualifying Interest) where it occurs within their territory (European Commission, 2019).
Annex II Species	One of the c.900 animal and plant species listed on Annex II of the Habitats Directive as species of community interest for which EU MS must consider the designation of core areas of their habitat as SACs where it occurs within a MS.
Annex IV species	The Habitats Directive also contains obligations in relation to the strict protection of Annex IV species wherever they occur, as set out in Article 12 and Article 13 of the Directive.
Appropriate Assessment	The procedure as prescribed by section 177V of the Planning Act, carried out by the competent authority under Part XAB, that shall include a determination under Article 6(3) of the Habitats Directive as to whether the proposed development would adversely affect the integrity of a European site and an AA appropriate assessment shall be carried out by the competent authority before consent is given for the proposed development.
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30th November 2009 on the Conservation of Wild Birds.
Conservation Objectives	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.
Dublin Array	Dublin Array Offshore Wind Farm. Refers to all geographical areas of the development, i.e. both offshore, onshore and O&M Base as defined in Section 1.1 and Part 4: Volume 1 Project Description.
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
Environmental Impact Assessment Report	The report that outlines the likely significant effects, if any, which the proposed project would have on the environment. Prepared by the developer to inform the EIA process required by the EIA Directive.

Term	Definition
European site	A candidate site of Community importance (cSCI); a site of Community importance (SCI); a candidate special area of conservation (cSAC); a special area of conservation (SAC); a candidate special protection area (cSPA); and a special protection area (SPA).
Favourable Conservation Status	Favourable Conservation Status of a natural habitat is defined as the conservation status of a natural habitat when; ▪ 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; Favourable Conservation Status of a species is defined as the conservation status of a species 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, ▪ 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.
GCP	Grid Connection Point at existing Carrickmines 220 kV substation
Habitats Directive	Means Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended.
Habitats Directive Assessment	Means: the Project Description (HDA: Volume 1); the Flexibility and Maximum Design Option (MDO)(HDA: Volume 2); the Supporting Information for Screening for Appropriate Assessment (SISAA)(HDA: Volume 3); the Natura Impact Statement (NIS)(HDA: Volume 4); and Appendices (HDA: Volume 5)
Habitats Regulations	The European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) as amended.
Invasive alien species (IAS)	This is a species which has been introduced outside its natural range and has the ability to negatively alter its new habitat and out-compete native flora and fauna. The (EU) Invasive Alien Species Regulation 1143/2014 provides for the publication and updating of a list of Invasive Alien Species of Union concern - (EU) Regulation 2016/1141 as revised and up-dated from time to time. S.I. No. 374/2024 - European Union (Invasive Alien Species) Regulations 2024 gives effect to the (EU) Invasive Alien Species Regulation and includes a further list of Invasive Alien Species of National concern, which may be revised and up-dated from time to time.
Landfall	The location at the land-sea interface where the transmission cable from an offshore development meets the land boundary.
Likely Significant Effects (LSEs)	This term is adapted from Article 6 (3) of the Habitats Directive (“likely to have a significant effect”). It describes the type of effects which the project, either individually or in-combination with other

Term	Definition
	plans or projects, will or may have on a European site(s) and as a result trigger the requirement to conduct an Appropriate Assessment.
Maritime Area Consent (MAC)	The MAC is a statutory consent which may be granted by MARA under section 81(1)(a) of the Marine Area Planning Act 2021, as amended.
Maximum Design Option (MDO)	The design scenario that is assessed which would result in the greatest impact (for example largest footprint, longest exposure, or largest dimensions inter alia). The design information is based on the best available information and the parameters outlined in the project description Chapters are realistic and considered estimations of future design parameters.
MHWS	MHWS is the highest level that spring tides reach on average over a period of time (often 19 years). The height of MHWS is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mitigation	This is defined in the Habitats Regulations as " a measure or a combination of measures that, in relation to Article 6(3) of the Habitats Directive, has the effect of ensuring that a plan or project, individually or in combination with other plans or projects, will not have a significant effect on, or adversely affect the integrity of, a European Site".
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.
Natura 2000 network	The European network of special areas of conservation under the Habitats Directive and special protection areas under the Birds Directive, provided for by Article 3(1) of the Habitats Directive and, includes European Sites as defined in S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011.
Natura Impact Statement NIS	This means a report comprising the scientific examination of a plan or project and the relevant European Site or European Sites, to identify whether the project will adversely affect the integrity of a European site(s) either individually or in combination with other plans and projects in view of the site's conservation objectives, and to characterise any such adverse effects.
Onshore Electrical System (OES)	Collective term for all onshore infrastructure from the Mean Low Water Spring to the GCP which are likely to be necessary to connect the project to the national grid
Onshore Compensation Compound (OCC)	Part of the OES, the substation is required to facilitate the grid connection.
Operation and Maintenance Base (O&M Base)	This is the location from where the daily operations and normal repairs, replacement of parts and structural components, and other activities needed to preserve the offshore assets will be conducted.
Offshore ECC	The Offshore Export Cable Corridor connecting the Offshore Substation Platform (OSP) and array to the Landfall/TJB at Shanganagh WWTP

Term	Definition
Onshore ECC	The route corridors within which the proposed cables will be installed underground from the Landfall to OCC and beyond the OCC to the GCP.
Precautionary principle	Adopted by the UN Conference on the Environment and Development (1992) to protect the environment and is detailed in Article 191 of the Treaty on the Functioning of the European Union. The former provides that where threats to the environment are shown to be serious or provide irreversible damage, then lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
Planning Act	The Planning Act means the Planning and Development Act, 2000, as amended.
Qualifying Interest (QI)	The habitats and species for which each European site is selected are the QI for SACs and special conservation interests (SCI) for SPAs of each site. These are collectively referred to as qualifying interests (QI) in this report.
Screening for Appropriate Assessment	The procedure as prescribed by section 177U of the Planning Acts, that is carried out by the competent authority to assess, in view of best scientific knowledge, if the proposed development, individually or in combination with another plan or project, is likely to have a significant effect on a European site
Sites of Community Importance	Under section 177R of the Planning Act, a "site of community importance" means a site that has been included in the list of sites of Community importance as adopted by the European Commission in accordance with the procedure laid down in Article 21 of the Habitats Directive, while a "candidate site of community importance" means a site included in a list transmitted to the European Commission prior to formal adoption of that site
Special Conservation Interest(s)	The species for which an SPA is selected. See definition of Qualifying Interests (QI).
Source-pathway - receptor (S-P-R)	The 'source-pathway receptor' approach was applied to identify European sites to be considered in Screening. The method seeks to characterise the means (pathways) via which effect-sources arising from the project could be experienced by receptors (sensitive QI of a European site).
TJB	Transmission Joint Bay. The proposed infrastructure at the Landfall location where the offshore and onshore cables connect.
Zone of Influence ZOI	The area over which the proposed development could affect the receiving environment such that it could potentially have significant effects on the qualifying interests or SCI of a European site, or on the achievement of their conservation objectives.

Acronyms

Term	Definition
µV	Microvolts
1SD	One Standard Deviation
AA	Appropriate Assessment
ABP	An Bord Pleanála
ABWP2	Arklow Bank Wind Park 2
ADD	Acoustic Deterrent Device
AEOI	Adverse Effect On Integrity
AFS	Anti-fouling System
AOWFL	Aberdeen Offshore Windfarm Limited
BDMPS	Biologically Defined Minimum Population Scales
BEIS	Business, Energy and Industrial Strategy
BNG	Biodiversity Net Gain
BTO	British Trust for Ornithology
BWI	Bird Watch Ireland
BWM	Ballast Water Management
CBRA	Cable Burial Risk Assessment
CEMP	Construction Environmental Management Plan
CGR	Counterfactual of the Population Growth Rate
CHIRP	Compressed High-Intensity Radiated Pulses
CI	Confidence Interval
CIEEM	Chartered Institute of Ecology and Environmental Management
CIP	Cable Installation Plan
CIS	Celtic and Irish Seas
CJEU	Court of Justice of the European Union
COWRIE	Collaborative Offshore Wind Research into the Environment
CPS	Counterfactual Population Size
CRM	Collision Risk Modelling
CSIP	Cetacean Strandings Investigation Programme
CSTP	Celtic Sea Trout Project
CTV	Crew Transfer Vessel
CV	Coefficients of Variation

Term	Definition
CWP	Codling Wind Park
DA	Dublin Array
DAERA	Department of Agriculture, Environment and Rural Affairs
DAHG	Department of Arts, Heritage and the Gaeltacht
DAPPMS	Dublin Array Physical Process Modelling System
DC	Direct Current
DCCAE	Department of Communications, Climate Action and the Environment
DDT	Dichloro-Diphenyl-Trichloroethane
DDV	Drop Down Video
DEARA	Department of Agriculture, Environment and Rural Affairs
DEB	Dynamic Energy Budget
DECC	Department of the Environment, Climate and Communications
DEFRA	Department for Environment Food and Rural Affairs
DEHLG	Department of Housing, Local Government and Heritage
DEPONS	Disturbance Effects of Noise on the Harbour Porpoise Population in the North Sea
DHPLG	Department Of Housing, Planning and Local Government
DHT	Dihydrotestosterone
DLRCC	Dún Laoghaire-Rathdown County Council
EC	European Council
ECC	Export Cable Corridor
EDR	Effective Deterrent Ranges
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EMF	Electro-Magnetic Field
EOD	Explosive Ordnance
EOWDC	European Offshore Wind development Centre
ESB	Electricity Supply Board
EU	European Union
FCS	Favourable Conservation Status
FHG	Functional Hearing Group

Term	Definition
GCP	Grid Connection Point
gt	Gross Tonnage
HDA	Habitats Directive Assessment(s)
HDD	Horizontal Directional Drilling
HF	High-Frequency
HRA	Habitats Regulations Assessment
HVDC	High Voltage Direct Current
IAC	Inter-array Cable
IAMMWG	Inter-Agency Marine Mammal Working Group
IAS	Invasive Alien Species
ICES	International Council for the Exploration of the Sea
IDWG	Irish Dolphin and Whale Group
IEMA	Institute of Environmental Management and Assessment
IMARES	Integrated Marine Ecosystem Assessments
IMO	International Maritime Organisation
IND	Individual
IRCG	Irish Coast Guard
ITM	Irish Transverse Mercator
IWDG	Irish whale and Dolphin Group
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effects
MAC	Maritime Area Consent
MAG	Magnetometer
MARA	Maritime Area Regulatory Authority
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam Echo Sounder
MDO	Maximum Design Option
MHWM	Mean High Water Mark
MHWS	Mean High Water Springs
MMFR	Mean Maximum Foraging Range
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Maritime Organisation

Term	Definition
MSL	Mean Sea Level
MU	Management Unit
MW&SQ	Marin Water and Sediment Quality
NBHF	Narrow-Band High Frequency
NERI	National Environmental Research Institute
NIS	Natura Impact Statement
NISA	North Irish Sea Array
NMFS	National Marine Fisheries Service
NMPF	National Marine Planning Framework
NOAA	National Oceanic and Atmospheric Administration
NPWS	National Parks and Wildlife Service
NRA	Navigational Risk Assessment
NRW	National Resources Wales
NWIS	North-west Irish Sea
OCC	Onshore Compensation Compound
OES	Onshore Electrical System
OREDP	Offshore Renewable Energy Development Plan
ORJIP	Offshore Renewables Joint Industry Plan
OSP	Offshore Substation
OSPAR	The Convention for the Protection of the Marine Medio ambiente of the North-East Atlantic
OWF	Offshore Wind Farm
PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivores in Water
PEMP	Project Environmental Management Plan
PTS	Permanent Threshold Shift
PVA	Population Viability Analysis
QI	Qualifying Interests
ROV	Remote Operated Vehicle
RPM	Round Per Minute
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SBP	Sub-bottom Profiler

Term	Definition
SCANS	Small cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SEA	Strategic Environmental Assessment
SISAA	Supporting Information for Screening for Appropriate Assessment
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SPA	Special Protected Area
SPL	Sound Pressure Level
SPO	Source Pathway Receptor
SPR	Suspended Sediment Concentration
SSC	Side Scan Sonar
SSS	Tributyltin
TBT	Trichloroethylene
TCE	Tetrahydrocannabinol
THC	Transition Joint Bay
TJB	Trailer Suction Hopper Dredger
TSHD	Temporary Threshold Shift
TTS	Ultra-High Resolution Seismic
UHRS	United Kingdon
UK	United Nations
UN	Ultra-short Baseline
USBL	Unexploded Ordnance
UXO	Very High-Frequency
VHF	Vessel Management Plan
VMP	Wind Turbine Generator
WTG	Waste Water Treatment Plant
WWTP	Zone of Influence
ZoI	Zone of Influence

1 Introduction

1.1 Background

1.1.1.1 Dublin Array Offshore Wind Farm (Dublin Array) is a proposed offshore wind farm on the Kish and Bray Banks. The Kish and Bray Banks are located, approximately 10 km off the east coast of Ireland, immediately south of Dublin city off the coast of counties Dublin and Wicklow. The location of the proposed wind farm site is shown in Figure 1 below. The wind farm will be located within an area of approximately 59 km^2, in water depths ranging from 2 metres to 50 metres lowest astronomical tide (LAT).

1.1.1.2 The Applicant for development permission is "Kish Offshore Wind Limited" on behalf of Kish Offshore Wind Limited and Bray Offshore Wind Limited respectively (hereafter referred to as the Applicant). The project involves development partly in the maritime area and partly on land. The Applicant holds three maritime area consents ('MACs') for three parts of the maritime area. The Applicant holds each MAC jointly with the other specified MAC holders.

- MAC Reference No. 2022-MAC-003 and 004
- MAC Reference No. 20230012
- MAC Reference No. 240020

1.1.1.3 Dublin Array is comprised of the offshore wind farm array and associated infrastructure (including landfall/transition joint bay (TJB) and operations and maintenance base and the onshore electrical system (OES):

- Offshore Wind Farm Infrastructure: will comprise between 39-50 wind turbine generators with a maximum blade tip height (when a rotor blade is in a vertical orientation) of between 265.5 m to 307.5 m; minimum blade tip height of 31.6 m above mean high water springs (MHWS); associated offshore infrastructure including turbine foundations; subsea inter array electricity cables; an offshore substation platform (OSP) and offshore electricity export cables;
- Landfall and Transition Joint Bay (TJB): will comprise the landfall location where the offshore export cables will come ashore and the TJB will be located. The proposed landfall/TJB is located at Shanganagh to the south of the Uisce Eireann Shanganagh Wastewater Treatment Plant;
- The Operations and Maintenance (O&M) base: will be located at Dún Laoghaire Harbour and will comprise the O&M Base for the proposed wind farm. Once the O&M Base is operational, it will also be used to support the construction of the offshore wind farm; and

- Onshore Electrical System (OES): comprises the related onshore works that are necessary to facilitate the operation of the wind farm. This includes underground electricity transmission cables; an onshore substation (referred to in the EIAR as an onshore compensation compound [OCC]); and underground electricity cable circuits connecting the OCC to an existing Eirgrid substation. The grid connection option being assessed in the EIA is located on the former Ballyogan Landfill site and is referenced in the EIAR as the Jamestown OCC.

1.1.1.4 In January 2021, a foreshore site investigations licence (FS007029) was granted to RWE Renewables Ireland Limited and site investigations and surveys were undertaken between 2021-2022 under that licence. Following a decision of the High Court delivered on 2 September 2024 in Coastal Concern Alliance v Minister for Housing, Local Government and Heritage & Others and RWE Renewables Ireland Limited [2024] IEHC 524, the Court has set aside the decision made on 12 November 2020 to grant the licence by Order made on 6 December 2024, and has directed that the application be remitted to the Minister for the Environment, Climate and Communications to be reconsidered in accordance with the Court's findings and directions. On remittal the Minister is to seek information from RWE as to the nature, extent and timing of the surveys that were actually carried out, and to undertake an Appropriate Assessment screening based on this scope and the facts and circumstances that were applicable as of 12 November 2020, which was when an error was made by the Minister in the original AA procedure. Only if determined to be necessary, the Minister is to then undertake an Appropriate Assessment (Stage II). Ultimately, the Minister is to reach a determination as to whether a revised licence covering the nature and extent and timing of the actual surveys carried out would have been issued, based on the facts and circumstances as of November 2020. Relevant documentation and determinations are to be published on the Minister's website.

1.1.1.5 While the invalidated licence no longer exists as a matter of law, the data gathered under it is not invalidated nor is the use of such data in this Application precluded. In the Coastal Concern case, the Court refused an application for leave to amend the proceedings to pursue a claim for declaratory relief that this survey data could not be used in any future development consent application. On a 'de bene esse' or provisional basis, the Court rejected the merits of a claim that the remedial obligation under the Habitats Directive should require the use of such data to be precluded in any future development consent application. The Court's reasoning is set out in paragraphs 55-59 of the judgment, and similar reasoning was given by the High Court in a separate subsequent decision in which the same claim arose and was rejected in Toole & Ors v Minister for Housing, Local Government and Heritage & Others and Codling Wind Park Limited [2024] IEHC 610 (paragraphs 190-191).

1.1.1.6 Accordingly, all relevant survey and site investigation data gathered by and on behalf of the Applicant under the invalidated licence and included in this Application may be used and relied on.

1.1.1.7 The location of Dublin Array is presented in Figure 1 with the project description provided in Volume 1: Project Description of this Habitats Directive Assessment.

1.1.1.8 This Natura Impact Statement (NIS) comprises the Applicant's assessment of the impact of the project (either alone or in combination with other plans or projects) against the relevant European sites' conservation objectives, and ascertaining whether it will affect the integrity of the sites concerned, taking into account any mitigation measures.

1.1.1.9 This NIS should be read in conjunction with the other documents submitted as part of the Habitats Directive Assessment:

- Project Description (Volume 1);
- Flexibility and Maximum Design Option (MDO) (Volume 2);
- Supporting Information for Screening for Appropriate Assessment (Volume 3); and
- Appendices (Volume 5):
  - Appendix A: Conservation Objectives;
  - Appendix B: Harbour Porpoise Bioenergetic Modelling (SMRU, 2024);
  - Appendix C: Apportioning Report;
  - Appendix D: In Combination long list; and
  - Appendix E: Harbour Porpoise Bioenergetic Modelling In combination with NISA (SMRU, 2024).

1.1.1.10 As noted in the Methodological Guidance on Article 6(3), the integration and coordination of environmental assessments required under EU law is thought to greatly contribute to improving the efficiency of environmental permitting procedures. Streamlining provisions in the EIA and SEA Directives aim to avoid duplication of assessments under other EU Directives including the Habitats and Birds Directives, without prejudice to the specific requirements of each directive. Recital 37 of EIA Directive 2014/52/EU provides that, to improve the effectiveness of assessments, reduce administrative complexity and increase economic efficiency, where the obligation to carry out AA and EIA arises simultaneously, Member States should ensure that coordinated or joint procedures are provided, and this is reflected in the amendment in that Directive to Article 2 of EIA Directive 2011/92/EU.

1.1.1.11 The proposed development is subject to the development permission application procedures under section 291 of the Planning Act, which ensures a co-ordinated decision-making process by the competent authority, An Bord Pleanála (ABP), responsible both for the AA and the EIA. The relevant AA procedures are set out in Part XAB of the Planning Act, while the relevant EIA provisions are set out in Part X. This NIS is prepared by competent experts, as set out in Section 1.1.2 of this NIS, who have taken account of the best scientific knowledge in the field, including relevant baseline information contained in the EIAR. There has been close cooperation and proper information exchange between the experts preparing the SISAA, NIS, and the EIAR, and the experts preparing this NIS have had regard to relevant modelling and site-specific studies contained in the EIAR. This is consistent with the obligation to ensure that the NIS is based on objective and, if possible, quantifiable criteria and that impacts are predicted as precisely as possible, and the basis of these predictions should be made clear and recorded in the NIS. Accordingly, this NIS draws upon and refers to relevant sources of information in the following Chapters and appendices of the EIAR:

- Volume 4, Appendix 4.3.3-1: Benthic and Intertidal Ecology Technical Baseline (hereafter referred to as the Benthic Ecology Baseline);
- Volume 4, Appendix 4.3.4-1: Fish and Shellfish Technical Baseline (hereafter referred to as Fish and Shellfish Baseline);
- Volume 4, Appendix 4.3.5-1: Marine Mammals Technical Baseline (hereafter referred to as Marine Mammals Baseline);
- Volume 4, Appendix 4.3.6-1: Offshore Ornithology Technical Baseline (hereafter referred to as Ornithology Baseline);
- Volume 4, Appendix 4.3.1-2: Physical Process Modelling for Dublin Array Offshore Wind Farm (hereafter referred to as the Physical Processes Modelling Report);
- Volume 4, Appendix 4.3.5-7: Underwater noise assessment (hereafter referred to as the Underwater noise assessment);
- Volume 4, Appendix 4.3.20-1: Operations and Maintenance Base Offshore Technical Baseline;
- Appendix 4.3.6-4: Collision Risk Modelling (hereafter referred to as the CRM);
- Appendix 4.3.6-5 Migratory Collision Risk Modelling (hereafter referred to as the migratory CRM);
- Appendix 4.3.6-6 Displacement Matrices, (hereafter referred to as the displacement report); and
- Appendix 4.3.6-7 Offshore Ornithology Population Viability Analyses (hereafter referred to as PVA).

1.1.2 Author competencies

1.1.2.1 The HDA team is led by SLR Consulting Ireland Ltd (SLR) and GoBe Consultants Ltd (GoBe) with assistance from specialist consultants.

SLR Consulting Ltd

1.1.2.2 SLR is a multidisciplinary technical consultancy providing services to public and private sector clients in several sectors including energy, infrastructure and waste. SLR is a registered Environmental Impact Assessor Member of the Institute of Environmental Management and Assessment (IEMA) and holds the IEMA Environmental Impact Assessment Quality Mark. Further information on SLR can be found on its corporate website at www.slrconsulting.com

GoBe

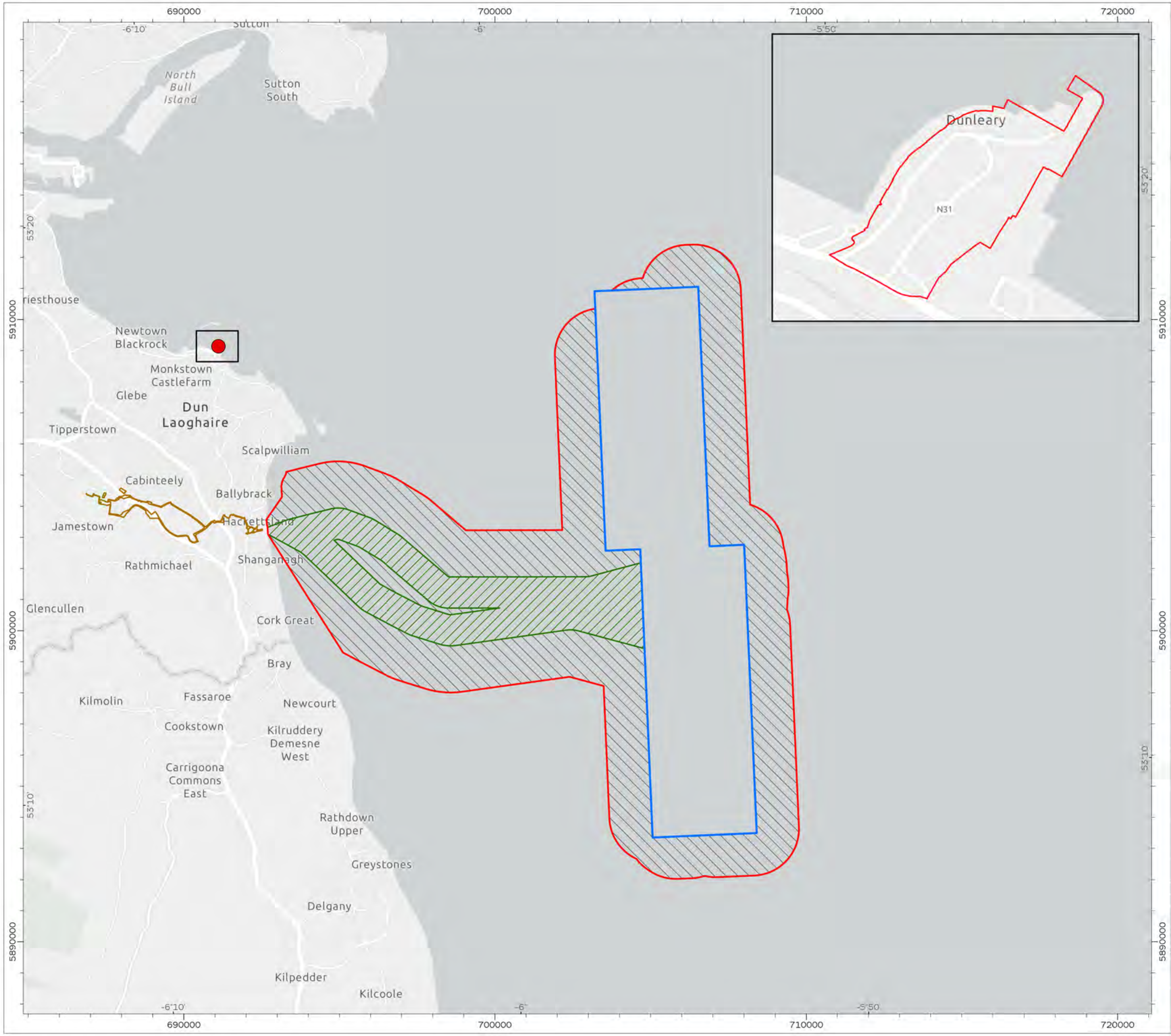
1.1.2.3 GoBe is an independent environment and planning consultancy offering a broad range of expertise and experience with a focus on the offshore wind farm development market. GoBe provides a full range of environmental planning and consultancy services to the offshore wind sector, covering both onshore and offshore infrastructure and throughout the full development lifecycle. GoBe is part of the APEM Group. Further information on GoBe can be found on its corporate website www.gobeconsultants.com.

1.1.2.4 The Applicant confirms that the specialist personnel and organisations that have undertaken surveys, prepared baseline technical information, and produced the Supporting Information for Screening for Appropriate Assessment (SISAA) and Natura Impact Statement (NIS), have the requisite relevant competency, expertise, and qualifications.

Table 1 NIS team competencies

Discipline	Specialist Assessor	Qualifications	Experience
Project Management	Justine Davies GoBe	MSc, BSc	Justine is a Principle Marine Consultant with 15 years of experience as an EIA practitioner and an additional 9 years in the marine environmental field. Justine has significant experience across a range of sectors, having managed projects for the offshore wind industry, ports, marine aggregates and technical involvement in cables and pipelines. Justine has extensive project management experience through her previous role as Consultancy Manager and her work on various NSIP projects. Justine has worked on Dublin Array Offshore Wind Farm in Ireland since 2019, taking on a project management role and providing technical support across the scoping and EIA phases.
Benthic and Intertidal assessment	Chris Nikitik GoBe	MSc, BSc	Chris Nikitik is a Senior Marine Ecology Specialist at GoBe with specific expertise in benthic environments. Chris has over 25 years' experience of delivering projects related to a number of drivers such as power generation, port construction and maintenance, industrial developments and transport infrastructure and has routinely acted as technical lead on all benthic aspects of a project from initial programme design through to reporting. Chris is also experienced with the requirements of environmental reporting in relation to appropriate assessments/EIAs/HRAs etc. and has authored numerous reports and contributed to EIA Chapters
Fish assessment	Simone Pfeifer GoBe	PhD MSc Diploma biology	Simone Pfeifer is a Senior Marine Ecology Specialist at GoBe with a strong background providing scientific advice to UK consenting authorities and developers on the impacts of offshore activities on marine habitats and faunal assemblages. Simone has experience in conducting Appropriate Assessment screening assessments and advising developers on the risk of causing injury or disturbance to marine European Protected Species. She has also been involved in the development of sampling protocols for Annex I habitats and guidelines to assess impacts on features protected in Natura 2000 sites and UK Marine Conservation Zones. Simone is familiar with current EIA and HRA assessment approaches and relevant environmental legislations and policies. Simone has been involved in the Dublin Array project since August 2023, contributing to the delivery of the Fish and Shellfish assessments within the NIS and EIAR.
Marine mammals assessment	Ross Culloch APEM	Ph.D. • M.Sc. Marine Mammal	Ross is the Associate Director & Head of the Marine Mammal Team within APEM and brings a wealth of expertise in the field of marine mammal ecology, conservation and management, and a practical understanding of the legislation and policy relating to marine mammals and the

Discipline	Specialist Assessor	Qualifications	Experience
		Science, • B.Sc. (Hons) Aquatic Bioscience,	consenting of major marine infrastructure projects leading on numerous scoping of EIA and screening during the HRA process. Ross has 20 years experience in the field, he has over 30 peer-reviewed publications on a diverse range of topics. Across his career Ross has led research and desk-based studies on topics such as identifying and implementing suitable monitoring and mitigation plans for better understanding anthropogenic impacts, and designing scientific studies aimed at reducing knowledge gaps that are barriers to the consenting of major marine infrastructure projects.
Dynamic Energy Budget (DEB) modelling	Rachael Sinclair SMRU	BSc Hons in Marine Biology MRes in Marine Mammal Science	Rachael is a Principal Scientist at SMRU Consulting. She has been working in marine mammal science since graduating in 2011 and has been working in consultancy since 2013. Rachael has extensive experience as the lead author of marine mammal baseline characterisation reports and EIA Chapters for numerous offshore wind farms in England, Scotland, Wales and Ireland
Onshore	Jake Matthews SLR	MSc ecology BSc (Hons) wildlife conservation	Jake is a Senior Ecologist with expertise in ornithology, bats, and newts, and has extensive experience supporting major infrastructure, wind farm, quarry, and housing projects. Jake has over five years' experience as a consultant ecologist in the UK and Ireland and has worked on a variety of projects including EIAR Chapters, Appropriate Assessment (AA) screenings and Natura Impact Statements (NIS) reports. He specializes in ecological surveys and assessments, including Preliminary Ecological Appraisals (PEA), Appropriate Assessments (AA), Biodiversity Net Gain (BNG) assessments, and Ecological Clerk of Works (ECoW).
Ornithology	Jessica George GoBe	MSc BSc IEMA (grad)	Within her role as an ornithological consultant at GoBe, Jessica has developed a good understanding of offshore windfarm developments in regard to seabirds. Jessica has focused on derogation, developing compensation measures for a variety of species, post-consent monitoring as well as ornithological assessments. Jessica has worked on projects in England, Scotland, Wales, Ireland, Isle of Mann and Poland (Baltic Sea). Jessica has also engaged and led workshops with stakeholders, including Natural England, JNCC, and RSPB.



- O and M Base
- Array Area
- Temporary Occupation Area
- Offshore Development Boundary
- Export Cable Corridor
- Onshore Development Boundary

DRAWING STATUS

FINAL

DISCLAIMER

MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Location of Dublin Array Offshore Windfarm

DRAWING NUMBER: 1

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-16	For Issue	GB	BB	SS

0 1 2 3 4 km
0 0.6 1.1 1.7 2.2 nm

N

SCALE	1:125,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

1.2 Legislative context

1.2.1.1 The Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna) adopted in 1992 provides the framework for the legal protection to ensure the conservation of a wide range of rare, threatened or endemic animal and plant species throughout the European Union. The Habitats Directive and the Birds Directive (2009/147/EC) are transposed into Irish legislation inter alia by the Habitats Regulations and the Planning Act.

1.2.1.2 The Habitats Directive provides the framework for the legal protection to ensure the conservation of a wide range of rare, threatened or endemic animal and plant species throughout the European Union. The Birds Directive aims to conserve and protect listed wild bird species naturally occurring in the European Union. The Directives provide the obligation to establish a network of designated sites comprising Special Areas of Conservation (SACs) designated under the Habitats Directive; and Special Protection Areas (SPAs) classified under the Birds Directive. SACs and SPAs (including candidate and proposed sites) collectively known as the Natura 2000 network of European sites.

1.2.1.3 The requirement for Appropriate Assessment (AA) is set out in Article 6(3) of the Habitats Directive. If a project is likely to have a significant effect on the conservation objectives of a European site, either alone or in combination with other plans or projects, it must undergo an AA process.

1.2.1.4 Article 6(3) of the Habitats Directive states: *"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in-combination with other plans or projects, shall be subject to appropriate assessment 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 after having ascertained that it will not adversely affect the integrity of the site concerned and if appropriate, after having obtained the opinion of the general public"*.

1.2.1.5 Should the conclusion of the AA in accordance with Article 6(3) as referred to in the previous paragraph be that adverse impacts on the integrity of the site concerned cannot be ruled out beyond reasonable scientific doubt, Article 6(4) provides: "*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 European Commission to other imperative reasons of overriding public interest."*

2 Irish legislation

2.1.1.1 The Applicant is applying for development permission for the proposed development under section 291 of the Planning Act. By virtue of section 318 of that Act, the Screening for Appropriate Assessment and Appropriate Assessment procedures are set out in Part XAB of the Act.

2.1.1.2 As the competent authority, ABP may only grant permission for the proposed development after all relevant procedures prescribed by Part XAB of the Act have been followed to the extent necessary. The Screening "Stage One" procedure is set out in section 177U, while the AA "Stage Two" is set out in Section 177V.

2.1.1.3 This report is intended to support the planning application in assessing the impacts of the project (either alone or in combination with other plans or projects) against the relevant sites' conservation objectives and ascertaining whether it will affect the integrity of the sites concerned, taking into account any mitigation measures.

2.2 The Appropriate Assessment ("AA") Process

2.2.1.1 According to the European Commission's Methodological Guidance on Article 6(3) and 6(4) of the Habitats Directive:

2.2.1.2 'Article 6(3) and (4) sets out a step-by-step procedure for assessing plans or projects that are likely to have impact on Natura 2000 sites. This involves three main stages:

- Stage one: screening. The first part of the procedure consists of a pre-assessment stage ('screening') to ascertain whether the plan or project is directly connected with, or necessary to, the management of a Natura 2000 site, and, if this is not the case, then whether it is likely to have a significant effect on the site (either alone or in combination with other plans or projects) in view of the site's conservation objectives. Stage one is governed by the first part of the first sentence of Article 6(3).

- Stage two: the appropriate assessment. If likely significant effects cannot be excluded, the next stage of the procedure involves assessing the impact of the plan or project (either alone or in combination with other plans or projects) against the site's conservation objectives and ascertaining whether it will affect the integrity of the Natura 2000 site, taking into account any mitigation measures. It will be for the competent authorities to decide whether or not to approve the plan or project in light of the findings of the appropriate assessment. Stage two is governed by the second part of the first sentence and the second sentence of Article 6(3).

- Stage three: derogation from Article 6(3) under certain conditions. The third stage of the procedure governed by Article 6(4). It only comes into play if, despite a negative assessment, the developer considers that the plan or project should still be carried out for imperative reasons of overriding public interest. This is only possible if there are no alternative solutions, the imperative reasons of overriding public interest are duly justified[1], and if suitable compensatory measures are adopted to ensure that the overall coherence of the Natura 2000 network is protected. In practice, more than one site may need to be considered.

2.2.1.3 Each stage of the procedure is influenced by the previous one. The order in which the stages are followed is therefore essential for applying Article 6(3) and (4) correctly. Figure 2 gives a flow chart of this procedure.' The current report provides the information to support Stage 2: Appropriate Assessment.

[1] Directive (EU) 2023/2413 amending Directive (EU) 2018/2001 as regards the promotion of energy from renewable sources (RED III), provides in Article 16f that from 21 February 2024 until climate neutrality is achieved, Member States shall ensure that, in the permit-granting procedure, the planning, construction and operation of renewable energy plants, the connection of such plants to the grid, the related grid itself, and storage assets are presumed as being in the overriding public interest and serving public health and safety when balancing legal interests in individual cases for the purposes of Article 6(4) of the Habitats Directive.

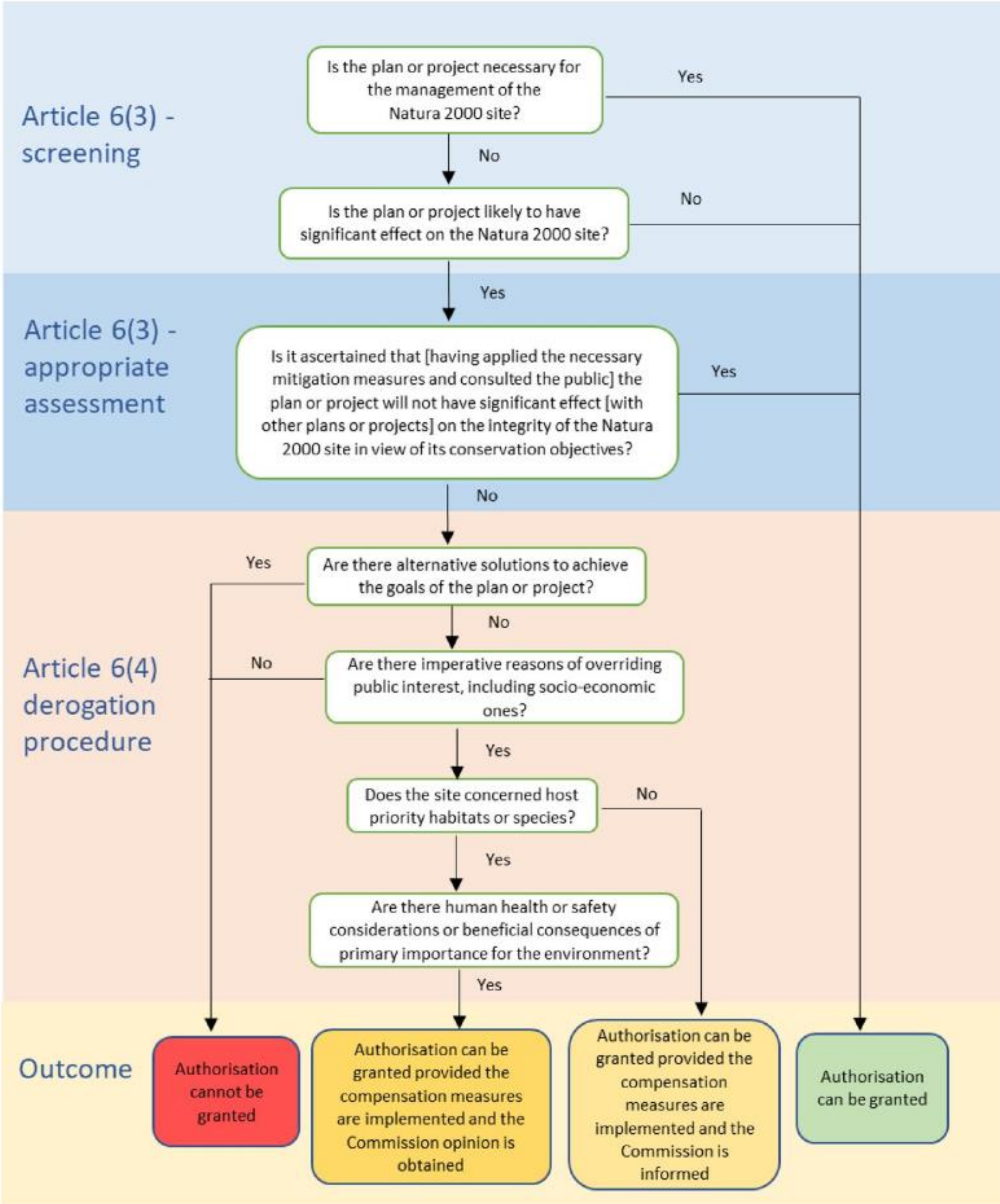


Figure 2 Procedure of Article 6 of the Habitats Directive (Source: European Commission, 2021)

2.2.2 Stage One: Screening for Appropriate Assessment

2.2.2.1 Section 177U(1) of the Planning Act provides that an assessment shall be carried out by ABP of the proposed development to assess, in view of best scientific knowledge, if that proposed development, individually or in combination with another plan or project, is likely to have a significant effect on the European site. This assessment is contained in the SISAA (see Volume 3 of the Habitats Directive Assessment of the development consent application).

2.2.2.2 This NIS assesses all European Sites identified with potential for likely significant effect which were screened in by the SISAA.

2.2.3 Stage Two: Appropriate Assessment

2.2.3.1 The Stage 2 Appropriate Assessment procedure is set out in section 177V (1) of the Planning Act. This section provides that an AA of a proposed development shall include a determination by ABP under Article 6(3) of the Habitats Directive as to whether or not a proposed development would adversely affect the integrity of a European site and an AA shall be carried out by ABP where it has made a determination under section 177U(4) that an AA is required, before consent is given for the proposed development.

2.2.3.2 In carrying out the AA, section 177V(2) provides that ABP shall take into account each of the following matters:

- the NIS;
- any supplemental information requested by or otherwise provided to ABP in relation to the NIS;
- any information or advice obtained by ABP;
- any written submissions or observations received by ABP;
- any other relevant information.
- any supplemental information requested by or otherwise provided to ABP in relation to the NIS;
- any information or advice obtained by ABP;
- any written submissions or observations received by ABP;
- any other relevant information.

2.2.3.3 ABP shall grant consent for the proposed development only after it determines that the proposed development shall not adversely affect the integrity of a European site.

2.2.3.4 Consent may be given by ABP where it has modified or attached conditions to the consent which would modify the proposed development, where ABP is satisfied to do so having determined that the proposed development would not adversely affect the integrity of the European site if it is carried out in accordance with the consent and the modifications or conditions attaching thereto.

2.2.3.5 A decision to grant consent shall include ABP's AA determination including reasons, and shall be made available to the public 'as soon as may be' after making the decision

2.2.3.6 Measures of the type referred to by the CJEU in Case C-323/17 People over Wind, being measures intended to avoid or reduce a likely harmful effects of the proposed project on a European site ('mitigation measures'), should be considered and assessed as part of the AA procedure.

2.2.3.7 An assessment carried out under Article 6(3) of the Habitats Directive must contain complete, precise and definitive findings and conclusions in the light of the best scientific knowledge in the field. It must be capable of removing all reasonable scientific doubts as to the effects of the plan or project proposed on the protected site concerned.

2.2.3.8 This NIS presents information to support the competent authority, in this case ABP, to undertake Stage 2: AA. The report aims to inform and assist the competent authority in carrying out the AA. ABP, as the competent authority, is not bound to reach the same conclusion as this report.

2.2.4 Stage three: Derogation from Article 6(3)

2.2.4.1 Section 177AA(1) of the Planning Act provides that, where, notwithstanding a determination by ABP that the proposed development will adversely affect the integrity of a European site, and in the absence of alternative solutions, ABP considers that consent should nevertheless be given for the proposed development for imperative reasons of overriding public interest, ABP shall

- (a) set out the imperative reasons of overriding public interest that necessitate the giving of consent for the proposed development,
- (b) propose the compensatory measures that are necessary to ensure that the overall coherence of the Natura 2000 network is protected,
- (c) prepare a statement of case that imperative reasons of overriding public interest exist and of the compensatory measures that are required,
- (d) forward the said statement to the Minister for Heritage, together with a copy of the planning application and NIS.

2.2.4.2 Section 177AA(2) provides that such statement of case shall specify—

- (a) the considerations that led to the assessment by ABP that the proposed development would adversely affect the integrity of a European site,

- (b) the reasons for the forming of the view by the competent authority that there are no alternative solutions (including the option of not giving consent for the proposed development),
- (c) the reasons for the forming of the view by the competent authority that imperative reasons of overriding public interest apply to the proposed development,
- (d) compensatory measures that are being proposed as necessary to ensure the overall coherence of Natura 2000 including, if appropriate, the provision of compensatory habitat and the conditions to which any consent for proposed development shall be subject requiring that the compensatory measures are carried out.

2.2.4.3 In relation to a European site that does not host a priority natural habitat type or priority species, section 177AA(3) provides that the imperative reasons of overriding public interest may include those of a social or economic nature.

2.2.4.4 In relation to a European site that hosts a priority natural habitat type or priority species, section 177AA(4) provides that the only imperative reasons of overriding public interest that may be considered are those relating to—

- (a) human health,
- (b) public safety,
- (c) beneficial consequences of primary importance to the environment, or
- (d) subject to subsection (7), having obtained an opinion from the European Commission other imperative reasons of overriding public interest.

2.2.4.5 Section 177AA(5) and (6) require ABP to furnish the statement of case to the Applicant and to make it available for inspection by the public . ABP is required under section 177AA(7) to advise the Minister as to why the Minister should be satisfied to request an opinion from the Commission on invoking imperative reasons of overriding public interest.

2.2.4.6 Section 177AA(8) defines ‘compensatory measures’ for the purposes of that section and sections 177AB and 177AC as measures proposed by the Applicant and adopted by ABP or the Minister for the purposes of ensuring that the overall coherence of the Natura 2000 network is protected and such measures may include the provision of compensatory habitat. ABP is entitled under section 177A(9) to attach conditions relating to compensatory measures, which may include a condition requiring the making of contributions to finance the provision of compensatory measures and any such condition shall have effect as if it was attached to the grant of consent for proposed development, pursuant to the relevant provisions of this Act, that apply to such a grant of consent.

2.2.4.7 Section 177AB of the Planning Act sets out the procedure to be followed where the Minister receives a statement of case under section 177AA relating to a European site or sites that does or do not host a priority habitat type or priority species. In this situation, the Minister shall form a view as to whether the compensatory measures proposed are sufficient to ensure that the overall coherence of the Natura 2000 network is protected. The Minister may engage in consultations with ABP and the Applicant in relation to any modifications to such measures as may be required, and where the Minister forms an opinion that the proposed compensatory measures (as may be modified) are sufficient, the Minister shall issue a notice to this effect, and ABP may then proceed to grant consent for the proposed development. Where the Minister forms a contrary opinion, ABP shall not grant consent. The Minister shall notify the European Commission of any project consented pursuant to Article 6(4) procedures, including the compensatory measures proposed.

2.2.4.8 Section 177AC of the Planning Act sets out the procedure to be followed where the Minister receives a statement of case under section 177AA relating to a European site or sites that does or do host a priority habitat or priority species. In this situation, in addition to considering the adequacy of the compensatory measures proposed, the Minister shall also consider whether it is necessary to obtain the opinion of the European commission as to whether imperative reasons of overriding public interest would justify a derogation from Article 6(4) in the circumstances of the particular case.

3 Methodology and Guidance

3.1.1.1 The report has been produced in accordance with 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 February 10);
- Guidelines for Ecological Impact Assessment in the UK and Ireland. Chartered Institute of Ecology and Environmental Management (CIEEM 2018, updated April 2022);
- Offshore Renewable Energy Development Plan II: Strategic Environmental Assessment Report. Department of Environment, Climate and Communications & Sustainable Energy Authority Ireland (2023);
- Offshore Renewable Energy Development Plan II: Principles Report. Department of Environment, Climate and Communications & Sustainable Energy Authority Ireland (2022);
- Offshore Renewable Energy Development Plan II: Appropriate Assessment – Screening Report. Department of Environment, Climate and Communications & Sustainable Energy Authority Ireland (2022)
- Guidance on EIS and NIS preparation for Offshore Renewable Energy Projects. Department of Communications, Climate Action and Environment, Department of Communications, Climate Action and Environment and the Sustainable Energy Authority of Ireland (2017);
- Commission Notice 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 (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);
- Managing Natura 2000 Sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. European Commission (2019);
- European Commission: Directorate-General for Environment, Guidance document on assessment of plans and projects in relation to Natura 2000 sites – A summary (Publications Office of the European Union, 2022)
- 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 (2012);

- Guidance to Manage the Risk to Marine Mammals from Manmade Sound Sources in Irish Waters. Department of Arts, Heritage and Gaeltacht (2014);
- Wind energy developments and Natura 2000. European Commission (EC, 2011); and
- 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).

3.1.1.2 In addition to the Guidance outlined above on the approach to assessments and structure of the NIS, topic specific guidance is outlined within Section 5 that draws upon the latest receptor specific research and outcomes of monitoring studies undertaken during the construction and O&M phases of operational windfarms across the UK, across Europe and worldwide. This NIS takes account of the latest scientific findings referenced throughout. This approach is intended to avoid the potential for scientific doubt within the assessments.

3.2 Consultation

3.2.1.1 Consultation by the Applicant has been ongoing throughout the preparation of the NIS and the EIAR. Early engagement with prescribed bodies, the public and other relevant bodies and organisations have informed the approach to the assessment. Where practicable and appropriate, the information, data sources and advice received from the consultation process has informed the AA process and project design of the Dublin Array offshore wind farm.

3.2.1.2 Consultation undertaken to support this NIS is provided within the SISAA, comments are captured from consultation specific to the AA process but also, where relevant, consultation undertaken as part of the wider consultation process for the project and EIAR.

3.3 Approach to assessment alone

3.3.1.1 The assessment criteria and conclusions draw upon the relevant baseline technical reports of the EIAR (as referenced in Section 1) and are informed by the site-specific surveys and modelling as referenced throughout the assessment.

3.3.1.2 The assessment criteria draws upon relevant technical guidance for each receptor and effect defined using the most recent guidance and experience from other wind farm projects in Ireland and across the UK and Europe. This approach is intended to avoid the potential for scientific doubt within the assessments. The assessment approach and criteria for each receptor is identified upfront of the assessments.

3.3.1.3 Integrity of the site relates to its QIs, COs and the condition of the site. Ecological integrity has been defined in Managing Natura 2000 sites, (EC, 2019) 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". "As regards the connotation or meaning of 'integrity', this clearly relates to **ecological integrity**. This can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation".

3.3.2 Flexibility and Maximum Design Option

3.3.2.1 In line with guidance (EC, 2021). the approach to screening identified all elements of the proposed works with the potential to have a significant effect on a European site. As set out in the Application for Opinion under Section 287B, flexibility is being sought for the offshore infrastructure where details or groups of details may not be confirmed at the time of the application. In summary, and as subsequently set out in the ABP Opinion on Flexibility (issued on 3 December 2024), the flexibility being sought relates to those details or groups of details associated with the following components (see further detail in Part 1: Project Description of this Habitats Directive Assessment):

- WTG (model – dimensions and number);
- OSP (dimensions);
- Array layout (layout and limits of deviation);
- Foundation type (WTG and OSP; types and dimensions and scour protection techniques); and
- Offshore cables (IAC and ECC; length, layout, limits of deviation).

3.3.2.2 As defined in Volume 2 of this Habitats Directive Assessment, to ensure a robust and transparent assessment, and one that is compliant with the Opinion under Section 287B, those details or groups of details associated with those components where flexibility is being sought are defined in the form of a MDO and alternative design option(s).

3.3.2.3 In addition to the details or groups of details associated with the components listed above (where flexibility is being sought) the wider design details and construction methods that are also referenced in Section 3 will be assessed as appropriate. Whilst flexibility is not being sought under Section 287B for these elements, those associated design details and construction methods are also incorporated into the MDO and alternative option(s) approach to ensure that all details are considered and assessed.

3.3.2.4 The precautionary approach to defining the maximum design i.e. those design options which will give rise to the greatest effect and all alternative options will ensure that the AA stage will identify all aspects of the project for which there is a possibility of significant effects on the integrity of European protected sites or species. Accordingly, the MDO will be defined as that which would have the greatest magnitude of effects on a relevant European site.

3.3.2.5 This NIS will include an assessment of the effects arising from all the design options and parameters that have been screened in at Stage 1. No adverse effect of greater significance than those which have been assessed will arise from the project. Therefore, there can be certainty that all the aspects of the project which can, either individually or in combination with other plans or projects, affect those (conservation) objectives have been identified in the light of the best scientific knowledge in the field.

3.3.2.6 The onshore assessment of the OES and O&M Base in Dún Laoghaire Harbour are not subject to an opinion on flexibility under Section 287B with all assessments undertaken against the project description outlined in Part 1 of this Habitats Directive Assessment.

3.3.3 Decommissioning

3.3.3.1 The Decommissioning and Restoration Plan (Volume 7, Appendix 2), including the three rehabilitation schedules attached thereto, describe how the Applicant proposes to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usages the subject of the MACs (Reference Nos. 2022-MAC-003 and 004 / 20230012 and 240020). It is based on the best scientific and technical knowledge available at the time of submission of this planning application.

3.3.3.2 However, the lengthy passage of time between submission of the application and the carrying out of decommissioning works (expected to be in the region of 30-35 years) gives rise to knowledge limitations and technical difficulties. Accordingly, the Decommissioning and Restoration Plan will be kept under review by the Applicant as the project progresses, and an alteration application will be submitted if necessary. In particular, the Plan will be reviewed having regard to the following:

- The baseline environment at the time rehabilitation works are proposed to be carried out;
- What, if any, adverse effects have occurred that require rehabilitation;
- Technological developments relating to the rehabilitation of marine environments;
- Changes in what is accepted as best practice relating to the rehabilitation of marine environments;
- Submissions or recommendations made to the Applicant by interested parties, organisations and other bodies concerned with the rehabilitation of marine environments; and/or
- Any new relevant regulatory requirements.

3.3.3.3 For the purposes of the NIS, the assessment will take account of the Decommissioning and Restoration Plan which provides a description of the decommissioning activities. As the final details of same are not yet certain, the impacts on all receptors during the decommissioning phase are considered to be similar to those outlined in the construction phase. For offshore infrastructure, turbines are to be removed in a reversal of construction methodology with pilings cut off at or below the seabed to a depth so as not to become uncovered in the future, cables and scour protection left in situ with all hazardous materials to be removed or contained prior to removal from site. Similarly, the Offshore Substation Platform (OSP) will be removed and returned to shore for decommissioning and disposal.

3.3.3.4 Insofar as the onshore electrical infrastructure is concerned, this will be transferred into the ownership of Eirgrid after the proving period. Eirgrid will be the ultimate entity with responsibility for the onshore electrical system and will decide whether to decommission or continue to use the assets. Accordingly, this planning application does not seek permission for decommissioning of the onshore electrical system. However, for the purpose of enabling environmental assessment, the Applicant's recommended approach to decommissioning the onshore electrical system is set out in the Part 1: Project Description. The Applicant has environmentally assessed this proposal. This proposal is based on the Applicant's experience of decommissioning onshore electrical systems and knowledge of how Eirgrid typically do this. As above, where a potential for LSE arises for construction activity, sites have been screened in for both decommissioning and construction.

3.3.3.5 In so far as the onshore O&M Base is concerned, the proposed approach to decommissioning is set out in the Decommissioning and Restoration Plan. The O&M building will be either re-purposed for an alternative use or demolished following the decommissioning of the offshore infrastructure. Following the decommissioning of the offshore infrastructure the fencing and pontoon will be removed and the hardstanding area will be taken over by DLRCC for general harbour operations. Decommissioning activities for the OES and the O&M Base are not anticipated to exceed the construction phase design parameters which have been assessed

3.3.4 Conservation Objectives

3.3.4.1 In order to determine whether significant effects are likely to occur to an SAC or SPA, the predicted effects must be measured against each site's conservation objectives ("CO").

3.3.4.2 Where site specific CO documents have been published, these specific CO and QI target attributes that define Favourable Conservation Status for a particular habitat or species at a given site have been considered. The full list of COs have been included as Appendix A and are included up front of the relevant site assessments.

3.3.4.3 For some sites designated for marine mammal receptors, e.g. sites where marine mammal QIs have recently been designated, site specific CO have not yet been published. In these cases, to ensure a robust and precautionary assessment, the approach taken in this NIS has been to assess against proxy site-specific CO from nearby sites with similar ecological conditions e.g. habitats and species with the same QIs as these provide more focussed advice than the generic CO identified. We are satisfied this enables a robust assessment for the potential for adverse effects on the integrity of relevant European Sites. The conservation objectives have been identified within Appendix A and throughout.

3.3.4.4 This NIS includes an assessment of the effects arising from all the design options and parameters that have been screened in at Stage 1. No adverse effect of greater significance than those which have been assessed will arise from the project. Therefore, there can be certainty that all the aspects of the project which can, either individually or in combination with other plans or projects, affect those (conservation) objectives have been identified in the light of the best scientific knowledge in the field.

3.3.4.5 If adverse effects on integrity of sites are identified, mitigation measures are introduced to avoid the relevant impacts or reduce them to a level where they will no longer adversely affect the integrity of the site.

3.3.5 Project design features and avoidance and preventative measures

3.3.5.1 For Dublin Array mitigation measures are presented as project design features or other avoidance and preventative measures as presented below:

- Project Design Features: These are features of the Dublin Array project that were selected as part of the iterative design process, which are demonstrated to avoid and prevent significant adverse effects on the environment that are presented within Part 1 of this HDA: Project Description;
- Other Avoidance and Preventative Measures: These are measures that were identified throughout the early development phase of the Dublin Array project, also to avoid and prevent likely significant effects, which go beyond design features. These measures were incorporated in as constituent elements of the project, they are referenced in the project description Chapter of this HDA and they form part of the project for which development consent is being sought. These measures are distinct from design features and are found within the suite of management plans detailed throughout; and
- Additional Mitigation: These are measures that were introduced to the Dublin Array project where the potential for adverse effect on integrity process arises. These measures are detailed as relevant within the individual site assessments.

3.3.5.2 All project design, avoidance and preventative measures, together with any additional mitigation identified throughout the alone or in combination assessments are presented within Section 7 of this document.

3.4 Approach to in-combination assessment

3.4.1.1 Article 6(3) of the Habitats Directives requires the Competent Authority to subject "*any plan or project not directly connected with or necessary to the management of a European Site but likely to have a significant effect thereon, either alone or in-combination with other plans or projects to an appropriate assessment of its implications for the site.*"

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. "

3.4.1.2 As set out in the Commission's 2019 Notice (EC, 2019), significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned.

3.4.1.3 Projects have been screened in from a long list, developed in line with guidance outlined in Section 2., Plans or projects which are completed, approved but uncompleted, or proposed have been considered. EC (2019) specifically advises 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"*.

3.4.1.4 Due consideration has been given to establishing the maximum suite of projects with potential for connectivity to QI and European sites resulting in an in- combination effect to arise. The long list of projects has been established based upon extensive areas of search, appropriate for each receptor and which take into account species range and mobility as well as the pathways for effects. Within the search areas defined for the receptors all plans and projects that can reasonably be foreseen were screened.

3.4.1.5 The search areas have been informed by expert judgement and from precedents set by jurisdictions and countries with an established offshore renewable energy sectors and where comprehensive guidance has been developed. For additional information on the areas of search that have been included within the long lists and approach to defining the long list please refer to the SISAA.

3.4.1.6 The full short list of projects for each receptor group is provided in Section 2, 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.

3.4.1.7 As is typical for an in-combination assessment, for many plans and projects there is a degree of uncertainty regarding project design and timeframe but also quantified environmental impacts. To take account of the level of detail available projects were tiered reflecting their current stage within the planning and development process at the point that the in-combination assessment was completed. The tier structure is intended to ensure that there is a clear understanding of the level of confidence in the in-combination assessment. Tiers are defined as per Table 2 with each project tiering identified in the tables.

Table 2 Description of tiers of other developments considered

Tier	Developments considered
Tier 1	Project under construction. Those projects that are only partially constructed at the time that baseline characterisation is undertaken.
	Projects 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.
	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.
Tier 2	Permitted application(s), but not yet implemented.
Tier 3	Submitted consent application(s), but not yet determined. This will include the Phase 1 projects awarded a MAC with applications submitted.
	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.
	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.
	Reasonably foreseeable projects in the pre-planning phase, whereby an application for development consent has not yet been made but there is sufficient information in the public domain about the project and its likely significant effects in order to include it in this assessment.

3.4.1.8 The full short lists of plans/projects are provided for each receptor group in Section 6.

3.4.1.9 The approach to assessing in combination draws upon guidance in the same way as the project alone assessment but is also informed by additional quantitative modelling that is outlined in the relevant sections.

3.5 Document Structure

3.5.1.1 The structure of the NIS can be broadly summarised as follows:

- Section 1 and 2: Introduction. A background to the proposed development and purpose of this document, including relevant legislation and guidance and the approach to the assessment;
- Section 4: Screening. Sets out the results of Stage 1: Screening for Appropriate Assessment, including information on the European sites likely to be significantly affected by the proposed works alone or in-combination, Qualifying interests (QIs) of each site screened in, and the elements of the proposed works that could potentially give rise to an adverse effect on integrity (AEoI) on sites and their qualifying interests;
- 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: Mitigation measures provides a summary of the mitigation measures proposed and how these will address the potential impacts; and
- Section 8: Provides the screening statement and conclusions of the AA process, together with a Transboundary Statement which provides information on European sites outside the jurisdiction of Ireland.

4 Screening outcomes

4.1.1.1 In total fifty three SACs and eighty nine SPAs were considered for the potential for LSE to arise via the identified source-receptor-pathways. With reference to the qualifying interest, sensitivities and the COs for the sites, the screening assessment concluded the possibility of LSE with respect to 45 SACs and 38 SPAs.

4.1.1.2 These SACs and SPAs are listed below in Table 3 and are taken forward for assessment within Section 5 for project alone and Section 6 in combination with other plans and projects.

Table 3 European sites screened in for Stage 2 AA for the potential of LSE from construction, decommissioning and O&M of the offshore infrastructure

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
SACs screened in for assessment				
Ireland	Rockabill to Dalkey Island SAC [IE003000]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
		Reef	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species	▪ Accidental pollution) ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species ▪ EMF
Ireland	South Dublin Bay SAC [IE 000210]	Mudflats and sandflats Salicornia and other annuals	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species
Ireland	North Dublin Bay SAC [IE000206]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution ▪ Invasive species
Ireland	Baldoyle Bay SAC [IE000199]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution ▪ Invasive species

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Mediterranean salt meadows		
Ireland	The Murrough Wetlands SAC [IE002249]	Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution) ▪ Invasive species
Ireland	Codling Fault Zone SAC [IE003015]	Submarine structures made by leaking gases	▪ Accidental pollution ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution ▪ Invasive species
		Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
Ireland	Wicklow Mountains SAC [IE002122]	Otters	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey ▪ Habitat loss ▪ Habitat disturbance ▪ Underwater noise	▪ Disturbance and displacement ▪ Accidental pollution
Ireland	Slaney River Valley SAC [IE000781]	Twaite shad Atlantic salmon Sea lamprey Freshwater pearl mussel	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	▪ Underwater noise ▪ EMF ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey
Ireland	River Boyne and River Blackwater SAC [IE002299]	Atlantic Salmon	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	▪ Underwater noise ▪ EMF ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Ireland	Lambay Island SAC [IE000204]	Grey seal Harbour seal Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
Ireland	Blackwater Bank SAC [IE002953]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	Pen Llyn a'r Sarnau SAC [UK0013117]	Grey seal Bottlenose dolphin	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	Cardigan Bay SAC [UK0012712]	Bottlenose dolphin	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Hook Head SAC [IE0000764]	Harbour porpoise Bottlenose dolphin	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Bunduff, Lough and Machair/ Trawalua/	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
	Mullaghmore SAC [IE0000625]		▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Kilkieran Bay and Islands SAC [IE0002111]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Inishmore Island SAC [IE0000213]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	West Connacht Coast SAC [IE0002998]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Kenmare River SAC [IE0002158]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Carnsore Point SAC [IE0002269]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Ireland	Belgica Mound Province SAC [IE0002327]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	North Anglesey Marine SAC [UK0030398]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	West Wales Marine / Gorllewin Cymru Forol SAC [UK0030397]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	North Channel SAC [UK0030399]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Wales	The Bristol Channel Approaches SAC [UK0030396]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Roaringwater Bay and Islands SAC [IE000101]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
			▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Accidental pollution (Offshore infrastructure and O&M Base)
Ireland	Blasket Island SAC [IE002172]	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
France	French SAC (18 sites) Abers – Côte des Légendes SAC [FR5300017], Anse de Vauville SAC [FR2502019], Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC [FR5300012], Baie de Morlaix SAC [FR5300015], Baie de Saint-Brieuc – Est SAC [FR5310050], Baie du Mont Saint-Michel SAC [FR2500077], Banc et récifs de Surtainville SAC [FR2502018],	Harbour porpoise	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
	Cap d'Erquy-Cap Fréhel SAC [FR3102002], Chausey SAC [FR3102003], Chaussée de Sein SAC [FR5302007], Côte de Granit Rose-Sept Iles SAC [FR5310011], Côtes de Crozon SAC [FR5302006], Estuaire de la Rance SAC [FR5300061], Mers Celtiques – Talus du golfe de Gascogne SAC [FR5302015], Nord Bretagne DH SAC [FR2502022], Ouessant-Molène SAC [FR5300018], Récifs et landes de la Hague SAC [FR2500084], Tregor Goëlo SAC [FR5300010]			
SPAs screened in for assessment				
Ireland	North-west Irish Sea SPA [IE004236]	Arctic tern Black-headed gull Common gull Common tern	▪ Indirect effects on prey	▪ Indirect effects on prey

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Cormorant Fulmar Great black-backed gull Guillemot Herring gull Kittiwake Lesser black-backed gull Little gull Little tern Manx shearwater Razorbill Roseate tern Shag		
		Common scoter Great northern diver Red-throated diver	▪ Disturbance and displacement ▪ Indirect effects on prey	▪ Disturbance and displacement ▪ Indirect effects on prey
Ireland	South Dublin Bay and River Tolka Estuary SPA [IE004024]	Common tern Roseate tern	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk
		Arctic tern Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey
		Dunlin Grey plover Knot Light-bellied brent goose Oystercatcher Redshank Ringed plover	-	▪ Migratory collision risk
Ireland	North Bull Island SPA [IE004006]	Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey
		Curlew Dunlin Grey plover	-	▪ Migratory collision risk

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Knot Light bellied goose Oystercatcher Pintail Redshank Shoveler Shelduck Teal Turnstone		
Ireland	Dalkey Island SPA [IE004172]	Arctic tern	▪ Indirect effects on prey	▪ Indirect effects on prey
		Common tern Roseate tern	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk
Ireland	Howth Head SPA [IE004113]	Kittiwake	▪ Indirect effects on prey ▪ Disturbance and displacement	▪ Indirect effects on prey ▪ Disturbance and displacement ▪ Collision risk
Ireland	Ireland's Eye SPA [IE004117]	Herring gull	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk
		Guillemot Razorbill	▪ Indirect effects on prey ▪ Disturbance and displacement	▪ Indirect effects on prey ▪ Disturbance and displacement
		Kittiwake	▪ Indirect effects on prey ▪ Disturbance and displacement	▪ Indirect effects on prey ▪ Disturbance and displacement ▪ Collision risk
		Cormorant	▪ Indirect effects on prey ▪ Disturbance and displacement	▪ Indirect effects on prey
Ireland	Wicklow Mountains SPA [IE002122]	Merlin	-	▪ Migratory collision risk

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Ireland	Baldoyle Bay SPA [IE004016]	Grey plover Light-bellied brent goose Ringed plover Shelduck	-	▪ Migratory collision risk
Ireland	The Murrough SPA [IE004186]	Red-throated diver	▪ Disturbance and displacement ▪ Indirect effects on prey	▪ Disturbance and displacement ▪ Indirect effects on prey
		Black-headed gull Herring gull Little tern	▪ Indirect effects on prey	▪ Indirect effects on prey
		Light-bellied brent goose Teal Wigeon	-	▪ Migratory collision risk
Ireland	Lambay Island SPA [IE004069]	Guillemot Razorbill Shag	▪ Disturbance and displacement	▪ Disturbance and displacement
		Herring gull Lesser black-backed gull	-	▪ Collision risk
		Cormorant	▪ Disturbance and displacement	-
		Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
Ireland	Wicklow Head SPA [IE004127]	Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement
Ireland	Skerries Islands SPA [IE004122]	Herring gull	-	▪ Collision risk
		Cormorant	▪ Disturbance and displacement	-
Wales	Aberdaron Coast and Bardsey Island	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement

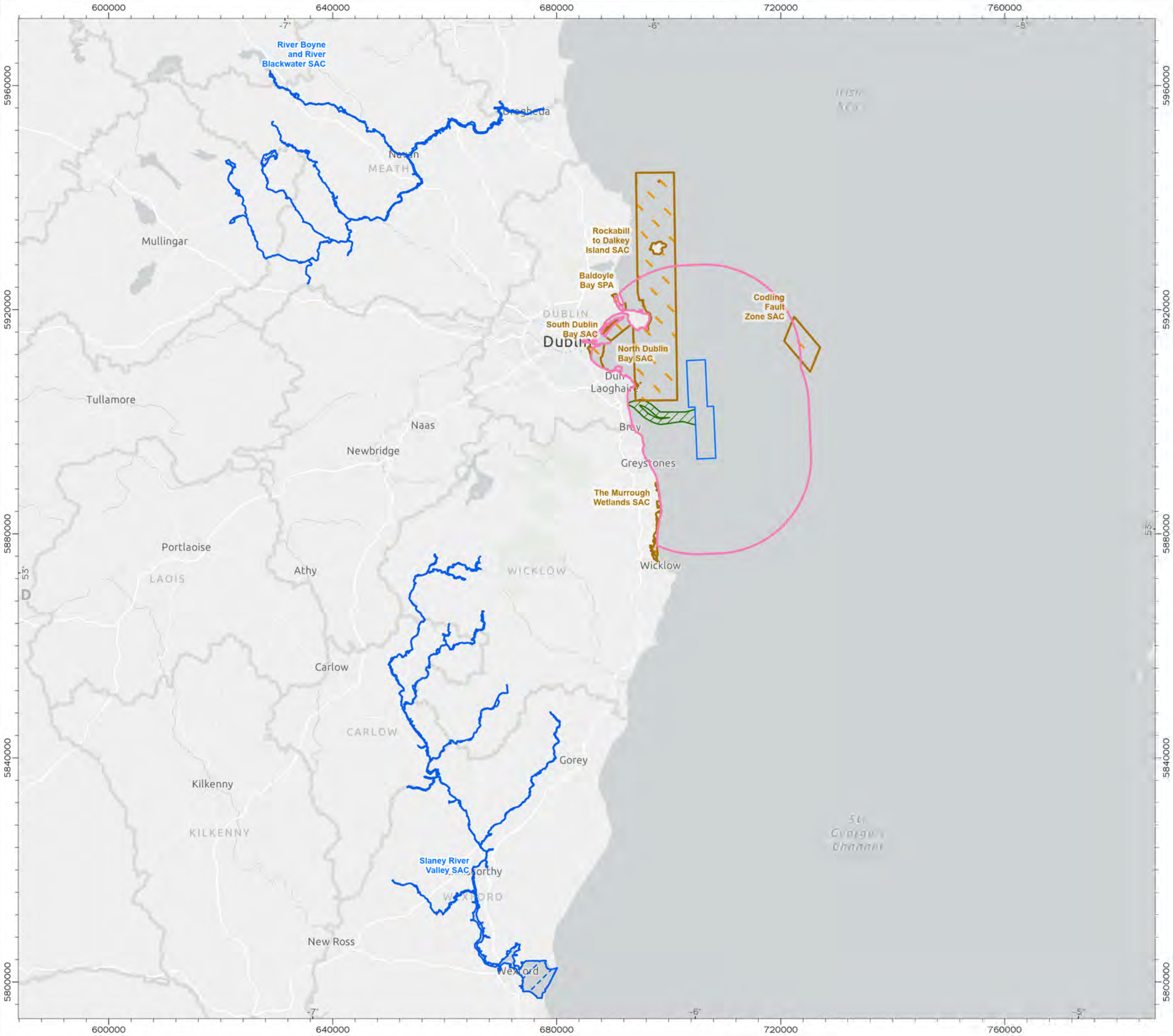
Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
	/ Glannau Aberdaron ac Ynys Enlli [UK9013121]			
Ireland	Saltee Islands SPA [IE004002]	Guillemot Razorbill	▪ Disturbance and displacement	▪ Disturbance and displacement
		Lesser black-backed gull	-	▪ Collision risk
		Gannet Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement
Northern Ireland	Copeland Islands SPA [UK9020291]	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
Wales	Skomer, Skokholm the Seas off Pembrokeshire SPA [UK9014051]	Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement
		Guillemot Razorbill	▪ Disturbance and displacement	▪ Disturbance and displacement
		Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
		Lesser black-backed gull	-	▪ Collision risk

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Wales	Grassholm SPA [UK9014041]	Gannet	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
Ireland	Dungarvan Harbour SPA [IE004032]	Black-tailed godwit Curlew Dunlin Great crested grebe Grey plover Knot Lapwing Light-bellied brent goose Oystercatcher Red-breasted merganser Redshank Shelduck Turnstone	-	▪ Migratory collision risk
Ireland	Helvick Head and Ballyquin SPA [IE0004192]	Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement
Ireland	Old Head of Kinsale SPA [IE0004021]	Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement
Ireland	Blackwater Estuary SPA [IE0004028]	Black-tailed godwit Curlew Dunlin Lapwing Redshank Wigeon	-	▪ Migratory collision risk
England	Ribble and Alt Estuaries SPA [UK9005103]	Lesser black-backed gull	-	▪ Collision risk
Ireland	Ballymacoda Bay SPA [IE0004023]	Black-tailed godwit Curlew Dunlin Grey plover	-	▪ Migratory collision risk

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Lapwing Redshank Ringed plover Teal Turnstone Wigeon		
England	Morecambe Bay and Duddon Estuary SPA [UK9020326]	Herring gull Lesser black-backed gull	-	▪ Collision risk
Ireland	Ballycotton Bay SPA [IE0004022]	Black-tailed godwit Curlew Grey plover Lapwing Ringed plover Teal Turnstone	-	▪ Migratory collision risk
Northern Ireland	Rathlin Island SPA [UK9020011]	Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
		Guillemot Razorbill	-	▪ Disturbance and displacement
Scotland	Ailsa Craig SPA [UK9003091]	Gannet Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
		Lesser black-backed gull	-	▪ Collision risk
Scotland	North Colonsay and Western Cliffs SPA [UK9003171]	Guillemot	-	▪ Disturbance and displacement

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
England	Isles of Scilly SPA [UK9020288]	Lesser black-backed gull Great black-backed gull	-	▪ Collision risk
Scotland	Mingulay and Berneray SPA [UK9001121]	Guillemot Razorbill	-	▪ Disturbance and displacement
Scotland	Rum SPA [UK9001341]	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
Scotland	Shiant Isles SPA [UK900104]	Razorbill	-	▪ Disturbance and displacement
Scotland	St Kilda SPA [UK9001031]	Gannet	-	▪ Disturbance and displacement ▪ Collision risk
		Guillemot	-	▪ Disturbance and displacement
Scotland	Flannan Isle SPA [UK9001021]	Guillemot	-	▪ Disturbance and displacement
Scotland	Handa SPA [UK9001241]	Razorbill Guillemot	-	▪ Disturbance and displacement
Scotland	Cape Wrath SPA [UK9001231]	Razorbill Guillemot	-	▪ Disturbance and displacement

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
Scotland	Sule Skerry and Sule Stack SPA [UK9002181]	Gannet	-	▪ Disturbance and displacement ▪ Collision risk
		Guillemot	-	▪ Disturbance and displacement
Scotland	North Rona and Sula Sgeir SPA [UK9001011]	Gannet	-	▪ Disturbance and displacement ▪ Collision risk



- Array Area
- Export Cable Corridor
- Fish and Intertidal/Subtidal Habitats (17km Buffer)

Special Areas of Conservation (SACs)

- Designated Sites for Subtidal and Intertidal Features
- Designated Sites for Fish

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

SACs Screened in for AA - Fish and Intertidal/Subtidal

DRAWING NUMBER: 3

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-16	For Issue	GB	BB	SS

0 6 12 18 24 km
0 3 6 9 12 nm

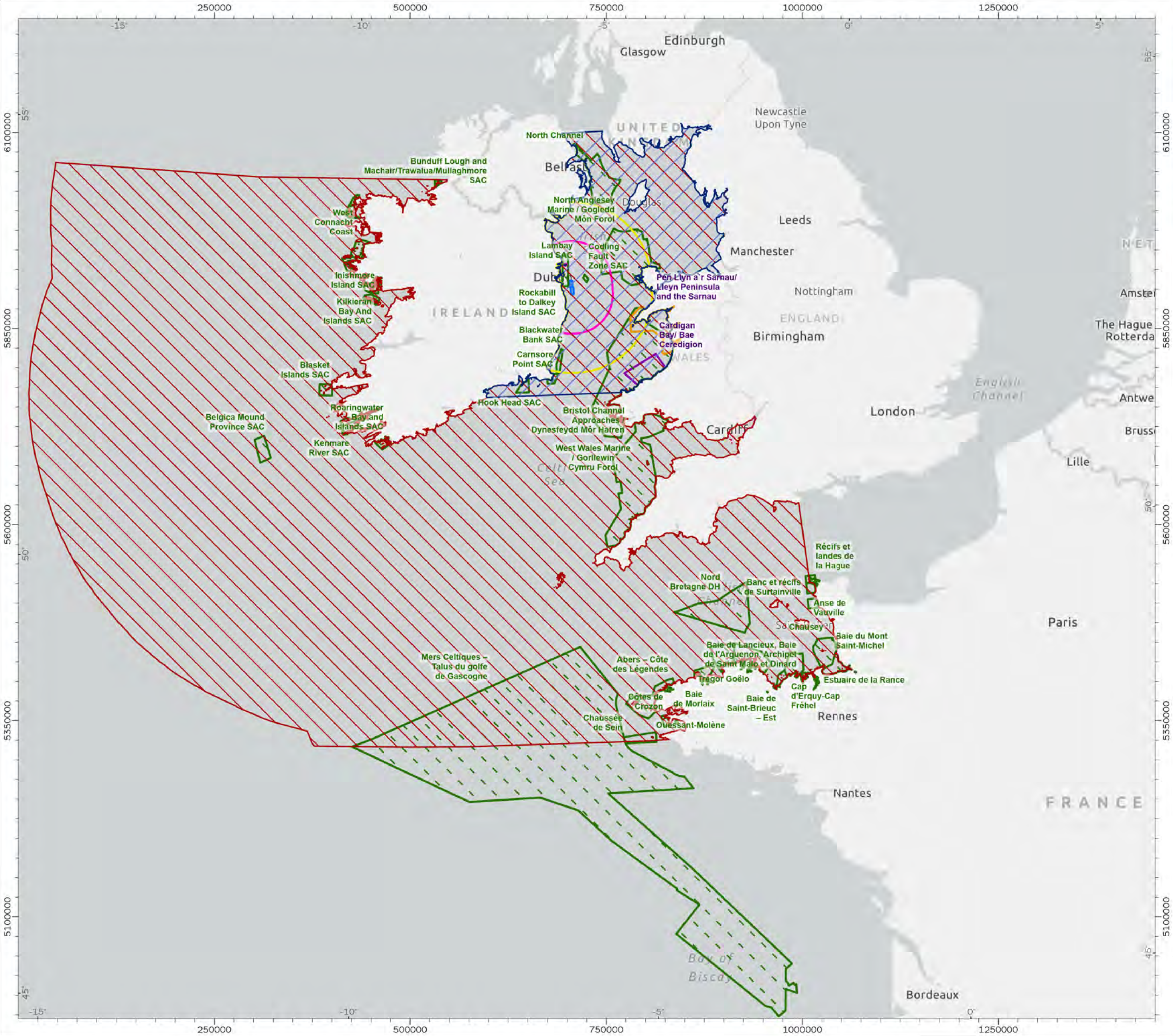
N

SCALE	1:700,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited



- Array Area
- Harbour Seals (50km Buffer)
- Grey Seal and Fish (100km Buffer)
- Harbour Porpoise - Celtic & Irish Seas Management Unit
- Bottlenose Dolphin - Irish Sea Management Unit
- Bottlenose Dolphin SACs
- Harbour Porpoise SACs
- Grey Seal SACs
- Harbour Seal SACs

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PROJECT TITLE

Dublin Array

DRAWING TITLE

SACs Screened in for AA - Harbour Porpoise and Bottlenose Dolphin

DRAWING NUMBER: 4

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-16	For Issue	GB	BB	SS

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0 20 40 60 80 nm

SCALE 1:5,000,000 | PLOT SIZE A3
DATUM WGS 1984 | VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array — Generation for generations — Kish Offshore Wind Limited - Bray Offshore Wind Limited

Array Area
Special Protection Area (SPA)

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PROJECT TITLE
Dublin Array

DRAWING TITLE
SPAs Screened in for AA

DRAWING NUMBER: 5 | PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
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0 20 40 60 80 nm

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DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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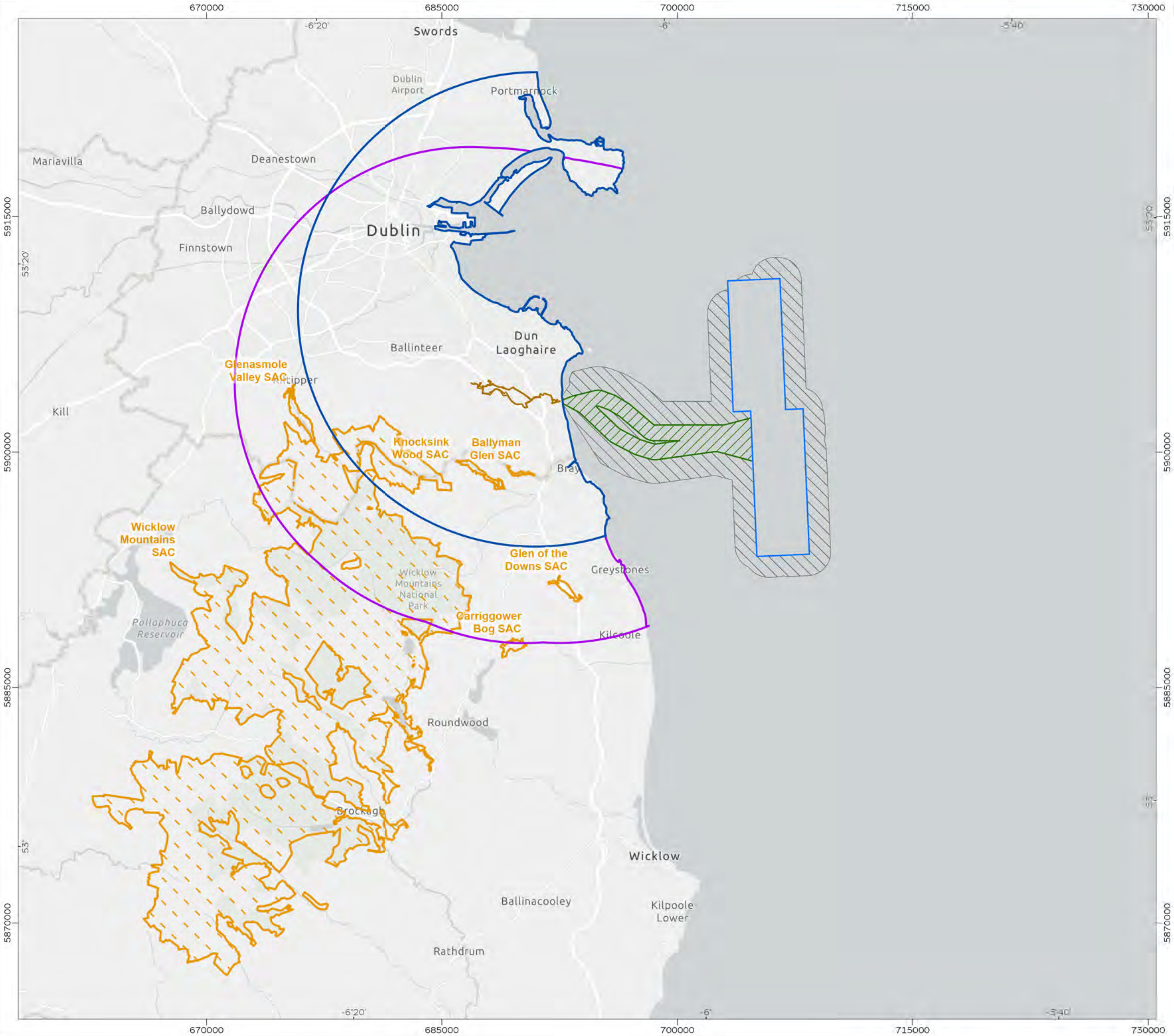
Table 4 European sites screened in for LSE associated with construction of the O&M Base

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
SACs screened in for assessment				
Ireland	Rockabill to Dalkey Island SAC [IE003000]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Codling Fault Zone SAC [IE003015]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Lambay Island SAC [IE000204]	Grey seal Harbour seal Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Blackwater Bank SAC [IE002953]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Wicklow Mountains SAC [IE002122]	Otter	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey ▪ Habitat loss ▪ Habitat disturbance ▪ Underwater noise	▪ Disturbance and displacement ▪ Accidental pollution
Wales	Pen Llyn a'r Sarnau SAC [UK0013117]	Grey seal Bottlenose dolphin	▪ Accidental Pollution	▪ Accidental Pollution
Wales	Cardigan Bay SAC [UK0012712]	Bottlenose dolphin	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Hook Head SAC [IE0000764]	Harbor porpoise Bottlenose dolphin	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Bunduff, Lough and Machair/ Trawalua/ Mullaghmore SAC [IE0000625]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Lough Swilly SAC [IE0002287]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Kilkieran Bay and Islands SAC [IE0002111]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution

Jurisdiction	European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Ireland	Inishmore Island SAC [IE0000213]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	West Connacht Coast SAC [IE0002998]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Kenmare River SAC [IE0002158]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Carnsore Point SAC [IE0002269]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Belgica Mound Province SAC [IE0002327]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Wales	North Anglesey Marine SAC [UK0030398]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Wales	West Wales Marine / Gorllewin Cymru Forol SAC [UK0030397]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Wales	North Channel SAC [UK0030399]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Wales	The Bristol Channel Approaches SAC [UK0030396]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Roaringwater Bay and Islands SAC [IE000101]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
Ireland	Blasket Island SAC [IE002172]	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution
France	French SAC (18 sites)	Harbour porpoise	▪ Accidental Pollution	▪ Accidental Pollution

Table 5 European sites screened in for LSE associated with construction of the onshore infrastructure (TJB/landfall and OES)

Jurisdiction	European site name	QI	Effects screened in for construction and decommissioning	Effects screened in for O&M
SACs screened in for assessment				
Ireland	Wicklow Mountains SAC [IE002122]	Otter	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey ▪ Habitat loss ▪ Habitat disturbance ▪ Underwater noise	▪ Disturbance and displacement ▪ Accidental pollution



- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Onshore Development Boundary
- Onshore Corridor (15km Buffer)
- Onshore - O&M Base (15km Buffer)
- Special Areas of Conservation (SACs)

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

SACs Screened in for AA - Onshore Sites

DRAWING NUMBER: 6

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-16	For Issue	GB	BB	SS

0 2 4 6 8 km
0 1 2 3 4 nm

SCALE	1:250,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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5 Assessment of adverse effects for project alone

5.1 Introduction

5.1.1.1 As defined in Section 3.3, where potential for LSE on a European site has been identified, there is a requirement to consider whether those effects will adversely affect the integrity of the site in view of its conservation objectives. The information for all European sites screened in is presented below according to the following receptor groupings:

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

5.1.1.2 The assessment follows the approach outlined in Section 3.3, with an overview of key guidance and supporting information drawn upon for each receptor grouping.

5.2 Subtidal and intertidal benthic ecology

5.2.1 Assessment approach

5.2.1.1 In line with the EIAR the sensitivities of different biotopes and community complexes[2] have been classified by The Marine Life Information Network (MarLIN) on the MarESA four-point scale (high, medium, low and not sensitive). 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.

5.2.1.2 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.).

5.2.1.3 Detailed information on the benchmarks used and further information on the definition of resistance and resilience can be found on the MarLIN website[3].

5.2.1.4 The sites and effects screened in for subtidal and intertidal benthic ecology are summarised in Table 6 with a summary of each effect and the key information relied upon for the assessment provided below.

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2 Note, whilst community complexes are not specially covered by MarLIN, the community complexes have been aligned to the most applicable biotope to enable a complex sensitivity review.

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

5.2.1.5 To inform the assessment, determination of which option (MDO or Alternative Design Option) presents the greatest potential for AEoI on designated sites has been presented within Volume 2 of this HDA.

Table 6 SACs screened in for benthic and intertidal features

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Rockabill to Dalkey Island SAC [IE003000]	Reefs	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species ▪ EMF
South Dublin Bay SAC [IE000210]	Mudflats and sandflats Salicornia and other annuals	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species
North Dublin Bay SAC [IE000206]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species
Baldoyle Bay SAC [IE000199]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species
Murrough Wetlands SAC [IE0002249]	Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species
Codling Fault Zone SAC [IE003015]	Submarine structures made by leaking gases	▪ Accidental pollution (offshore infrastructure and O&M Base)	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
		▪ Suspended sediment and deposition ▪ Invasive species	

Accidental pollution

5.2.1.6 Pollution events could occur as a result of construction, O&M and decommissioning activities associated with the offshore infrastructure and O&M through accidental spillages. Disturbance of sediments during construction or maintenance activity of the offshore infrastructure can also result in the disturbance of contaminated materials. There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation, leading to an effect on subtidal and intertidal benthic receptors.

5.2.1.7 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.

5.2.1.8 The assessment has drawn upon site specific contaminants sampling undertaken for the project (which results are reported in the MW&SQ Chapter of the EIAR), which provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations. One sample located to the south of the Kish and Bray Banks exceeded the Lower Limit for arsenic, while relatively high levels of aluminium were recorded at two sites in the Offshore ECC, although these were comparable with concentration reported previously from Dublin Bay Cunningham (2018) and the samples align with expected contaminant levels (pers.comm, Cronin, 2021).

5.2.1.9 No samples exhibited PAH[4] at levels in exceedance of the Irish Sediment Quality Guidelines (Cronin *et al*., 2006; Marine Institute, 2019). No elevated levels of THC and n-Alkanes were detected and levels of DHT (Dihydrotestosterone) and TBT (tributyltin) were well below the Irish Sediment Quality Lower Level.

5.2.1.10 Similarly, data from Dún Laoghaire Harbour indicate sediment bound contaminant levels to be low and of no environmental concern (Hydrographic Services, 2015). Sediment data for samples collected from Dún Laoghaire Harbour in the vicinity of the planned O&M Base indicated marginally elevated (Class 2) concentrations of arsenic (Hydrographic Services, 2015). These metals levels are not considered to represent an environmental risk.

[4] Polycyclic aromatic hydrocarbons are a class of chemicals that occur naturally in coal, crude oil. Delta-9-tetrahydrocannabinol (also known as THC)

5.2.1.11 Sediments collected from Dún Laoghaire Harbour showed no elevated levels of PAHs when compared to Marine Institute guidelines (Cronin *et al,* 2006; Marine Institute, 2019); with the exception of one marginally elevated level of the pesticide DDT at one site no detectable traces of other organic contaminants were recorded (Hydrographic Services, 2015).

5.2.1.12 No samples analysed showed elevated concentrations of organic chemicals when compared to the Irish Sediment Quality Guidelines (Cronin *et al.*, 2006; Marine Institute, 2019). The majority of sediment samples showed heavy metal concentrations below the lower-level screening guideline value. The samples with the highest heavy metal concentrations were those at depth, samples taken at the surface showed much reduced concentrations suggesting the most heavily contaminated sediments had come from historic industrial activities.

5.2.1.13 In addition, 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.

5.2.1.14 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan, contained within the PEMP (Volume 7, Appendix 1), in line with the Sea Pollution Act 1991 and MARPOL convention and other similar binding rules and obligations imposed on ship owners and operators by inter alia the International Maritime Organisation as relevant. The Marine Pollution Contingency Plan will cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020). Measures include storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.

Increased suspended sediment and deposition

5.2.1.15 Construction activities involving physical disturbance of the seabed/surface substrate could lead to the suspension and redistribution of surface sediment in the water column. This can 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 and impacts on habitats that are sensitive to increased levels of turbidity e.g. Zostera marina due to resulting reduced levels of light penetration which can limit photosynthesis Physical disturbance of the seabed/surface substrate and suspension and redistribution of sediment in the water column can also lead to smothering where sediment is re-deposited in areas where habitats and species that are sensitive to smothering are present.

5.2.1.16 The site specific surveys provided the baseline suspended sediment concentration (SSC) across the site, which naturally vary both spatially and temporally, with a general pattern of an inshore to offshore gradient in SSC. The annual average surface SSC across the array area is approximately 5 mg/l. The highest SSCs across the site were recorded north of the Offshore ECC in Dublin Port, with concentrations decreasing with distance offshore. SSCs vary seasonally, with the highest monthly average concentrations throughout the year, for the site occurring in December, increasing to approximately 7 to 8 mg/l, these peaks in SSC typically correlate with winter storm events (the highest recorded peaks of SSC withing Dublin Bay during storm events were recorded in the order of 100s to 1000s of mg/l).

5.2.1.17 To assess the impacts of the various activities during the construction phase of the offshore infrastructure that could disturb or release fine fraction sediments into the water column, a collection of seabed disturbance scenarios were modelled using the DAPPMS[5] (Dublin Array Physical Process Modelling System) Particle Tracking model and reported in the Physical Processes Modelling Report. Proposed activities represented in the modelling include: the clearance of material to level the seabed in preparation of the construction of foundations or seabed cables; the drilling of foundation piles; and trenching activities for the burial of seabed cables. Sediments disturbed or released during these activities are predicted to have only a transient impact on suspended sediment concentrations as material is dispersed quickly and fall below mean background levels within hours of the completion of construction works. Dominant flood tide currents generally transport material northwards from the development array.

5.2.1.18 The Physical Processes Modelling Report also considered the impact of Dublin Array on the local sediment regime during the operational phase, assessed through analysis of changes to bed shear stress around the array site for both baseline (pre-scheme) and with-scheme scenarios.

5.2.1.19 The modelling outputs recorded sediment plumes caused by seabed preparation and installation activities along the Offshore ECC expected to be restricted to approximately 2 km from the point of release. Sediment plumes caused by seabed preparation and installation activities within the array area are anticipated to be restricted to 10 km from the works. Plumes containing coarser sediment fractions are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time (within 24 hours) to background levels (5 mg/l). Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source).

[5] Dublin Array Physical Process Modelling System has been constructed to characterise and quantify the wave climate, tidal currents and water levels within the study area and used to determine the potential changes to SSC and bed levels arising from activities in support of the installation of the offshore infrastructure.

5.2.1.20 Sediment plumes caused by trenchless cable installation techniques in the intertidal area are anticipated to be measurable (20 mg/ l) up to circa 1,000 m from the area of release for the instantaneous release of bentonite. A similar reduction in SSC will be achieved within 200 m for the passive release stage of the plume. The effects are expected to last no longer than 24 hours. Effects of deposition from the works for Dublin Array would be limited to the immediate vicinity of the works or sediment disposal, with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally.

Introduction of invasive alien species

5.2.1.21 During all stages of the project, the movement of vessels in and out of Dublin Array has the potential to contribute to the risk of introduction or spread of marine invasive alien species (IAS) 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 IAS species (due to the higher variety of ports and passage routes).

5.2.1.22 During O&M, there is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by IAS 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.

5.2.1.23 Permanent structures on the seabed would replace the naturally occurring predominant sandy habitats and associated biota, while adding to the amount of hard substrate already present. However, the introduction of artificial hard structures may increase biodiversity as it has been shown that communities colonising wind turbine monopiles can be significantly different from those on adjacent, naturally occurring hard substrates (Wilhelmsson *et al.*, 2006; Wilhelmsson and Malm, 2008).

5.2.1.24 During the lifetime of the project the Applicant and its contractors will comply with all measures outlined in the Marine Biosecurity Plan (contained within the PEMP (Volume 7, Appendix 1), to include:

- All vessels of 400 gross tonnage (gt) and above to be in possession of a current international Anti-fouling System (AFS) certificate;
- Details of all ship hull inspections and biofouling management measures be documented by the Contractor; and
- All vessels to be compliant (where applicable) with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention, developed and adopted by the International Maritime Organisation (IMO).

Physical habitat loss and disturbance

5.2.1.25 Temporary habitat disturbance has the potential to occur as a result of construction and seabed preparation prior to foundation installation, jack up and anchoring operations and the installation of inter-array and export cables and through any works required during O&M phase or decommissioning that interact with the seabed. Temporary loss/disturbance would be restricted to discrete areas only within Dublin Array with no pathway of effect therefore existing for subtidal or intertidal habitats outside of the project footprint.

5.2.1.26 Within the project footprint the habitats likely to be affected are primarily sedimentary in nature characterised by sands of varying coarseness, although there is the possibility of potential ex situ Annex I reef habitat that may be encountered in the nearshore portion of the Offshore ECC, although this is outside the boundary of any designated site, as considered within the assessment of Rockabill to Dalkey SAC.

EMF

5.2.1.27 Electric and magnetic fields are produced as a result of power transmission in the inter array cables and the export cables to shore. The WTGs themselves will also have an electrical signature.

5.2.1.28 Potential impacts of anthropogenic EMF on marine organisms are relatively sparsely studied, with assumed sensitivity of many species based on a limited number of studies on a small number of species; however, it is thought that benthic invertebrates can detect EMF. Additionally, due to the challenges of monitoring a wide variety of marine organisms in single studies in situ, many studies have been laboratory based, which have limited ability to determine behavioural reactions which may or may not occur in real world scenarios.

5.2.1.29 The MarESA sensitivity assessments do not consider there to be sufficient evidence to support assessments of impacts of EMF on benthic and intertidal habitats; therefore, a desktop study has been undertaken to describe the typical responses of benthic invertebrates and inform the sensitivity assessment of benthic receptors. A number of research reports are available into the likely field strengths and potential effects on marine species including studies by COWRIE (CMACS 2003; CMAS 2005; CMACS 2006) which have been used to inform the assessment.

5.2.1.30 As part of the project design, the installation of cables will be to an optimum cable burial depth, with offshore cables, where possible, buried in the seabed to the optimal performance burial depth for the specific ground conditions. Where optimum burial depth cannot be achieved secondary protection measure will be deployed e.g. concrete mattress, rock berm, grout bags or an equivalent in key areas. Although cable burial does not prevent EMFs from emanating into the marine environment, it increases the distance between the EMF source and sensitive receptors, thereby reducing the EMF strengths to which individuals are subjected. B-fields attenuate rapidly away from the central line of the cable and therefore are likely to be detectable above background levels only in close proximity to the cables (i.e., within about 10 metres either side of the cable) (e.g. Normandeau Associates et al., 2011).

5.2.2 Rockabill to Dalkey Island SAC

5.2.2.1 Rockabill to Dalkey Island SAC lies 1.8 km inshore of the array area and directly to the north of the offshore ECC with a slight overlap of 0.16 km^2, which represents 0.06% of the total SAC area. The following subtidal and intertidal benthic qualifying interest have been screened in for further assessment:

- Reefs.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Reef

5.2.2.2 The Conservation Objectives for the Annex I habitat[6] is to maintain the favourable conservation condition of reefs in Rockabill to Dalkey Island SAC, as defined by the following three site-specific conservation objective 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

5.2.2.3 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.

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

5.2.2.5 The species associated with this community complex include the fucoid seaweeds (*Fucus serratus, F. vesiculosus, F. spiralis)*, knotweed (*Ascophyllum nodosum)*, channelled wrack (*Pelvetia canaliculate)*, 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 vulgate* and *Littorina* sp. are also recorded here. In all areas the kelp species *Laminaria digitata* is recorded at the low water mark.

[6] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO003000.pdf

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

Community type: Subtidal Reef Community Complex

5.2.2.7 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 for the reef features here ranges from moderately exposed reef to exposed. 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.20 m. In the northern reaches of the site, at Rockabill and Ireland's Eye, areas of both scoured sediment and a thin veneer of silt were observed on the reefs; a veneer of silt is also present at Lambay Island. In the south of the site, strong currents were experienced in the channel between Dalkey Island and the Muglins (NPWS, 2013a).

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

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

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

Assessment of Effects - Rockabill to Dalkey Island SAC

Accidental pollution (construction, decommissioning, O&M phase of offshore infrastructure and O&M Base)

5.2.2.11 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.2.12 Site-specific contaminants sampling undertaken in support of the EIA and reported in the Benthic Baseline of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations and below lower Irish Action Levels i.e. concentrations that are between background concentrations and the upper end of the no-effects range (see Cronin *et al* ., 2006 and Marine Institute, 2019). The exception being levels of arsenic recorded in one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

5.2.2.13 Levels of arsenic and nickel within sediment collected from Dún Laoghaire Harbour in the vicinity of the planned O&M Base were marginally above the relevant lower Action Levels, although the reported concentration are not considered to constitute an environmental risk.

5.2.2.14 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan, contained within the PEMP (see details in Section 5.2.1). The implementation of these avoidance and preventative measures and low levels of sediment bound contaminants enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on either the reef features in Rockabill to Dalkey Island SAC or ex situ reef or the conservation objectives of the site in relation to accidental pollution.

Increased suspended sediment and deposition (construction, decommissioning, O&M phase of offshore infrastructure and O&M Base)

5.2.2.15 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. Increased turbidity can lead to impacts on sessile filter feeders. In addition, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms. As detailed in the sediment Physical Processes Modelling Report, sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the Offshore ECC restricted to 2 km. Plumes from trenchless landfall works are anticipated to be measurable up to circa 1,000 m from the area of release for the instantaneous release of bentonite. It is likely that effects of sediment deposition from the works for Dublin Array would be limited to the immediate vicinity of the works or sediment disposal, with fine material distributed more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally.

Within the SAC

5.2.2.16 The Rockabill to Dalkey Island SAC overlaps marginally with the northern boundary of the Offshore ECC and lies 1.8 km inshore of the array area. The extent of the known geogenic reefs within the SAC have been mapped and are presented in the Rockabill to Dalkey Island SAC, Conservation Objectives Supporting Document for Marine Habitats and Species (NPWS, 2013a). Whilst the SAC boundary overlaps with the Offshore ECC, no reef features of conservation importance within the boundary of the SAC (NPWS, 2013a) are noted within the Offshore ECC (reef habitats within the SAC 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). Of the reef features within the SAC those at Dalkey Island, Howth Head and Ireland's Eye are within 10 km of the array area and as such are likely to be subject to impacts associated with SSC plumes and deposition. No reef features identified within the SAC are within 2 km of the Offshore ECC and as such no impacts associated with SSC and deposition from works in the Offshore ECC are anticipated.

5.2.2.17 The communities inhabiting the identified geogenic reef habitats 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 assessed within the MarLIN Marine Evidence based Sensitivity Assessments (MarESA)[7] , '*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles' represent the biotope of highest sensitivity (Medium) to sediment deposition (note the biotope has low sensitivity to increased SSC) (Tillin, 2015), due to the sensitivity of limpet and Littorinid populations. However, as stated within the sensitivity assessment (MarESA), the level of exposure to the impact may be reduced by wave action or water flows so that site-specific vulnerability may be lower as no significant sediment accumulation occurs. The MarESA assessment takes a precautionary approach, assuming repeated deposition events, and wide-ranging impact extents (Tillin, 2015) which are likely to be of greater magnitude than those associated with the construction activities (e.g. sandwave clearance, drilling and cable installation), maintenance operations and decommissioning.

5.2.2.18 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 Conservation Objectives 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.

[7] https://hub.jncc.gov.uk/assets/fcf9a4ea-2430-4396-8fa9-46a059cfc656

5.2.2.19 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, O&M and decommissioning of the offshore infrastructure 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.

5.2.2.20 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, allied to the temporary nature of the impact, and the low sensitivity of the geogenic reef biotopes identified within the SAC, it is of scientific certainty that the risk of suspended sediments escaping into the wider marine environment beyond Dublin Array 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. The construction, O&M and decommissioning phases of Dublin Array will not adversely affect the integrity of Rockabill to Dalkey Island SAC and no reasonable scientific doubt remains as to the absence of such effects.

Ex situ reef

5.2.2.21 While not within the boundary of the SAC the following biotopes identified within the nearshore subtidal and intertidal portions of the Offshore ECC represent potential Annex I geogenic reef habitats:

- Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock' (IR.MIR.KR.XFoR);
- 'Faunal turf communities on Atlantic circalittoral rock' (CR.HCR.FaT);
- Kelp and seaweed communities on Atlantic infralittoral rock' (IR.HIR.KFaR);
- Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata (LR.FLR.Eph.EphX);
- *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock (LR.MLR.BF.Fser.R);
- *Porphyra purpurea* and *Enteromorpha* spp. On sand-scoured mid or lower eulittoral rock (LR.FLR.Eph.EntPor); and
- Robust fucoid and/or red seaweed communities (LR.HLR.FR).

5.2.2.22 Taking into consideration the assessment for reef features within the SAC, the significant capacity of Dublin Bay to dilute elevated concentrations of suspended sediments, the naturally occurring variability of SSCs across the site, allied to the temporary nature of the impact, and the low sensitivity of the geogenic reef biotopes identified ex situ of the SAC, it is of scientific certainty that the risk of suspended sediments escaping into the wider marine environment beyond Dublin Array will not adversely impact the ex situ reef or imperil the conservation target to conserve the Intertidal and Subtidal reef community complexes in Rockabill to Dalkey Island SAC in a natural condition.

5.2.2.23 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Physical habitat loss (construction, decommissioning, O&M phase of offshore infrastructure)

5.2.2.24 Physical habitat loss will result through the presence of project infrastructure and associated scour protection and cable protection, with impacts restricted to discrete areas within the array area and Offshore ECC.

Within the SAC

5.2.2.25 As the Rockabill to Dalkey Island SAC overlaps with the Offshore ECC (0.16 km^2 – representing 0.06% of the SAC), the potential for effects on the qualifying interests within the SAC from habitat loss are considered here.

5.2.2.26 No reef features of conservation importance within the SAC have been mapped within the Offshore ECC as indicated by the Rockabill to Dalkey Island SAC Conservation Objectives Supporting Document for Marine Habitats and Species (NPWS, 2013a). However, it cannot be discounted that geogenic reefs may exist elsewhere within the footprint of the SAC that have not been mapped. Therefore, under the precautionary principle, without the use of mitigation measures, reefs were screened in for potential for adverse effects on the qualifying interests of the SAC.

5.2.2.27 The impact 'physical habitat loss' relates to the conservation targets for 'Habitat Area' and 'Habitat Distribution'. These targets 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 Conservation objectives 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.

5.2.2.28 Therefore, the 'Habitat Area' and 'Habitat Distribution' conservation targets have the potential to be undermined by the impact of 'physical habitat loss' from the construction, O&M and decommissioning of Dublin Array.

5.2.2.29 As geogenic reefs are formed by geological processes, these features cannot be restored or extended. Therefore, the loss of these features as a result of the installation of cables and cable protection within the Offshore ECC, would result in the permanent loss of geogenic reef.

5.2.2.30 However, should Annex I geogenic reef be recorded in the pre-construction survey[8] within the boundary of Rockabill to Dalkey Island SAC the Applicant commits to avoidance of these features to preclude direct impacts to these reefs from cable installation and protection within the Offshore ECC. This approach, allied to the minor overlap of the Offshore ECC and SAC, will result in no potential for risk of habitat loss and no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition.

Ex situ reef habitat

5.2.2.31 Previous studies undertaken to support site investigations for the Dublin Array offshore infrastructure and wider regional studies (Fugro, 2021, Aquafact, 2021, MERC consultants, 2022), identified areas of potential Annex I reef habitat conforming to the EU Annex I habitat Reef (EU Habitat code 1170) outside of the SAC. The habitat has been identified from the shallow sublittoral running parallel to the shore between Killiney in the north and Bray in the south. The Broad Scale Predictive Habitat Map (EUSeaMap, 2019) also indicates a band of sublittoral geogenic reef extending along the inshore section of the Offshore ECC between Killiney and Bray. Further surveys in this near shore area within the footprint of the Offshore ECC recorded habitat considered to be low and medium resemblance stony reef according to criteria detailed by Irving (2009) (APEM, 2024).

5.2.2.32 No evidence of reef features from geophysical or benthic studies have been identified within the footprint of the array area.

5.2.2.33 Ex situ reef habitat is known from the nearshore area of the Offshore ECC where a maximum of 4.51 ha of this potential reef habitat may be temporarily disturbed from construction activities, which represent 2.59% of habitat between Killiney and Bray and as mapped by MERC Consultants (2022). The estimated area of reef is a precautionary figure as reef features are not contiguous across the identified habitat. To put this temporary disturbance to Annex I stony reef into the national context, 9,474 km^2 of Annex I reef is present in Irish waters (West *et al*., 2024). Assuming that as a worst case 100% of works within the potential rocky reef habitat was to directly reef features, the area of reef temporarily affected represent 0.0005% of the total area of reef habitat in Irish waters.

[8] The requirement for pre construction surveys is outlined with Volume 1: Project Description

5.2.2.34 It is anticipated that disturbance of geogenic reef habitat will be short-term resulting in some direct temporary losses to epifaunal species, which in turn may temporarily affect other species at a local level in relation to reduced availability of prey species in these areas until recovery and recolonisation occurs. Encrusting species are known to become completely lost through winter storms, although, where there is high recruitment potential, recolonisation is rapid, often occurring within a year (Holt *et al*. 1998). Consequently, this habitat is considered to have a high recoverability and recolonisation of rocky reef communities is expected following temporary disturbance. Furthermore, as detailed in Volume 1 of this HDA Project Description, material excavated in relation to cable installation at the landfall will be utilised to backfill excavations, much of the biota will not be removed from the area thus enabling biotope recovery and minimising impacts.

5.2.2.35 Recruitment is an important factor affecting structure and functions of reef habitat as the supply of new larvae is essential for continued survival of a reef community or for recovery following disturbance. Reduction of recruitment could lead to the undermining of community function resulting in lower community abundance and diversity (West *et al*., 2024).

5.2.2.36 However, there is no spatial overlap between the inshore reef habitat and the SAC reef features and any potential impacts on biological connectivity (e.g. larval supply and recruitment) will be negligible due to the small proportion of habitat affected and the natural temporal and spatial variability of such events (see Wahl, 2001; Watson and Barnes, 2014). Consequently, temporary loss of ex situ reef habitat will not have an adverse effect on the structure and function of the reef features within Rockabill to Dalkey SAC or its conservation objectives.

5.2.2.37 In relation to decommissioning activities and ex situ reef, it is anticipated that buried cables and any scour and cable protection will be left in situ as detailed within the Decommissioning and Restoration Plan. Where the cables have been buried, over the lifetime of the project, the seabed is likely to have recovered to its condition prior to work starting. Should infrastructure be removed, the nature and extent of habitat loss during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase as noted above noting the habitat is considered to have a high recoverability and recolonisation of rocky reef communities is expected following temporary disturbance.

5.2.2.38 This will result in no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition from decommissioning activity.

5.2.2.39 With the implementation of avoidance measures of any identified reef within the boundary of the SAC during construction activities the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Habitat disturbance (construction, decommissioning and O&M phase of offshore infrastructure)

5.2.2.40 Temporary habitat disturbance is expected to occur as a result of construction and seabed preparation prior to foundation installation, jack up and anchoring operations and the installation of inter-array and export cables, O&M activity and decommissioning. All disturbance to benthic habitats will be restricted to discrete areas within the offshore temporary occupation area, array area and Offshore ECC.

Within the SAC

5.2.2.41 No reef features of conservation importance of the Rockabill to Dalkey Island SAC overlap with the Offshore ECC as indicated in the Rockabill to Dalkey Island SAC Conservation Objectives Supporting Document for Marine Habitats and Species (NPWS, 2013a) and as such disturbance of reef habitat within the SAC is not anticipated. However, it cannot be discounted that geogenic reefs may exist within the overlap between the SAC and Offshore ECC. Therefore, under the precautionary principle, without the use of mitigation measures, reefs were screened in for potential for adverse effects on the qualifying interests of the SAC.

5.2.2.42 The impact 'habitat disturbance' relates to the 'Community Structure' target, to conserve the intertidal and subtidal reef community complexes in a natural condition. 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 habitat disturbance from construction, O&M and decommissioning works.

5.2.2.43 Paragraph 5.2.2.21 defines the biotopes supported by geogenic reef as identified across the site. The MarESA sensitivity assessments determined all reef biotopes to be of low sensitivity to abrasion and disturbance impacts, with the exemption of '*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock', which was assigned a sensitivity score of medium, with a shift in community compositions anticipated after disturbance.

5.2.2.44 It should be noted that there is considerable evidence that benthic communities associated with geogenic reef habitat can demonstrate signs of recovery and be restored towards a natural state if pressures are removed for a sufficient period of time (Ballantine 2014; Lester *et al,* 2009). However, restoration to a viable community of similar functionality may occur, but the community might not support the same species assemblages present prior to damage, and particularly rare or sensitive species may not return.

5.2.2.45 However, should Annex I geogenic reef be recorded in the pre-construction survey within Rockabill to Dalkey Island SAC the Applicant commits to avoidance of these features within the boundary of the SAC to preclude direct impacts to these reefs from cable installation and protection within the Offshore ECC. This approach, allied to the minor overlap of the offshore ECC and SAC, will result in no potential for risk of habitat disturbance and no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition

Ex situ reef habitat

5.2.2.46 Site-specific surveys have shown that geogenic reefs are present elsewhere within the Offshore ECC within the nearshore portion of the offshore and not within the SAC. Ex situ reef habitat is known from the nearshore area of the Offshore ECC where a maximum of 4.51 ha of this habitat may be disturbed by cable laying activities representing 2.59% of the mapped area of reef between Killiney and Bray. However, any disturbance will be short-term and excavated material will be used to backfill the excavations. Furthermore, there is no spatial overlap between the inshore reef habitat and the SAC reef features and any potential impacts on biological connectivity (e.g. larval supply and recruitment) will be negligible due to the short-term nature of the disturbance allied to the small proportion of habitat affected and the natural temporal and spatial variability of such events (see Wahl, 2001; Watson and Barnes, 2014). Consequently, disturbance of ex situ reef habitat during construction will not have an adverse effect on the structure and function of the reef features within Rockabill to Dalkey SAC or its conservation objectives.

5.2.2.47 In relation to decommissioning activities and ex situ reef, it is anticipated that buried cables and any scour and cable protection will be left in situ as detailed within the Decommissioning and Restoration Plan. Where the cables have been buried, over the lifetime of the project, the seabed is likely to have recovered to its condition prior to work starting. Should infrastructure be removed, the nature and extent of habitat loss during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase as noted above noting the habitat is considered to have a high recoverability and recolonisation of rocky reef communities is expected following temporary disturbance. This will result in no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition from decommissioning activity.

5.2.2.48 With the implementation of avoidance measures within the SAC, the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Introduction of Invasive alien species (commissioning, decommissioning and O&M phase of offshore commissioning)

5.2.2.49 There is the potential for the introduction of invasive species as a result of construction and O&M phases of the offshore infrastructure due to the introduction of hard substrates onto the seafloor. 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 Dublin Array 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 reef habitat in the area. Such changes to the site's biodiversity will be long term.

5.2.2.50 The movement of construction vessels has the potential to impact upon benthic subtidal ecology and biodiversity by contributing to the risk of introduction or spread of IAS through ballast water discharge. However, the movement of commercial vessels is common throughout the region and represents an existing and potentially more likely method of transport for IAS. Therefore, any contribution of construction vessels would be negligible in comparison to the impacts of other marine users. Potential risks of the introduction or spread of IAS will be minimised by the adoption of biosecurity measures detailed in the Marine Biosecurity Plan. During the lifetime of the project the Applicant and its contractors will comply with all measures outlined in the Marine Biosecurity Plan as referenced in Section 5.2.1.

5.2.2.51 While the Offshore ECC overlaps marginally with the Rockabill to Dalkey Island SAC (0.16 km^2 – representing 0.06% of the SAC) this does not incorporate any identified reef features as indicated in the site Conservation Objectives Supporting Document for Marine Habitats and Species (NPWS, 2013a). However, this does not preclude the possibility of the spread of IAS associated with construction and O&M phase activities into reef habitats within the SAC or to ex situ Annex I habitat outside of the SAC. Therefore, under the precautionary principle, without the use of mitigation measures, reefs were screened in for potential for adverse effects on the qualifying interests of the SAC.

5.2.2.52 The impact 'introduction of invasive alien species' relates to the 'Community Structure' target, to conserve the intertidal and subtidal reef community complexes in a natural condition. As stated in NPWS (2013b), 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.

5.2.2.53 Paragraph 5.2.2.21 defines the biotopes supported by geogenic reef as identified across the site. The sensitivity assessments, as conducted by the MarESA sensitivity assessments, determined all biotopes to be of low sensitivity to the introduction of invasive species, with the exemption of '*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock', which was assigned a sensitivity score of medium, and '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel' which was assigned a sensitivity score of high.

5.2.2.54 It should be noted that any changes to the biodiversity of the site, including the introduction of invasive species, will primarily be localised to the array area and the offshore ECC, although these could act as a stepping stone for IAS into the wider area. However, the avoidance and preventative measures outlined within the Marine Biosecurity Plan as detailed in Section 5.2.1 have been designed to ensure that the risk of potential introduction and spread of IAS will be minimised. As such, the potential for risk of invasive species will not adversely affect the conservation target to conserve the Intertidal and Subtidal reef community complexes in Rockabill to Dalkey Island SAC in a natural condition.

5.2.2.55 Subject to implementation of the measures the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

EMF (O&M phase of offshore infrastructure)

5.2.2.56 Electromagnetic fields are generated from power transmission in the cables and have the potential to impact electrosensitive species. Benthic species associated with subtidal and intertidal reef community complexes have the potential to be affected by EMF generated by operational cables. EMFs are only detectable above background levels in close proximity to the cables, with the extent of the impact being largely restricted by the burial of the cables.

Within the SAC

5.2.2.57 No reef features of conservation importance of the Rockabill to Dalkey Island SAC overlap with the Offshore ECC as indicated in the Rockabill to Dalkey Island SAC Conservation Objectives Supporting Document for Marine Habitats and Species (NPWS, 2013a). However, it cannot be discounted that geogenic reefs may exist within the overlap between the SAC and offshore ECC. Therefore, under the precautionary principle, without the use of mitigation measures, reefs were screened in for potential for adverse effects of EMF on the qualifying interests of the SAC.

5.2.2.58 The impact of 'EMF' relates to the 'Community Structure' target, to conserve the intertidal and subtidal reef community complexes in a natural condition. 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.

5.2.2.59 The MarESA sensitivity assessments of the effects of EMF on the identified biotopes within the development boundary concluded there was not sufficient evidence to confidently assess the sensitivity of the biotopes.

5.2.2.60 However, literature has shown evidence of sensing, responding to, or orienting to natural magnetic field cues by invertebrates including molluscs and arthropods (Lohman and Willows, 1987; Ugolini and Pezzani, 1995; Ugolini, 2006; Boles and Lohmann, 2003). Scott *et al.* (2021) investigated the effects of EMF (strengths 250µT, 500µT and 1000µT) from submarine power cables on edible crab, which showed limited physiological and behavioural effects on the crabs exposed to EMF of 250µT. Crab exposed to EMF of 500µT or above showed physiological stress and changes to behavioural trends, specifically an attraction to EMF. It is to be noted however, that these studies investigated EMF strengths significantly higher than those that receptors will typically be exposed to as a result of offshore wind cables in the marine environment. Specifically, the lowest experimental EMF used in Scott *et al.* (2021) was a factor of 10 higher than that expected for the project at 1 m from the cable (i.e. 30µT), with no impacts identified at this EMF strength. Effects were only noted in these studies using EMF strengths which were a factor of 20 – 1,000 higher than those expected from the project cables. Therefore, it is considered that it is unlikely that there would be any impacts to crustaceans from EMF resulting from cables.

5.2.2.61 A laboratory study assessing the effects of an electromagnetic field (EMF) of value typically recorded in the vicinity of submarine cables on the behaviour and physiology of the common ragworm (*Hediste diversicolor*) did not find any evidence of avoidance or attraction behaviours (Jakubowska *et al.*, 2019). The polychaetes did, however, exhibit enhanced burrowing activity when exposed to the B-field, with plausible consequences for their metabolism, although knowledge about the biological relevance of this response is currently absent (Jakubowska *et al*., 2019).

5.2.2.62 One recent study examined the difference in invertebrate communities along an energised and nearby surface laid cables which indicated that there were no functional differences between the communities on and around the cables up to three years after installation (Love *et al.*, 2016). This study also identified that the EMF levels reduce to background levels generally within one metre of the cable. This supports evidence collected from Nysted Wind Farm at Rødsand in Denmark.

5.2.2.63 For invertebrate receptor species it is difficult to translate the patchwork of knowledge about individual-level EMF effects into assessments of biologically or ecologically significant impacts on populations (Boehlert and Gill, 2010). Overall, the findings of studies investigating the effects of EMF on invertebrates indicate that these range from small behavioural changes to effects on embryonic development, while direct effects of EMF on survival rates of invertebrates have not been found (Hermans and Schilt, 2022). Therefore, given the evidence presented, it is predicted that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

5.2.2.64 Further to this, with the avoidance measure where the Applicant commits to avoidance of these features within the boundaries of the SAC this will preclude direct impacts to these reefs. This approach will result in no potential for risk of habitat loss and no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition.

Ex situ reef habitats

5.2.2.65 In relation to the geogenic reefs present within the nearshore portion of the offshore ECC, the same conclusion can be drawn that given the evidence presented, it is predicted that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid. Furthermore, it is proposed to bury or protect cables (see Part 1 of this HDA: Project Description) which will mitigate any impacts and potential behavioural response of benthic receptors. As such, the potential risk of EMF will not adversely affect the ex situ reef habitats or the conservation target to conserve the intertidal and subtidal reef community complexes in Rockabill to Dalkey Island SAC in a natural condition.

5.2.2.66 With the implementation of cable burial and protection measures the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.2.3 South Dublin Bay SAC

5.2.3.1 South Dublin SAC lies 6.4 km from the ECC and 13.6 km inshore of the array area. The SAC is 1.2 km from the O&M Base in Dún Laoghaire Harbour. The site covers 7.2 km^2 of intertidal sandy and muddy habitats. The following qualifying interests have been screened in for further assessment:

- Mudflats and sandflats not covered by seawater at low tide; and
- Salicornia and other annuals colonising mud and sand.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Mudflats and sandflats not covered by seawater at low tide

5.2.3.2 This feature extends to 7.2 km^2.The Conservation Objective[9] is to maintain the favourable conservation condition of mudflats and sandflats not covered by seawater at low tide, as defined by the following 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, subject to natural processes;
- Community Structure: Conserve the high quality of the following community type:
  - Zostera-dominated community, subject to natural processes;
- Community distribution: Conserve the following community type in a natural condition:
  - Fine sands with *Angulus tenuis* community complex.

Community type: Fine sands with *Angulus tenuis* community complex.

5.2.3.3 This community occurs throughout the SAC from the intertidal to a depth of approximately 6m. The distinguishing species of this community are the bivalve *Angulus tenuis* and the polychaetes *Scoloplos (Scoloplos) armiger, Pygospio elegans* and *Nephtys cirrosa*. These species are not uniformly distributed across the site and are generally recorded in low abundances. The gastropod *Peringia ulvae*, the polychaetes *Sigalion mathildae, Capitella* sp. and *Paraspio irrose* and the bivalves *Cerastoderma edule* and *Angulus fabula* are also recorded within this community complex. *Ulva* sp. is also recorded as occasional to abundant on the mid and low shores at Sandymount and to the north of Blackrock. The polychaete *Lanice conchilega* and the bivalve *Ensis ensis* are commonly recorded to the north of Blackrock, in this area and also at Sandymount *L. conchilega* and *Arenicola marina* also commonly occur.

[9] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000210.pdf

Qualifying Interest: Salicornia and other annuals colonising mud and sand

5.2.3.4 This feature extends to 0.01 ha. In the absence of any site specific conservation objectives or targets associated with this qualifying interest, the COs for *Salicornia* from North Dublin Bay SAC have been used given their proximity and similarity of the ecological conditions of the two sites.

5.2.3.5 The Conservation Objectives 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;
- Habitat Distribution: No decline or change in habitat distribution subject to natural processes;
- Physical Structure: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction; and
- Vegetation Structure: Maintain the range of coastal habitats including transitional zones.

Assessment of Effects - South Dublin Bay SAC

Accidental pollution (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.3.6 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to be released into the water column, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.3.7 Site-specific contaminants sampling undertaken in support of the EIA and reported in MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations and below lower Irish Action Levels i.e. concentrations that are between background concentrations and the upper end of the no-effects range (see Cronin *et al*., 2006 and Marine Institute, 2019). The exception being levels of arsenic recorded in one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

5.2.3.8 Levels of arsenic and nickel within sediment collected from Dún Laoghaire Harbour in the vicinity of the planned O&M Base were marginally above the relevant lower Action Levels, although the reported concentration are not considered to constitute an environmental risk.

5.2.3.9 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan as defined in Section 5.2.1. The implementation of these avoidance and preventative measures together with low levels of site-specific sediment bound contaminants at the site, enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on the features in South Dublin Bay SAC or the conservation objectives of the site in relation to accidental pollution.

Suspended sediment and deposition (construction, decommissioning O&M phase of offshore infrastructure and O&M Base)

5.2.3.10 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. As detailed in paragraph 5.2.1.15, increased turbidity can lead to impacts on sessile filter feeders. In addition, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.2.3.11 The South Dublin Bay SAC is 6.4 km from the Offshore ECC and 13.4 km inshore of the array area. As detailed in the sediment Physical Processes Modelling Report sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km. Plumes from the trenchless cable installation are anticipated to be measurable up to circa 1,000 m from the area of release for the instantaneous release of bentonite. Effects of sediment deposition from the works for Dublin Array would be limited to the immediate vicinity of the works or sediment disposal, with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally.

5.2.3.12 The conservation target for 'Habitat Area' of the mudflats and sandflats is met when the permanent area is stable or increasing, subject to natural processes. The South Dublin Bay SAC Conservation objectives supporting document for Marine Habitats and Species (NPWS, 2013b) notes that:

- the 'permanent area' target refers to activities or operations that propose to remove habitat from a site, thereby reducing the permanent amount of habitat area. It does not refer to long or short-term disturbance of the biology of a site.

5.2.3.13 The conservation target for 'Community Extent' of the 'Zostera dominated community' is met when the extent of the community is maintained. The South Dublin Bay SAC Conservation objectives supporting document for Marine Habitats and Species (NPWS, 2013b) notes that:

- Any significant anthropogenic disturbance to the extent of these communities should be avoided.

5.2.3.14 Therefore, the conservation targets for all Qualifying Interests of the site are referring to the loss of the permanent area, or extent of a Qualifying Interest. As the impact of increased SSCs and deposition is a disturbance effect, these targets will not be undermined by this impact. However, there is a possibility that the 'Community Structure and Distribution' targets to conserve the '*Zostera* dominated community' and the 'Fine sands with *Angulus tenuis* community complex' 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 community complexes for prolonged periods. As stated in NPWS (2013b), the 'Community Structure' target relates to the quality of the *Zostera*-dominated community 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.

5.2.3.15 The extents of the community complexes within the SAC have been identified and presented within the South Dublin Bay SAC Conservation objectives supporting document (NPWS, 2013b). There is no direct overlap between the SAC and the Offshore ECC, although there is potential for sediments disturbed by construction activity to enter the SAC and deposit in areas identified as 'Fine sands with *Angulus tenuis* community complex'. This community complex has been assessed within the MarESA sensitivity assessments to be 'not sensitive' to increased SSC and deposition impacts (Tillin and Ashley, 2018), therefore no adverse effects are anticipated on this qualifying interest.

5.2.3.16 The intertidal '*Zoster*a-dominated community' however, is of high sensitivity to increased SSC and sediment deposition (Tyler-Walters *et al,*. 2020). As shown in Each stage of the procedure is influenced by the previous one. The order in which the stages are followed is therefore essential for applying Article 6(3) and (4) correctly. Figure 2 gives a flow chart of this procedure.' The current report provides the information to support Stage 2: Appropriate Assessment. Figure 2 of the South Dublin Bay SAC Conservation Objectives Supporting Document (NPWS, 2013b), the array area and Offshore ECC will have no direct overlap with the area of '*Zostera*-dominated community'. Furthermore, the nearest point of the development area is 16 km from the Zostera dominated community and sediment plumes will not impinge on this feature.

5.2.3.17 Due to the capacity of Dublin Bay to dilute suspended sediments, the variability of SSCs across the site and the temporary nature of the impact, it is of scientific certainty, that the risk of suspended sediments escaping beyond Dublin Array will not imperil the conservation targets to conserve community complexes in the SAC in a natural condition. The construction, O&M and decommissioning phases of the offshore infrastructure will not adversely affect the integrity of South Dublin Bay SAC and no reasonable scientific doubt remains as to the absence of such effects.

5.2.3.18 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Introduction of invasive species (commissioning, decommissioning, O&M phase of offshore infrastructure and O&M Base)

5.2.3.19 Taking into consideration the lack of direct overlap between the South Dublin Bay SAC and the offshore infrastructure, there is no identifiable impact pathway from the introduction of hard substrates which would change the type of available habitat for benthic communities. As such the potential for introduction of invasive species is limited to the movement of construction vessels transiting to and from the offshore infrastructure.

5.2.3.20 It should be noted that any changes to the biodiversity of the site, including the introduction of invasive species, will primarily be localised to the array area and the offshore ECC, although these could act as a stepping stone for IAS into the wider area.

5.2.3.21 As part of the PEMP the project will commit to a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised through measures outlined in Section 5.2.1. With the implementation of these avoidance measures, the potential for risk of invasive species will not adversely affect the conservation target to conserve the QIs in South Dublin Bay SAC in a natural condition.

5.2.3.22 Subject to implementation of the measures included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.2.4 North Dublin Bay SAC

5.2.4.1 North Dublin SAC lies 11.5 km from the offshore ECC and lies 11.9 km inshore of the array area and covers 15 km^2. 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 maritime*)

Conservation Objectives of Qualifying Interests

Qualifying Interest: Mudflats and sandflats not covered by seawater at low tide

5.2.4.2 This feature extends to 5.8 km^2. The Conservation Objective is to maintain the favourable conservation condition of mudflats and sandflats not covered by seawater at low tide, as defined by the following attributes and targets:

- Habitat Area: The permanent habitat area is stable or increasing, subject to natural processes;

- Community Extent: Maintain the extent of the Mytilus edulis-dominated community, subject to natural processes;
- Community Structure: Conserve the high quality of the Mytilus edulis-dominated community, subject to natural processes; and
- Community distribution: Conserve the following communities in a natural condition:
  - Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex; and
  - Fine sand with *Spio martinensis* community complex.

Community type: Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex

5.2.4.3 This intertidal community complex is recorded extensively throughout the site from Drumleck Point to Dollymount.

5.2.4.4 The fauna of this community complex is distinguished by the polychaete *Pygospio elegans* and the crustacean *Crangon crangon*. The polychaetes *Scoloplos armiger*, *Tharyx* sp. and *Capitella* sp. Agg., the bivalve *Cerastoderma edule* and the amphipod *Corophium volutator* occur in moderate abundances here. The polychaete *Malacoceros fuliginosus* and the crustacean *Idotea baltica* are recorded in high abundances between Dollymount and North Bull Island where the mudflats border the salt marsh. The oligochaete *Tubificoides benedii* and the gastropod *Peringia ulvae* are also common within this community complex. The green algae *Ulva* sp. and the polychaete *Arenicola marina* are the most conspicuous species to occur here, with the latter estimated at densities of $20m^{-2}$ at Raheny.

Community type: Fine sand with *Spio martinensis* community complex

5.2.4.5 This community complex is recorded on the seaward side of North Bull Island, including Dollymount Strand, and on the leeward side of the island from Kilbarrack to Sutton; it extends from the intertidal into the shallow subtidal (<7 m). In general, the fauna of this community complex occur in low abundances, with the polychaete *Spio martinensis* being the dominant species. The polychaete *Nephtys cirrose*, the crustaceans *Bathyporeia guilliamsoniana, Corophium volutator and Praunus flexuosus* and the bivalves *Cerastoderma edule* and *Angulus tenuis* are all recorded here. The oligochaete *Tubificoides benedii* and the gastropod *Peringia ulvae* also occur here.

Mytilus edulis dominated community

5.2.4.6 Intertidally, a mussel (*Mytilus edulis*) dominated community occurs at this site between Sutton and Kilbarrack. They occur on a sediment of fine sand. The fauna of this community complex reflects those within the 'Fine sand with *Spio martinensis* community complex'.

Qualifying Interest: Salicornia and other annuals colonising mud and sand

5.2.4.7 This feature extends to 29 ha. The Conservation Objectives 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;
- Habitat Distribution: No decline or change in habitat distribution subject to natural processes;
- Physical Structure: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction; and
- Vegetation Structure: Maintain the range of coastal habitats including transitional zones.

Qualifying Interest: Atlantic salt meadows

5.2.4.8 This feature extends to 82 ha. The Conservation Objectives to maintain the favourable conservation condition of Atlantic salt meadows are defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing subject to natural processes;
- Habitat Distribution: No decline or change in habitat distribution, subject to natural processes;
- Physical Structure: Maintain natural circulation of sediments and organic matter, without any physical obstructions; and
- Vegetation Structure: Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.

Qualifying Interest: Mediterranean salt meadows

5.2.4.9 This feature extends to 8 ha. The Conservation Objectives to maintain the favourable conservation condition of Mediterranean salt meadows are defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing subject to natural processes;
- Habitat Distribution: No decline or change in habitat distribution, subject to natural processes;
- Physical Structure: Maintain natural circulation of sediments and organic matter, without any physical obstructions; and
- Vegetation Structure: Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.

Assessment of Effects - North Dublin Bay SAC

Accidental pollution (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.4.10 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to be released into the water column, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.4.11 Site-specific contaminants sampling undertaken in support of the EIA and reported in MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations and below lower Irish Action Levels i.e. concentrations that are between background concentrations and the upper end of the no-effects range (see Cronin *et al* ., 2006 and Marine Institute, 2019). The exception being levels of arsenic recorded in one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

5.2.4.12 Levels of arsenic and nickel within sediment collected from Dún Laoghaire Harbour in the vicinity of the planned O&M Base were marginally above the relevant lower Action Levels, although the reported concentration are not considered to constitute an environmental risk.

5.2.4.13 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan as defined in Section 5.2.1. The implementation of these avoidance and preventative measures together with low levels of site-specific sediment bound contaminants at the site, enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on the features in North Dublin Bay SAC or the conservation objectives of the site in relation to accidental pollution.

Suspended sediment and deposition (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.4.14 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. Increased turbidity can lead to impacts on sessile filter feeders. In addition, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.2.4.15 The North Dublin Bay SAC lies 11.5 km from the offshore ECC and lies 11.9 km inshore of the array area. As detailed in the sediment Physical Processes Modelling Report (sediment plumes caused by works within the array area are predicted from the modelling to be restricted to 10 km from the works, with plumes from the Offshore ECC restricted to 2 km (see Physical Process Modelling Report). The North Dublin Bay SAC therefore lies outwith the sediment plume extents, and therefore no impact pathway can be identified.

5.2.4.16 Furthermore, the conservation targets for Habitat Area, Distribution and Vegetation Structure are referring to the loss of the permanent area, or extent of a qualifying interest. As the impact of increased SSCs and deposition is a disturbance effect, these targets will not be undermined by this impact.

5.2.4.17 Due to the capacity of Dublin Bay to dilute suspended sediments, the variability of SSCs across the site, the low sensitivity of the receptors and the temporary nature of the impact, it is of scientific certainty, that the risk of suspended sediments escaping into the wider marine environment will not imperil the conservation target to conserve the qualifying interests and community complexes in North Dublin Bay SAC in a natural condition. The construction, O&M and decommissioning phases of Dublin Array will not adversely affect the integrity of North Dublin Bay SAC and no reasonable scientific doubt remains as to the absence of such effects.

Introduction of invasive species (commissioning, decommissioning, O&M phase of offshore infrastructure and O&M Base)

5.2.4.18 Taking into consideration the lack of direct overlap between the North Dublin Bay SAC and the offshore infrastructure, there is no identifiable impact pathway from the introduction of hard substrates which would change the type of available habitat for benthic communities. As such the potential for introduction of invasive species is limited to the movement of construction vessels transiting to and from the offshore infrastructure.

5.2.4.19 As part of the PEMP the project will commit to a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised through measures outlined in Section 5.2.1. With the implementation of these avoidance measures, the potential for risk of invasive species will not adversely affect the conservation target to conserve the QIs in North Dublin Bay SAC in a natural condition.

5.2.4.20 Subject to implementation of the measure included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.2.5 Baldoyle Bay SAC

5.2.5.1 Baldoyle Bay SAC lies 16.1 km from the offshore ECC and lies 14.1 km inshore of the array. The site extends to an area of 5.4 km^2.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; and
- Mediterranean salt meadows.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Mudflats and sandflats not covered by seawater at low tide

5.2.5.2 This feature extends to 4.1 km^2. The Conservation Objectives 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; and
- 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.

Community type: Fine sand dominated by *Angulus tenuis* community complex

5.2.5.3 This complex is located on the eastern reaches of the site from Claremont Beach at Howth in the south, north to Velvet Strand at Portmarnock; it extends westward as far as Portmarnock Point and Cush Point.

Community type: Estuarine sandy mud with *Pygospio elegans* and *Tubificoides benedii* community complex

5.2.5.4 This community complex occurs from Portmarnock Point and Cush Point to the inner reaches of the SAC. This community complex is distinguished by the polychaetes *Pygospio elegans* and *Hediste diversicolor* and the oligochaete *Tubificoides benedii*. Within this complex the bivalve *Cerastoderma edule* is abundant at the outer reaches of the estuary at Portmarnock Point and Cush Point whilst the polychaete *Hediste diversicolor* occurs in high abundance along the western shoreline from Mayne Bridge to Sutton. The algae *Ulva lactuca* and *Ulva* sp. are also recorded here.

Qualifying Interest: Salicornia and other annuals colonising mud and sand

5.2.5.5 This feature extends to 0.4 ha. The Conservation Objectives to maintain the favourable conservation condition of Salicornia and other annuals colonising mud and sand are defined by the following list of attributes and targets:

- Habitat Area: Area stable or increasing subject to natural processes;
- Habitat Distribution: No decline or change in habitat distribution subject to natural processes;
- Physical Structure: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction; and
- Vegetation structure: Maintain the range of coastal habitats including transitional zones.

Qualifying Interest: Atlantic salt meadows

5.2.5.6 This feature extends to 12.5 ha. The Conservation Objectives 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;
- Habitat Distribution: No decline or change in habitat distribution subject to natural processes;
- Physical Structure: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction; and
- Vegetation structure: Maintain the range of coastal habitats including transitional zones.

Qualifying Interest: Mediterranean salt meadows

5.2.5.7 This feature extends to 2.6ha. The Conservation Objectives 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;
- Habitat Distribution: No decline or change in habitat distribution subject to natural processes;
- Physical Structure: Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstruction; and
- Vegetation structure: Maintain the range of coastal habitats including transitional zones.

Assessment of Effects - Baldoyle Bay SAC

Accidental pollution (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.5.8 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.5.9 Baldoyle Bay SAC lies 16.1 km from the offshore ECC and lies 14.1 km inshore of the array area. As detailed in the sediment Physical Processes Modelling Report sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km. The Baldoyle Bay SAC therefore lies outwith the sediment plume extents, and therefore no impact pathway can be identified for pollutants released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to impact on the SAC.

5.2.5.10 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan as defined in Section 5.2.1. The implementation of these avoidance and preventative measures together with low levels of site-specific sediment bound contaminants at the site, enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on the features in Baldoyle Bay SAC or the conservation objectives of the site in relation to accidental pollution.

Suspended sediment and deposition (construction, decommissioning, O&M phase of offshore infrastructure and O&M Base)

5.2.5.11 Baldoyle Bay SAC lies 16.1 km from the offshore ECC and lies 14.1 km inshore of the array area. As detailed in the sediment Physical Processes Modelling Report sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km. The Baldoyle Bay SAC therefore lies outwith the sediment plume extents, and therefore no impact pathway can be identified.

5.2.5.12 Therefore, it is of scientific certainty, that the risk of suspended sediments escaping into the wider marine environment will not imperil the conservation target to conserve the qualifying interests and community complexes in the SAC in a natural condition. The construction, O&M and decommissioning phases of Dublin Array will not adversely affect the integrity of Baldoyle Bay SAC and no reasonable scientific doubt remains as to the absence of such effects.

Introduction of invasive species (commissioning, decommissioning and O&M phase of offshore infrastructure)

5.2.5.13 Taking into consideration the lack of direct overlap between the Baldoyle Bay SAC and the offshore infrastructure, there is no identifiable impact pathway from the introduction of hard substrates which would change the type of available habitat for benthic communities. As such the potential for introduction of invasive species is limited to the movement of construction vessels transiting to and from the offshore infrastructure.

5.2.5.14 As part of the PEMP the project will commit to a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised through measures outlined in Section 5.2.1. With the implementation of these avoidance measures, the potential for risk of invasive species will not adversely affect the conservation target to conserve the QIs in Baldoyle Bay SAC in a natural condition.

5.2.5.15 Subject to implementation of the measure included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.2.6 Murrough Wetlands SAC

5.2.6.1 Murrough Wetlands SAC lies 10.4 km to the south of the Offshore ECC and lies 8.2 km from the array. The site extends to 6 km^2. The following qualifying interests have been screened in for further assessment:

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); and
- Mediterranean salt meadows.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Atlantic salt meadows

5.2.6.2 This feature extends to 61 ha. The Conservation Objective is to restore the favourable conservation condition of Atlantic salt meadows in the Murrough Wetlands SAC, 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, subject to natural processes;
- Physical structure: No human disturbance;
- Vegetation structure (plant height): Standard deviation of median plant height more than 5%;
- Vegetation structure (disturbed ground): Cover of disturbed ground less than 5%;
- Vegetation structure (zonation): Adequate number of zones present, depending on geographical type of saltmarsh;
- Vegetation structure (transitions): No loss of natural transitions;
- Vegetation composition (typical species): Minimum of twelve typical species recorded across all plots;
- Vegetation composition (negative species): Spartina spp. have not been recorded in the habitat in this SAC and establishment should be prevented;
- Other negative indicators: No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators; and
- Indicators of local distinctiveness: No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.

Qualifying Interest: Mediterranean salt meadows

5.2.6.3 This feature extends to 18 ha. The Conservation Objective is to restore the favourable conservation condition of Mediterranean salt meadows in the Murrough Wetlands SAC, 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, subject to natural processes;
- Physical structure: No human disturbance;
- Vegetation structure (disturbed ground): Cover of disturbed ground less than 5%;
- Vegetation structure (transitions): No loss of natural transitions;
- Vegetation composition (typical species): Minimum of six typical species recorded across all plots; minimum two typical species in more than 25% of plots (excluding Juncus maritimus);
- Vegetation composition (negative species): *Spartina* spp. have not been recorded in the habitat in this SAC and establishment should be prevented;
- Other negative indicators: No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators; and
- Indicators of local distinctiveness: No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.

Assessment of Effects - Murrough Wetlands SAC

Accidental pollution (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.6.4 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to be released into the water column, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.6.5 Site-specific contaminants sampling undertaken in support of the EIA and reported in MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations and below lower Irish Action Levels i.e. concentrations that are between background concentrations and the upper end of the no-effects range (see Cronin *et al* ., 2006 and Marine Institute, 2019). The exception being levels of arsenic recorded in one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

5.2.6.6 Levels of arsenic and nickel within sediment collected from Dún Laoghaire Harbour in the vicinity of the planned O&M Base were marginally above the relevant lower Action Levels, although the reported concentration are not considered to constitute an environmental risk.

5.2.6.7 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan as defined in Section 5.2.1. The implementation of these avoidance and preventative measures together with low levels of site-specific sediment bound contaminants at the site, enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on the features Murrough Wetlands SAC or the conservation objectives of the site in relation to accidental pollution.

Suspended sediment and deposition (construction, decommissioning and O&M phase of offshore infrastructure)

5.2.6.8 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. Increased turbidity can lead to impacts on sessile filter feeders. In addition, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.2.6.9 Murrough wetlands SAC lies 10.4 km from the offshore ECC and lies 8.2 km inshore of the array. As detailed in the sediment Physical Processes Modelling Report sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km.

5.2.6.10 Sediment plumes are predicted to quickly dissipate after cessation of the activities (within 24 hours), due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. It is likely that effects of sediment deposition from the offshore infrastructure would be limited to the immediate vicinity of the works or sediment disposal, with fine material distributed much more widely and becoming so dispersed that it is unlikely to settle in measurable thickness locally.

5.2.6.11 Regarding the conservation targets assigned to the Qualifying Interests of the site, there is a possibility that the' vegetation composition' target to conserve the frequency of typical species within the community complexes, may be affected by sediment plumes and deposition impacts if the activities resulted in elevated concentrations of suspended sediments in for prolonged periods.

5.2.6.12 As assessed within the MarESA assessments, saltmarshes are of low sensitivity to smothering impacts, and moderate sensitivity to increased SSC. Due to the low sensitivity of receptors and the temporary nature of the impact it is of scientific certainty, that the risk of suspended sediments escaping into the wider marine environment beyond Dublin Array will not imperil the conservation target to conserve the saltmarsh community complexes in Murrough Wetlands SAC in a natural condition. The construction, O&M and decommissioning phases of the offshore infrastructure will not adversely affect the integrity of Murrough Wetlands SAC and no reasonable scientific doubt remains as to the absence of such effects.

5.2.6.13 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Invasive species (commissioning, decommissioning and O&M phase of offshore infrastructure)

5.2.6.14 Taking into consideration the lack of direct overlap between the Murrough Wetlands Bay SAC and the offshore infrastructure, there is no identifiable impact pathway from the introduction of hard substrates which would change the type of available habitat for benthic communities.

5.2.6.15 As part of the PEMP the project will commit to a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised through measures outlined in Section 5.2.1. With the implementation of these avoidance measures, the potential for risk of invasive species will not adversely affect the conservation target to conserve the QIs in Murrough Wetlands SAC in a natural condition.

5.2.6.16 Subject to implementation of the measure included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.2.7 Codling Fault Zone SAC

5.2.7.1 Codling Fault Zone SAC lies 14.5 km offshore from the array area and 18.3 km from the Offshore ECC. The following qualifying interests have been screened in for further assessment:

- Submarine structures made by leaking gases.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Submarine structures made by leaking gases

5.2.7.2 The following conservation objective has been assigned to the qualifying features ‘Submarine structures made by leaking gases’:

- To maintain or restore the favourable conservation condition of the Annex I habitat or Annex II species for which the SAC has been selected.

Assessment of Effects - Codling Fault Zone SAC

Accidental pollution (construction, decommissioning and O&M phase of offshore infrastructure and O&M Base)

5.2.7.3 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and other organic pollutants to be released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to be released into the water column, leading to an effect on benthic subtidal and intertidal ecology receptors.

5.2.7.4 Codling Fault Zone SAC lies 18.3 km from the offshore ECC and lies 14.5 km from the array area. As detailed in the Physical Processes Modelling Report sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km. The SAC therefore lies outwith the sediment plume extents, and therefore no impact pathway can be identified for pollutants released into the water column as a result of sediment mobilisation from construction, O&M and decommissioning activities to impact on the SAC.

5.2.7.5 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan as defined in Section 5.2.1. The implementation of these avoidance and preventative measures together with low levels of site-specific sediment bound contaminants at the site, enables the conclusion to be made that the construction, O&M and decommissioning of Dublin Array offshore infrastructure and O&M Base will have no AEoI on the features in Codling Fault Zone SAC or the conservation objectives of the site in relation to accidental pollution.

Suspended sediment and deposition (construction, decommissioning and O&M)

5.2.7.6 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. Increased turbidity can lead to impacts on sessile filter feeders. In addition, suspension and redistribution of sediment can lead to smothering of sensitive benthic organisms.

5.2.7.7 The Codling Fault Zone SAC lies 14.5 km offshore from the array area and 18.3 km from the Offshore ECC. As predicted in the modelling, sediment plumes caused by works within the array area are anticipated to be restricted to 10 km from the works, with plumes from the ECC restricted to 2 km (Physical Processes Modelling Report). Codling Fault SAC therefore lies outwith the sediment plume extents and therefore no impact pathway can be established. Therefore, the construction, O&M and decommissioning phases of the offshore infrastructure will not adversely affect the integrity of Codling Fault SAC and no reasonable scientific doubt remains as to the absence of such effects.

Introduction of invasive species (commissioning, decommissioning and O&M phase of offshore infrastructure)

5.2.7.8 Taking into consideration the lack of direct overlap between the Codling Fault SAC and the offshore infrastructure, there is no identifiable impact pathway from the introduction of hard substrates which would change the type of available habitat for benthic communities. As such the potential for introduction of invasive species is limited to the movement of construction vessels transiting to and from the offshore infrastructure.

5.2.7.9 As part of the PEMP the project will commit to a marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised through measures outlined in Section 5.2.1. With the implementation of these avoidance measures, the potential for risk of invasive species will not adversely affect the conservation target to conserve the QIs in Codling Fault Zone SAC in a natural condition.

5.2.7.10 Subject to implementation of the measure included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.3 Migratory fish species

5.3.1 Assessment approach

5.3.1.1 The assessment process for migratory fish species is in line with the process outlined in Section 3. The assessment is informed by site specific underwater noise modelling; further details of the modelling and the results are presented within the Underwater noise assessment.

5.3.1.2 Please note that this assessment considers freshwater pearl mussel alongside migratory fish. The lifecycle of the freshwater pearl mussel is such that in their first year, freshwater pearl mussel live on the gills of young Atlantic salmon. As the viability of the mussel population is inherently linked to the viability of the salmon population, conclusions made in relation to the salmon population will mirror those for freshwater pearl mussel.

5.3.1.3 The sites and effects screened in for migratory fish species are summarised Table 7 with a summary of each effect and the key information relied upon provided below. All effects screened in are associated with the construction, O&M and decommissioning of the offshore infrastructure only. All works associated with the O&M Base will be restricted to the confines of Dún Laoghaire Harbour with no pathway for effects on migratory fish species.

5.3.1.4 To inform the assessment, determination of which option (MDO or Alternative Design Option) presents the greatest potential for AEoI on designated sites has been presented within Volume 2 of this HDA.

Table 7 SACs screened in for migratory fish

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Slaney River Valley SAC [IE0000781]	Twaite shad Atlantic salmon Sea lamprey Freshwater pearl mussel	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey ▪ EMF
River Boyne and River Blackwater SAC [IE002299]	Atlantic salmon	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey ▪ EMF

Underwater noise

5.3.1.5 Effects from underwater noise on migratory fish are most likely to occur during the construction phase with any effects during O&M and decommissioning 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, cable installation 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). Impact piling will generate impulse sounds, which are characterised by high acoustic energy levels with a rapid rise time followed by a 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 from vessel movements, drilling, dredging and seabed preparation works will generate low levels of non-impulse sounds throughout the construction, O&M and decommissioning phases, which do not have a high peak pressure with rapid rise time.

5.3.1.6 Fish species vary in their sensitivity to noise due to differences in the morphology of their auditory structures. Fish species sense underwater sounds by detecting the acoustic pressure and/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).

5.3.1.7 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 short ranges. Lateral lines are known to be used to detect prey and for predator avoidance in the near-field (Higgs and Radford, 2016).

5.3.1.8 The ability of fish to utilise sound pressure in hearing depends on several factors, with the key factors being:

- Presence and size of a swim bladder or other gas-filled cavities. Pressure waves impinging upon a fish cause gas-filled chambers, such as the swim bladder, to oscillate, which allows the pressure component of the sound field to be converted into particle motion, which can then be detected by sensory organs in the inner ear (Higgs *et al*., 2003; Popper and Hawkins, 2019).

- Mechanical coupling of the swim bladder to the ear, present in some species, such as twaite shad, where the sound pressure energy is transmitted directly from the swim bladder to the inner ear (Popper and Hawkins, 2019).

5.3.1.9 The sensitivity of fishes to sounds is strongly dependent upon the morphology of their auditory structures, which determines the range of frequencies (or bandwidth) over which a species is able to detect sound and the lowest sound level that they can perceive (hearing threshold). Fish species in which hearing is enhanced through the presence of a swim bladder are more sensitive to underwater noise than species without a swim bladder. Mechanical links between the swim bladder and the sensory organs in the inner ear, such as found in shad species, allow sound signals to be transmitted without attenuation, further increasing the sensitivity to underwater sounds (Popper and Hawkins, 2019).

5.3.1.10 Based on their sound detection mechanism and hearing capabilities, fish receptors have been grouped into the following categories, based on the recommendations by Popper *et al*. (2014):

- 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[10] injuries 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 group 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).

[10] Barotrauma refers to tissue damage resulting from rapid changes in pressure that directly affect the body gasses including air-filled chambers such as the swim bladder.

5.3.1.11 The range of potential effects from impulse sound sources, such as pile driving and 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 lower an individual's fitness until hearing recovers. The extent to which underwater sound might cause an adverse environmental impact in a particular fish species is dependent upon the level of sound pressure or particle motion, its frequency, duration and/or repetition (Hastings and Popper, 2005). 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.

5.3.1.12 To assess the likely significance of effects from underwater sounds on migratory fish, potential effects have been divided into the following effect categories:

- Mortality and potential mortal injury: Exposure to sound may result in instantaneous or delayed mortality through physical trauma to organs and body tissue. The potential for mortality or mortal injury is likely to only occur in extreme proximity to intense sounds, such as those emitted during impact piling. The risk of mortality or mortal injury occurring during impact piling will be reduced by use of soft start techniques at the start of the piling sequence. This means that mobile 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 mobile 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). 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.

- 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) (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.

5.3.1.13 Project-specific underwater noise modelling (Underwater noise assessment) has been undertaken to identify potential ranges for the onset of mortality and potential mortal injury, as well as impairment (recoverable injury and TTS) due to piling noise, UXO and continuous noise, where relevant. These ranges are based on impact thresholds recommended by Popper *et al*. (2014) and represent current best practice sound exposure criteria for fish (Table 8 to Table 10).

5.3.1.14 There are no quantitative thresholds advised to be used to assess behavioural effects; 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 (Table 11 and Table 12). 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 8. Criteria for mortality and potential mortal injury, recoverable injury, and TTS in species of fish from impact piling noise (Popper *et al.*, 2014)

Hearing group	Mortality and potential mortal injury	Impairment	
		Recoverable injury	TTS
Group 1 : no swim bladder	> 219 dB SEL_{cum} or > 213 dB SPL_{peak}	> 216 dB SEL_{cum} or > 213 dB SPL_{peak}	>> 186 dB SEL_{cum}
Group 2: swim bladder not involved in hearing	210 dB SEL_{cum} or > 207 dB SPL_{peak}	203 dB SEL_{cum} or > 207 dB SPL_{peak}	> 186 dB SEL_{cum}

Hearing group	Mortality and potential mortal injury	Impairment Recoverable injury	TTS
Groups 3 and 4: swim bladder involved in hearing / close to ear	207 dB SEL_{cum} or > 207 dB SPL_{peak}	203 dB SEL_{cum} or > 207 dB SPL_{peak}	186 dB SEL_{cum}
Eggs and Larvae	> 210 dB SEL_{cum} or > 207 dB SPL_{peak}	See Table 11	

Notes: Sound levels are usually expressed in decibel (dB) with respect to a reference value. For underwater sounds, the reference value is 1 micropascal (µPa). SPL_{peak} values are presented as dB re 1 µPa; SEL_{cum} values are represented as dB re 1µPa^2. Decibels are expressed on a logarithmic scale, which means that a 6 dB increase equates to a doubling of the loudness of the sound, and, as such, small changes in higher numerical dB values can equate to significant increases in loudness.

Table 9. Criteria for recoverable injury and TTS in species of fish from continuous noise sources (Popper *et al.*, 2014)

Hearing group	Impairment Recoverable injury	TTS
Groups 3 and 4: swim bladder involved in hearing / close to ear	170 dB SPL_{RMS} for 48 hrs	158 dB SPL_{RMS} for 12 hours

Table 10. Criteria for potential mortal injury in species of fish from explosions (Popper *et al.*, 2014)

Hearing group	Mortality and potential mortal injury
Group 1 : no swim bladder	229 – 234 dB SPL_{peak}
Group 2: swim bladder not involved in hearing	229 – 234 dB SPL_{peak}
Groups 3 and 4: swim bladder involved in hearing / close to ear	229 – 234 dB SPL_{peak}
Eggs and Larvae	229 – 234 dB SPL_{peak}

Table 11. Summary of the qualitative effects on species of fish from impact piling noise (Popper *et al.*, 2014) (N = Near-field; I = Intermediate-field; F = Far-field)

<table>
<tr><th rowspan="2">Type of animal</th><th colspan="2">Impairment</th><th rowspan="2">Behaviour</th></tr>
<tr><th>Recoverable injury</th><th>TTS</th></tr>
<tr><td>Group 1 : no swim bladder</td><td colspan="2" rowspan="3">See Table 8</td><td>(N) High
(I) Moderate
(F) Low</td></tr>
<tr><td>Group 2: swim bladder not involved in hearing</td><td>(N) High
(I) Moderate
(F) Low</td></tr>
<tr><td>Groups 3 and 4: swim bladder involved in hearing / close to ear</td><td>(N) High
(I) High
(F) Moderate</td></tr>
<tr><td>Eggs and Larvae</td><td>(N) Moderate
(I) Low
(F) Low</td><td>(N) Moderate
(I) Low
(F) Low</td><td>(N) Moderate
(I) Low
(F) Low</td></tr>
</table>

Notes: For qualitative assessments, the relative risk (high, moderate, low) is given at three distances from the sound source, defined in relative terms as near/N (10s of metres), intermediate/I (100s of metres) and far/F (1000s of metres).

Table 12. Summary of the qualitative effects on fish from continuous noise from Popper *et al.* (2014) (N = Near-field; I = Intermediate-field; F = Far-field)

Type of animal	Mortality and potential mortal injury	Impairment		Behaviour
		Recoverable injury	TTS	
Group 1 : no swim bladder	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low
Group 2: swim bladder not involved in hearing	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low
Groups 3 and 4: swim bladder involved in hearing / close to ear	(N) Low (I) Low (F) Low	See Table 9		(N) High (I) Moderate (F) Low
Eggs and Larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Moderate (F) Low

5.3.1.15 Popper *et al*. (2014) present impact thresholds for pile driving as both single strike, unweighted peak Sound Pressure Levels (SPLpeak) and cumulative unweighted Sound Exposure Levels (SELcum). SPLpeak represents the maximum sound energy level of individual impulse sounds measured as differential pressure from positive to zero. By contrast, SELcum 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 (SPLpeak and SELcum) are commonly used to assess the risk of mortality and recoverably 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 non-impulsive sounds (e.g., from shipping) are typically presented as root-mean-square sound pressure levels (SPLrms), which represent the average of the sound pressure 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.

5.3.1.16 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 sound 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 will not alter the conclusions of the assessment.

5.3.1.17 To determine the potential spatial extent of underwater noise for the different effect categories described above, noise modelling has been undertaken for two representative locations (NE and SW) in the array area. All received sound levels were calculated by considering soft-start and ramp-up procedures and the maximum total duration of piling and hammer strike rates. Full details of the modelling approach are given in the Underwater noise assessment. For all qualifying fish species assessed in the NIS, 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 1.5 m/s.

5.3.1.18 It is acknowledged that there is limited evidence for fish fleeing from high intense sounds in the wild, and it is expected that the reaction would differ between species. Most species are likely to move away from a sound that is loud enough to cause harm (Dahl *et al*., 2015; Popper *et al*., 2014), some may seek protection in the sediment and others may dive deeper in the water column. For those species that flee, the speed chosen for this study of 1.5 m/s is relatively slow in relation to data from Hirata (1999) and thus is considered somewhat conservative (Underwater noise assessment).

5.3.1.19 The modelled maximum impact ranges for the respective impact onset thresholds relevant to monopile and jacket foundation piling and migratory fish species (i.e., SEL_{cum} for 186 dB, 203 dB, 207 dB, 210 dB, 213 dB, 216 dB and 219 dB; Table 8) are shown in Figure 7 and Figure 8, respectively. Note that modelled impact ranges less than 100 m from the piling source are not shown in the figures.

5.3.1.20 All screened in migratory species (i.e., sea lamprey, twaite shad and Atlantic salmon) are anadromous species and therefore have the potential to be present within the area affected by underwater noise from the construction, O&M and decommissioning of the offshore infrastructure whilst undertaking migrations or living at sea. The susceptibility of these species to underwater sounds generated during the construction, operation and maintenance and decommissioning phases are detailed in the next sections.

5.3.1.21 The Applicant has committed to a 10 dB reduction in at source noise levels for pile driving. This is a conservative estimate based on the existing types of mitigation that have been reviewed in Annex A to the Marine Megafauna Mitigation Plan (hereafter referred to as the MMMP) (Volume 7, Appendix 4, Annex A).

5.3.1.22 In addition to the implementation of at-source mitigation methods to minimise the underwater noise impacts, the Applicant has committed to a number of project design measures and avoidance and preventative measures to ensure compliance with all relevant guidance, specifically NPWS, (2014); DAHG (2014); IDWG (2020). All measures are detailed within the MMMP that provides the strategy for the project, to ensure appropriate controls are in place to manage environmental risks associated with the construction of the Dublin Array offshore infrastructure.

5.3.1.23 The primary purpose of the MMMP is to mitigate and minimise acoustic impacts in protected marine megafauna, including marine mammal species, basking shark and sea turtle. Although the measures are primarily designed for marine mammals, they will also offer a precautionary approach to protection for other species. In particular, the soft start and ramp up period are standard engineering practices which are necessary during the early stages of installation to maintain pile orientation and stability. These processes also result in the gradual introduction of noise into the marine environment, encouraging both fish species that are sensitive to sound to move away from the noise source.

5.3.1.24 For the full list of measures applicable to all species please see Table 223Table 223. Of note to this assessment are the measures for impact piling, will include:

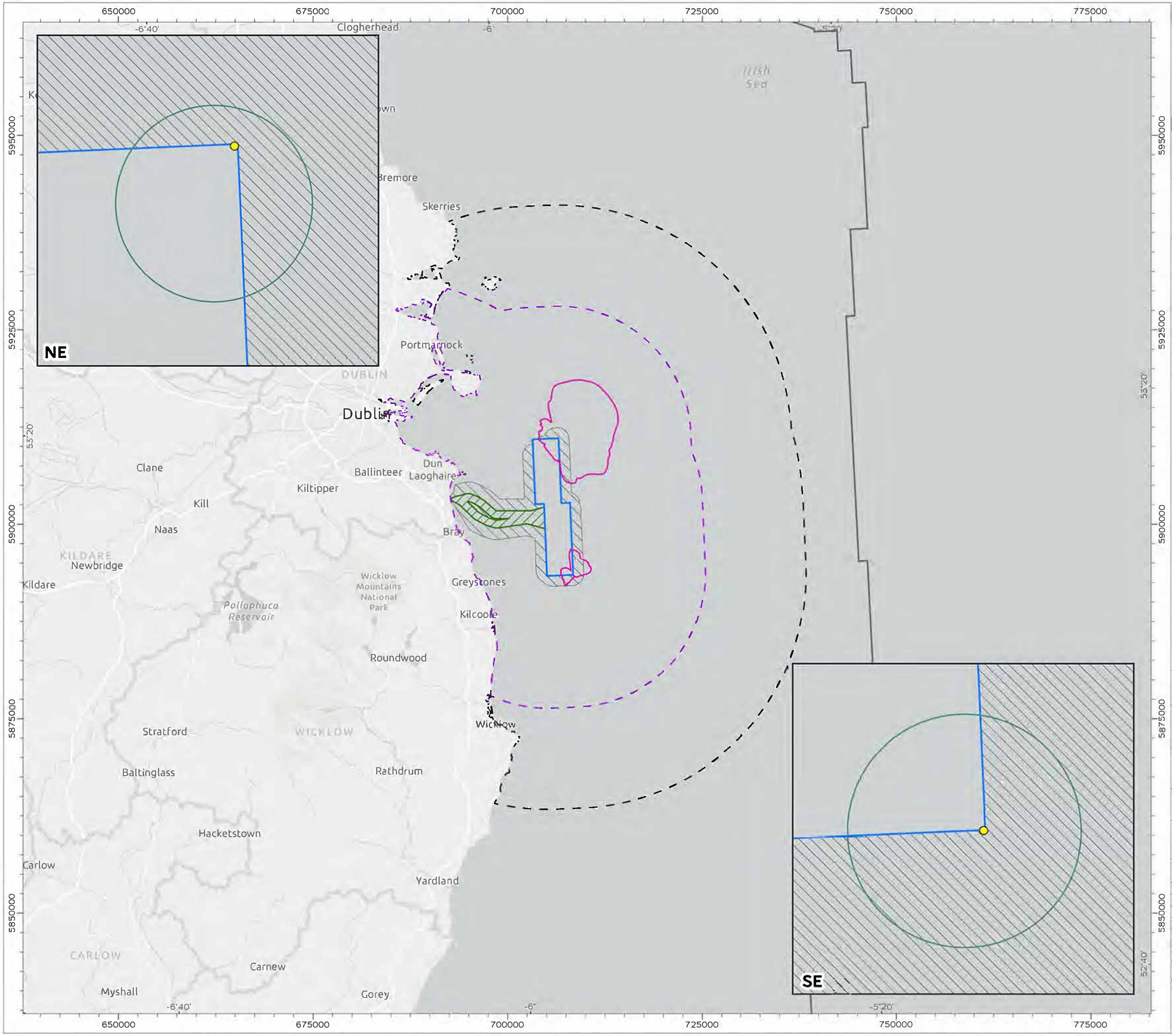
- Acoustic Deterrent Device (ADD), as an additional mitigation tool prior to the start of piling activities at night;
- Soft start procedure; and
- Breaks in piling procedure.

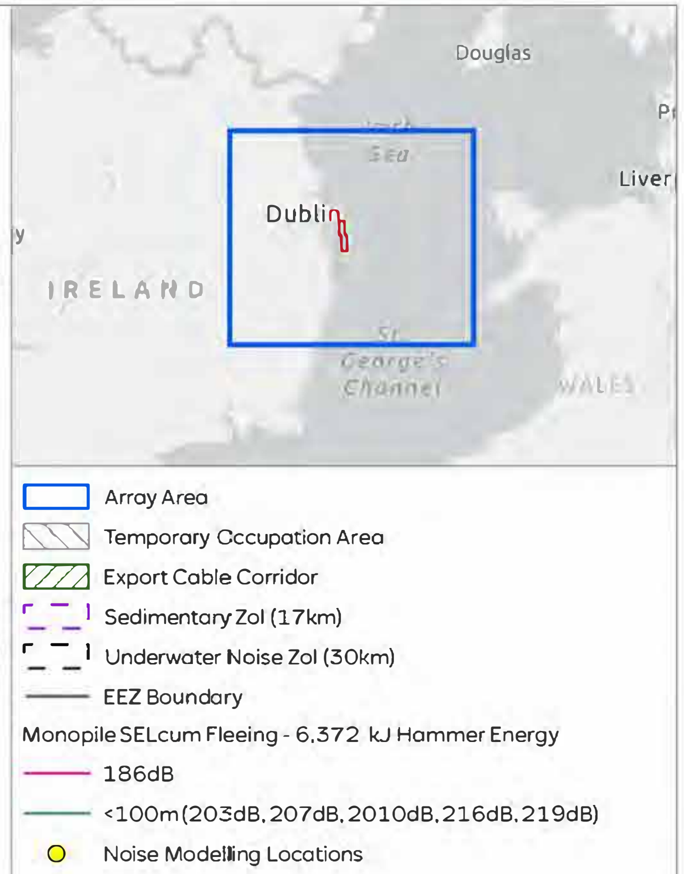
5.3.1.25 Relevant procedures for UXO detonation will include:

- Soft start charges for high order;
- Use of bubble curtains for high order clearance UXO; and

5.3.1.26 Procedures for geophysical surveys using 3D UHRS (sparker) equipment, will include:

- Soft start procedure;
- Line changes longer than 40 minutes will be stopped with a pre watch of 30 mins, followed by soft start to resume;





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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Maximum Impact Ranges for Fleeing Receptors from the Piling of Monopile Foundations within the Array Area (6,372 KJ)

DRAWING NUMBER: 7

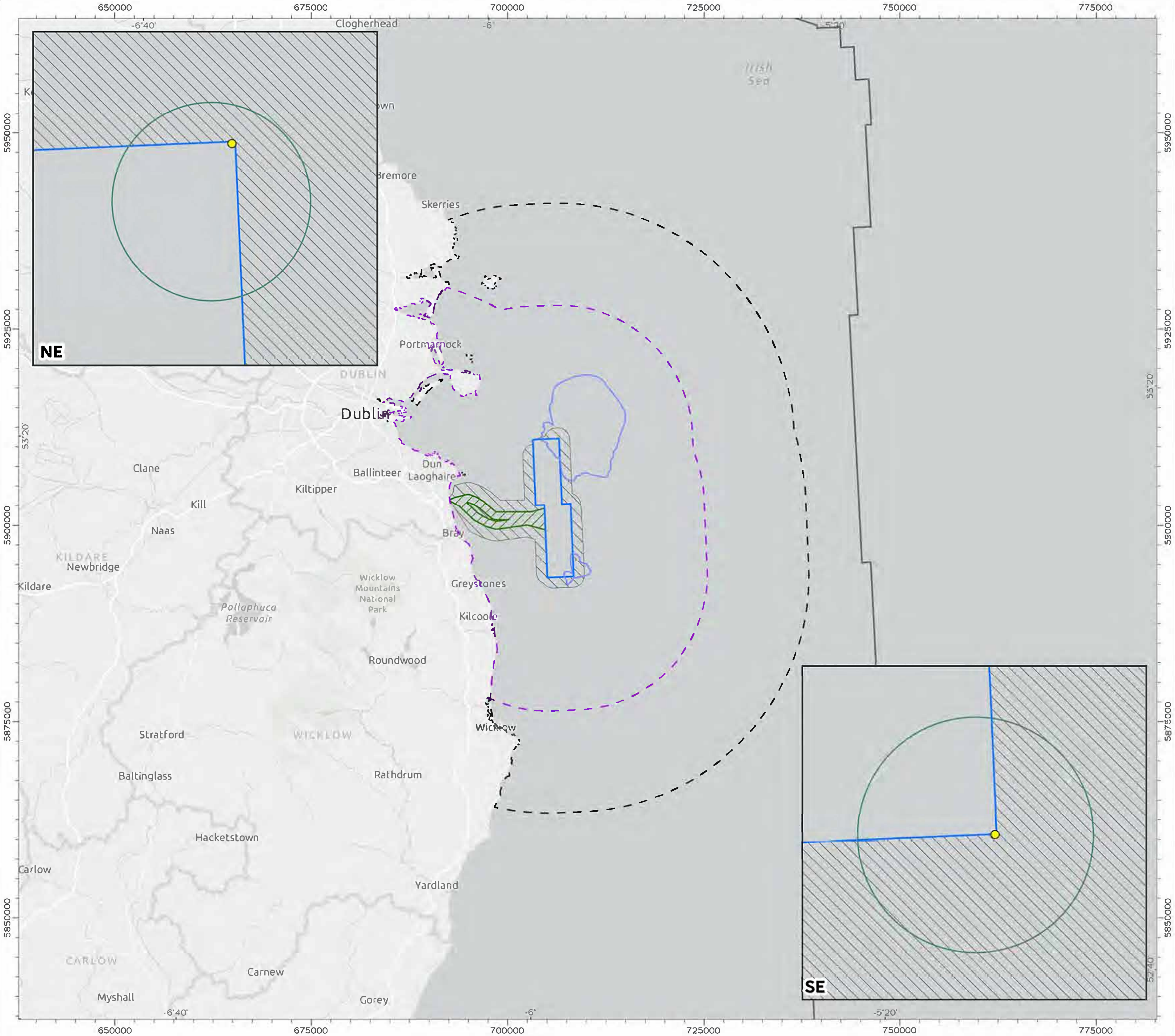
PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-29	For Issue	GB	BB	SS

SCALE 1:600,000 | PLOT SIZE A3 | DATUM WGS 1984 | VERTICAL REF LAT | PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array — Generation for generations — Kish Offshore Wind Limited - Bray Offshore Wind Limited



- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Sedimentary ZoI (17km)
- Underwater Noise ZoI (30km)
- EEZ Boundary

Jacket SELcum Fleeing - 4,695 kJ Hammer Energy

- 186dB
- <100m (203dB, 207dB, 2010dB, 216dB, 219dB)
- Noise Modelling Locations

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Maximum Impact Ranges for Fleeing Receptors from the Sequential Piling of Jacket Foundations within the Array Area (4,695KJ)

DRAWING NUMBER: 8

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
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SCALE	1:500,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Underwater noise from piling

Sea lamprey

5.3.1.27 Lamprey species belong to hearing Group 1, as defined above, as they lack a swim bladder and 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 300 Hz (Mickle *et al.,* 2019). Data on the potential for TTS and behavioural responses to anthropogenic noise stimuli in lampreys 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 20-1,000 Hz (Hildebrand, 2009). There is therefore potential for sea lamprey to exhibit behavioural responses during pile driving. Any behavioural responses are anticipated to be temporary, with affected individuals expected to resume normal behaviours or recolonise areas shortly after piling has ceased (Popper *et al.,* 2014). 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, depending on the intensity and duration of exposure (Popper *et al.,* 2014; Popper and Hawkins, 2019).

Atlantic salmon

5.3.1.28 Atlantic salmon belong to hearing Group 2 species of fish, 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 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 800 Hz, with greatest sensitivities occurring at frequency of less than 300 Hz (Harding *et al*., 2016; Hawkins and Johnstone, 1978).

5.3.1.29 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 move away from harmful piling sounds, thereby reducing the likelihood of lethal and recoverable injuries. There is also the potential for TTS and behavioural changes to occur during impact piling activities.

5.3.1.30 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 inconclusive 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 and changes in schooling behaviour (reviewed by Gillson *et al*., 2022). Given the limited data on TTS and behavioural changes in Atlantic salmon as a result of pile-driving sounds, a precautionary approach has been adopted, assuming the occurrence of TTS and behavioural effects in Atlantic salmon during piling operations.

5.3.1.31 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 might delay migration in the short-term.

Twaite shad

5.3.1.32 Shad species have an elongated swim bladder connected to two gas-filled bubbles ("auditory bullae"), which are themselves connected to the sensory organs of the inner ear by a thin elastic thread (Higgs *et al*., 2003). These anatomical specialisations seem to have allowed shad species to develop excellent hearing over a wide frequency range from around 100 Hz up to at least 180 kHz (Mann *et al.*, 1997; Popper and Fay, 2011). Behavioural and physiological studies on the American shad *A. sapidissima* showed greatest hearing sensitivities at low frequencies from 200-800 Hz and at high and ultrasonic frequencies from about 25-150 kHz (Mann *et al*., 1998, 1997). There is therefore potential for twaite shad to sense and react to impact piling noise.

5.3.1.33 The presence of a swim bladder close to the ear makes shad species highly susceptible to pressure-related tissue damage, and given their good hearing ability, they are also at higher risk of experiencing physiological and behavioural effects (Popper *et al*., 2014; Popper and Hawkins, 2019). Given their mobile nature, twaite shad would be able to adapt their behaviour during soft-start procedures and move away from harmful piling sounds. Moreover, as for other fishes, any behavioural responses and/ or TTS are anticipated to be temporary, with affected individuals anticipated to resume normal behaviours and recolonise areas shortly after piling has ceased.

Underwater noise from UXO

5.3.1.34 There is a possibility that UXO of varying sizes may exist within the array area, Offshore ECC and temporary occupation 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).

5.3.1.35 In the event that a UXO is identified, the preference will be to avoid the UXO target where possible through micro-siting of infrastructure (e.g., cable routing). If this is not an option, then relocation of the UXO to a safe area would be attempted. Where avoidance or relocation of the UXO are not practicable, low order clearance (also known as low order deflagration) would be the preferred clearance method and will be attempted on all suitable UXO. The low order technique uses a user filled shaped-charge to create a plasma-jet, which causes a build-up of pressure within the UXO target, leading to a burst of the UXO casing, disrupting the contents by introducing heat to ignite the explosive fill to rapidly burn.

5.3.1.36 Where low order deflagration of the UXO is not feasible or has been unsuccessful, high order detonation will be used as a last resort. High order clearance requires an external ‘donor charge’ initiator adjacent to the UXO target to detonate the explosive material in the UXO, producing a blast wave equivalent to the full detonation of the device.

5.3.1.37 High order detonation of UXO generates high amplitude sound levels that, like piling noise, are detectable over large spatial scales (10s of kms) (Lepper *et al*., 2024). 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 and 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 donor charge.

5.3.1.38 Small-scale mortality and physical injuries in fish as a result of underwater explosions have been reported by several authors, with physical injuries including rupture of the swim bladder and haemorrhage 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 and 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). Therefore, UXO detonations are considered to have a lower likelihood of triggering population level effects in marine species compared to impact piling due to the significantly reduced temporal footprint of the noise that would result from them (JNCC, 2020; Popper *et al*., 2014).

5.3.1.39 There is a low likelihood of UXO across the array area, Offshore ECC and temporary occupation area, and it has therefore been assumed that a maximum of four UXO detonations will be required based on a risk assessment.

5.3.1.40 High order clearance of UXO would represent the greatest risk to migratory fish and has consequently been used for underwater noise modelling and as the MDO for the impact assessment. In addition, the assessments also consider the potential for adverse effects from low order clearance as this option represents the preferred clearance method.

5.3.1.41 Given the high intensity nature of sounds generated during UXO detonation and the associated risk for adverse effects on marine species, mitigation is included by implementation of specific measures should UXO clearance be required. Of relevance to the assessment on migratory fish species are the measures contained within the MMMP outlined in Section 5.3.1 designed to ensure appropriate controls are in place to manage environmental risks associated with the construction of the Dublin Array offshore infrastructure.

5.3.1.42 Each identified UXO will be subject to a technical and risk assessment and the most appropriate mitigation method will be selected. In addition, if high order UXO clearance is required, bubble curtains will be deployed as a noise abatement measure to attenuate the noise propagated through the water column during detonations. It is considered that adoption of these mitigation measures will reduce the likelihood of potential lethal or recoverable physical injuries in the qualifying fish species. In addition, these measures are considered to reduce the number of individuals at risk of TTS or behavioural reactions through a reduction in noise impact ranges.

Underwater noise from continuous noise sources

5.3.1.43 Besides piling and the detonation of UXO, there will be several other activities that will produce underwater noise during the construction, operation and maintenance and decommissioning of Dublin Array, including dredging, drilling, cable laying, rock placement, geophysical surveys, and vessel noise. These activities produce non-impulsive (continuous) sounds and may occur either alongside piling and UXO clearance or separately.

5.3.1.44 Sound levels associated with construction and maintenance activities at offshore wind farms have received considerably less attention and very little monitoring data is available. Among the construction activities to take place at Dublin Array, suction dredging is predicted to generate the largest sound levels of 186 dB re 1 µPa at 1 m SEL_{rms} (Underwater noise assessment). Rock placement is generally considered to be the nosiest external cable or scour 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. The estimated source levels of underwater noise from rock placement is 172 dB re 1 µPa at 1 m, and the noise emitted from large vessels is estimated at 168 dB re 1 µPa at 1 m (Underwater noise assessment).

5.3.1.45 Vessel noise will be emitted 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 activities and anchor handling. Additional small vessels will be required for crew transport and maintenance on site. Similarly, non-impulse sounds will be emitted from vessels during maintenance and decommissioning activities.

5.3.1.46 Additional pre-construction and post-construction surveys will be required, which are included as part of this planning application. Pre-construction 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 and UXO that exist across the offshore development area).

5.3.1.47 Consideration is given to the measures outlined within the MMMP outlined in Section 5.3.1 of relevance to geophysical surveys that include soft start procedures that are appropriate to fish species as well as marine mammals.

5.3.1.48 There is currently no evidence that the non-impulsive sounds generated by the activities listed above cause mortality and 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 4 species). These effects were temporary, with recorded recovery times of ranging up to fourteen days following the exposure to continuous sounds (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). Based on the limited data on TTS and behavioural changes in fish in response to continuous noise, a precautionary approach has been taken in the assessment, which assumes that TTS and behavioural effects could occur in all migratory fish included in the assessment. The likelihood of effects for each of the hearing groups has been assessed using the qualitative criteria recommended by Popper *et al*. (2014).

EMF

5.3.1.49 During the operational phase, electric and magnetic fields (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 receptors that use electric or magnetic senses for foraging, navigation or communication. Of those species sensitive to EMF, some are electrosensitive, some magneto-sensitive and others are thought able to detect both.

5.3.1.50 Artificial EMFs are generated by electric currents that pass through the power cables. Two types of EMFs are produced directly: 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, either by the movement of alternating B-fields (in the case of alternating current (AC) transmission) through seawater or by the movement of seawater and/or an organism through a static B-field (in the case of direct current (DC) transmission).

5.3.1.51 EMFs also occur naturally in the marine environment from a variety of sources. The dominant source of background (natural) EMF is that from the geomagnetic field of the Earth. The background magnetic field strength in Irish waters is approximately 49µT (National Oceanic and Atmospheric Administration (NOAA), 2020). The other important type of natural EMFs is small bioelectric fields generated by electrical currents moving through living organisms (e.g., Tricas and Gill, 2011). The EMFs generated by geomagnetic and bioelectric fields are the signals that magneto- and electrosensitive marine species rely on for navigation and prey detection, respectively.

5.3.1.52 Potential impacts of anthropogenic EMFs on marine organisms are relatively sparsely investigated, with studies having so far focussed on a small number of species, including salmonids and lamprey species. Salmonids such as Atlantic salmon are magneto-sensitive, while lamprey species possess receptors to detect electric fields. The current evidence of EMF effects on fish indicates that sensitive fish may exhibit short-term, localised behavioural changes, which, however, are unlikely to affect migratory patterns and behaviour in the long-term (e.g., Wyman *et al.*, 2018).

5.3.1.53 As noted for benthic species, as part of the project design, the installation of cables will be to an optimum cable burial depth, with offshore cables, where possible, buried in the seabed to the optimal performance burial depth for the specific ground conditions. Where optimum burial depth cannot be achieved secondary protection measure will be deployed e.g. concrete mattress, rock berm, grout bags or an equivalent in key areas. Although cable burial does not prevent EMFs from emanating into the marine environment, it increases the distance between the EMF source and sensitive receptors, thereby reducing the EMF strengths to which individuals are subjected. B-fields attenuate rapidly away from the central line of the cable and therefore are likely to be detectable above background levels only in close proximity to the cables (i.e., within about 10 metres either side of the cable) (e.g. Normandeau Associates et al., 2011).

5.3.2 River Boyne and River Blackwater SAC

5.3.2.1 The River Boyne and River Blackwater SAC lies 43 km from the array area and 42 km from the Offshore ECC (Figure 3); this distance is provided to the mouth of the River Boyne, as the relevant range for migratory fish is not from the SAC itself but the point of access, i.e. the estuary mouth. The following qualifying interest has been screened in for further assessment:

- Atlantic Salmon.

Conservation Objectives of Qualifying Interests

Qualifying Interest: Atlantic Salmon

5.3.2.2 The Conservation Objectives for Atlantic salmon are:

- To restore the favourable conservation condition of Atlantic salmon in the River Boyne and River Blackwater SAC, defined by distribution extent of anadromy, adult spawning fish, salmon fry abundance, out migrating smolt abundance, number and distribution of redds, water quality.

Assessment of Effects - River Boyne and River Blackwater SAC

5.3.2.3 Effects from underwater noise and EMF to the Atlantic salmon population of the River Boyne and River Blackwater SAC are the effects that have been screened in as having the potential for an adverse effect on the qualifying Atlantic salmon population from the project alone. In addition, effects from accidental pollution and invasive species have been screened in as they may arise in the absence of mitigation. Atlantic salmon is a true anadromous species and therefore have the potential to be present at Dublin Array whilst undertaking migrations.

5.3.2.4 Effects from underwater noise on Atlantic salmon are most likely to occur during the construction phase with any effects during O&M and decommissioning expected to be less as there would be no piling and UXO clearance. Atlantic salmon are assessed within this NIS as a fleeing receptor only given their mobile nature while at sea (Figure 7).

Underwater noise from piling (Construction Phase)

5.3.2.5 Based on the noise modelling and the criteria set out in Popper *et al*. (2004), mortality and potential mortal injury and recoverable injury to Atlantic salmon (Group 2 fleeing receptor) during the course of piling (SEL_{cum}) are predicted to occur less than 100 m from the noise source for the piling of both monopiles (6,372 kJ hammer energy) and jacket foundations (4,695 kJ hammer energy). Instantaneous mortal or recoverable injuries during piling (SPL_{peak}) are predicted to occur up to 70 m from the installation of monopiles and up to 60 m from the piling of jacket foundations. TTS in fleeing Group 2 receptors during piling was modelled to occur up to 8.5 km from the noise source during the installation of monopile foundations (Figure 7), and up to 9.3 km from the noise source during the piling of jacket foundations (Figure 8). 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).

5.3.2.6 Based on the modelling results and the distance between the River Boyne estuary and the array area (43 km) and Offshore ECC (42 km), no mortality and potential mortal injury, recoverable injury, TTS and behavioural changes are predicted for Atlantic salmon within the SAC. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.2.7 The migratory movement patterns of Atlantic Salmon away from coastal waters to their oceanic feeding grounds in the north-east Atlantic are generally poorly understood. However, acoustic telemetry data suggest that young salmon (i.e., salmon smolts) from the River Boyne and other rivers along the east coast of Ireland migrate north to leave the Irish Sea (Barry *et a*., 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). These data suggest that Atlantic salmon from the River Boyne and River Blackwater SAC move further away from the array area (the source of effects) after leaving the estuary without getting closer or increasing the potential for effects, inherently decreasing the impact the noise may have on their migration. No information is available on the movement patterns of returning salmon; however, a similar migration route whereby returning Atlantic salmon enter the Irish Sea from the north may be assumed, with Atlantic salmon therefore avoiding Dublin Array and the areas affected by underwater noise on their return trip as well.

5.3.2.8 However, given this evidence is limited to a single study, there is still a potential for individuals to be within the areas affected by underwater noise during the construction, operation and maintenance and decommissioning of Dublin Array, and therefore an assessment of noise impacts on this species is still required.

5.3.2.9 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 maximum period of 18 months[11] may coincide with the peak migration periods of Atlantic salmon.

5.3.2.10 As outlined in paragraph 5.3.1.28 *et seq.*, Atlantic salmon belong to hearing Group 2, based on the presence of a swim bladder that is not involved in hearing. The presence of a swim bladder makes them more susceptible to lethal and sub-lethal injuries when close to the noise source. However, the mobile nature of the species enables individuals to vacate the area of impact during soft-start and ramp-up procedures, which would reduce the likelihood of injury or death. As discussed in paragraph 5.3.1.29 *et seq*., any TTS and behavioural responses are expected to be temporary, with affected individuals anticipated to continue their migration shortly after piling has ceased, including during piling free days. Based on this, combined with the evidence that indicates a northward migration of Atlantic salmon from the SAC away from the array area, it is concluded that impact piling at Dublin Array will not present a barrier for Atlantic salmon to access or leave the SAC.

[11] The longest piling programme is 18 months and involves the piling of jacket foundations. The shortest piling programme is four months and involves the installation of monopile foundations and the use of Irish sea ports.

5.3.2.11 Based on the above considerations and given the duration and frequency of piling (consisting of intermittent piling events over a maximum period of 18 months), it is concluded that any effects on Atlantic salmon individuals while at sea arising from underwater noise emitted during piling at Dublin Array will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

Underwater noise from UXO clearance (Construction Phase)

5.3.2.12 Mortality and potential mortal injury from high order UXO clearance in all fish receptors is predicted to occur up to 810 m from the detonation site when considering a maximum equivalent charge weight of 525 kg and an additional donor weight of 0.5 kg to initiate detonation (Underwater noise assessment). The modelling has assumed no degradation or burial of the UXO, and no smoothing of the impact wave over distance, and consequently the noise levels predicted are likely to be overestimated. For lower order clearance events, mortality and recoverable injuries are likely to occur up to 65 m from the detonation site, based on a charge weight of 0.25 kg.

5.3.2.13 The relative risk of recoverable injury and behavioural responses in Group 2 fish species as a result of underwater explosions 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).

5.3.2.14 UXO clearance operations could occur at any time of the year and therefore have the potential to interact with the key migration periods of Atlantic salmon. There is a low likelihood of UXO, and it has therefore been assumed that a maximum of four UXO detonations within the array area, Offshore ECC and temporary occupation area will be required based on a risk assessment. Each UXO detonation would be a discrete and brief (lasting less than one day) event, with the acoustic pulses generated at source during detonation expected to only last several seconds (Lepper *et al.,* 2024). While this may result in mortal and recoverable injuries to some individuals close to the detonation site, it is not anticipated to cause widespread and long-term displacement of Atlantic salmon from specific migration routes. Moreover, the risk of Atlantic salmon native to the River Boyne and River Blackwater SAC to be affected by UXO clearance operations at Dublin Array is considered to be low, based on the location and distance of the SAC from the project and the likely northward migration of salmon when leaving the SAC.

5.3.2.15 The Applicant will commit to use of avoidance and preventative measures, those relevant to fish species as defined in 5.3.1will include, soft start charges and use of bubble curtain for high order detonations.

5.3.2.16 This will, through a reduction in the impact zones, reduce the potential for lethal and recoverable injuries in Atlantic salmon as well as the number of individuals at risk of TTS and behavioural reactions. Any TTS and behavioural responses would be temporary, with individuals expected to be able to continue their migration following the clearance event.

5.3.2.17 Based on the above considerations and given the infrequent and brief nature of the impact, it is concluded that underwater noise arising from high order UXO clearance at Dublin Array will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC. It is considered that the same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated by these operations and the associated smaller scale of effects.

Underwater noise from other noise sources (Construction, O&M and Decommissioning Phase)

5.3.2.18 As discussed in paragraph 5.3.1.48 5.3.1.48*etc seq*., there is currently no evidence that non-impulsive sounds, such as those emitted during vessel operations, dredging and drilling, cause mortality and potential mortal injury in fish (Popper *et al*., 2014). Using the unweighted SEL_{rms} thresholds recommended by Popper *et al*. (2014), underwater noise modelling predicts that recoverable injuries and TTS in the most sensitive fish species (i.e., Group 3 and Group 4 species) would occur less than 50 m from the continuous noise sources (Underwater noise assessment). For such effects occurring, an animal would have to stay within the immediate vicinity of the noise source for 12 hours to induce TTS and 48 hours to incur recoverable injuries. Atlantic salmon (Group 2 species) have a lower hearing sensitivity and as such are considered to be of lower risk to experience auditory and other sub-lethal injuries. The likelihood of behavioural responses in Atlantic salmon as a result of continuous sounds is considered to be moderate at near and intermediate distances and low at far distances from the noise source (Popper *et al*., 2014).

5.3.2.19 Given their migratory nature, Atlantic salmon are anticipated to be transient within the marine area and are therefore not expected to be exposed to non-impulsive sounds for extended periods of time. Any potential effects on the behaviour and/ or distribution of Atlantic salmon are expected to be localised and temporary. Moreover, as discussed previously, tracking data (Barry *et al*., 2020) indicate a northward movement of Atlantic salmon from the River Boyne and River Blackwater SAC upon leaving the estuary, away from Dublin Array, thereby reducing the likelihood of underwater noise effects from activities at Dublin Array.

5.3.2.20 Based on the above considerations and given the intermittent and temporary nature of construction, operation and maintenance and decommissioning activities at Dublin Array, it is concluded that any effects on Atlantic salmon individuals while at sea arising from non-impulsive sounds will not result in an AEoI to the Atlantic salmon population of the River Boyne and River Blackwater SAC.

EMF from cables (Operational Phase)

5.3.2.21 The transmission of power through the inter-array and export cables during the operational phase of Dublin Array will produce EMFs 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 and/or communication.

5.3.2.22 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. 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 received EMF (from attenuation of the EMF) and potentially reducing the effects on those receptors.

5.3.2.23 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. More recent 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 Atlantic salmon 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. However, the generated B-fields are unlikely to affect the migratory behaviour and pathways in the long-term. While the impact will occur constantly throughout the 35-year operational phase of Dublin Array, EMFs generated by the power cables will be detectable above background levels only in close proximity to the cables (i.e., within 10 metres of the cable line), as the EMF created will rapidly attenuate away from the centre line of the cables (e.g., Hermans, 2022; Normandeau Associated *et al*., 2011). Cable burial below the sea floor and the placement of cable protection will further decrease the vertical and horizontal distance at which EMF attenuate into the marine environment (Normandeau Associated *et al*., 2011). Any potential behavioural responses of Atlantic salmon would therefore be localised and restricted to the immediate vicinity of the cables.

5.3.2.24 The potential exposure of Atlantic salmon to EMF will also be influenced by the proximity of the cables to natal rivers (Gill and Bartlett, 2010). The array area and Offshore ECC lie approximately 43 km to the south of the River Boyne estuary (Figure 3). Given the evidence that salmon native to the River Boyne and River Blackwater SAC leave the Irish Sea in a northward direction (Barry *et al*., 2020), it is considered unlikely that salmon resident to the SAC will transit through the Offshore ECC and array area. 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). Atlantic salmon are therefore not expected to be present in close proximity to the inter-array and export cables at Dublin Array for extended periods of time.

5.3.2.25 Based on the above considerations, it is concluded that EMFs emitted during the operational phase of Dublin Array will neither disrupt the migration of Atlantic salmon nor result in a barrier effect that would prevent Atlantic salmon from accessing or leaving the SAC. Therefore, it is concluded that any effects on Atlantic salmon arising from EMF generated during the operational phase of Dublin Array will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

Accidental Pollution (Construction, O&M and Decommissioning Phase)

5.3.2.26 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 maintenance and decommissioning activities. In addition, there is the risk of accidental spillage from equipment or collision incidents, potentially resulting in the release of pollutants such as fuel, oil and lubricants.

5.3.2.27 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP), in line with the Sea Pollution Act 1991 and MARPOL convention. The Marine Pollution Contingency Plan will cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG)) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020). Measures include storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.

5.3.2.28 The implementation of these avoidance and preventative measures will minimise the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on migratory fish.

5.3.2.29 Site-specific contaminants sampling undertaken in support of the EIA and reported in the MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations. Sediment concentrations were below lower Irish Action Levels, with the exception of arsenic levels at one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk. Moreover, sediment-bound contaminants are likely to be rapidly diluted by tidal currents, and therefore increased bioavailability that could result in adverse eco-toxicological effects to Atlantic salmon and their prey are not expected from the project alone.

5.3.2.30 Based on the above considerations, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC as a result of accidental pollution and the release of contaminated sediments.

5.3.2.31 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Introduction of invasive species (Construction, O&M and Decommissioning Phase)

5.3.2.32 There is the potential for the introduction and spread of invasive species by vessel movements and the introduction of hard substrates onto the seafloor. Invasive species may affect Atlantic salmon indirectly by changing food web dynamics or they may serve as vectors for disease that directly affect salmon. An example is the introduction of the parasitic salmon louse (*Lepeophtheirus salmonis*) through the expansion of aquaculture, which has been shown to negatively impact wild Atlantic salmon populations by increasing mortality rates (Vormedal, 2024). The likelihood of introducing invasive species will be reduced by implementation of avoidance and preventative measures included within a marine biosecurity plan presented within the PEMP, see detailed in Section 5.2.1.

5.3.2.33 Potential risks of the introduction or spread of IAS will be minimised by the adoption of biosecurity measures detailed in the Marine Biosecurity Plan (see Table 223). Adoption of these measures will minimise the likelihood of potentially harmful IAS to be released into the marine environment, thereby reducing the likelihood of effects on Atlantic salmon.

5.3.2.34 Subject to implementation of the measures included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.3.2.35 Based on the above considerations, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC as a result of invasive species.

Effects on prey (Construction, O&M and Decommissioning Phase)

5.3.2.36 Atlantic salmon are opportunistic pelagic feeders, which prey on a variety of fish, fish larvae and planktonic crustaceans (Rikardsen and Dempson, 2011). Feeding studies of post-smolts in Norwegian fjord systems showed a high utilisation of fish larvae, particularly sandeels, herring, and gadoids (Rikardsen *et al.,* 2004). Adult salmon studied in NE Atlantic feeding grounds were found to commonly feed on crustaceans and pelagic fish (Rikardsen and Dempson, 2011). The relative importance of different prey species has been shown to vary by season and geographic location, probably due to seasonal and geographical differences in availability of prey (Rikardsen and Dempson, 2011).

5.3.2.37 Sediment plumes arising during construction, O&M and decommissioning activities at Dublin Array will be intermittent and temporary and are not predicted to significantly affect fish receptors: all sediments are predicted to have settled out of suspension and been deposited within approximately three hours following the end of the release, and the coarse fraction is predicted to fall out of suspension in the order of minutes (Physical Processes Modelling Report). Any potential disturbance and long-term loss of sandeel habitats will be localised and small in the context of available suitable substrates within the wider region. As outlined previously, fish are also vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014).

5.3.2.38 Whilst underwater noise associated with piling and UXO clearance may result in localised mortality of fish, this is not predicted to result in wider scale effects and has no potential to result in changes at the population level. Disturbance associated with underwater noise may displace fish from a local area; however, any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling and UXO clearance have 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, activities associated with the construction, O&M and decommissioning of the offshore infrastructure are not predicted to result in significant adverse effects to fish including key prey species of Atlantic salmon. Moreover, as outlined previously, the risk of Atlantic salmon native to the River Boyne and River Blackwater SAC to be affected by operations at Dublin Array is considered to be low, based on distance of the SAC from the array area and the likely northward migration of Atlantic salmon away from Dublin Array when leaving the Boyne estuary.

5.3.2.39 Based on the above considerations, it is concluded that any changes to prey will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

5.3.3 Slaney River Valley SAC

5.3.3.1 Slaney River lies 96 km to the south of the Offshore ECC and array (Figure 3); this distance is provided to the mouth of the river as the relevant range for migratory fish is not from the SAC itself but the point of access, i.e. the estuary mouth.

- Twaite shad

- Atlantic salmon
- Sea lamprey
- Freshwater pearl mussel

Conservation Objectives of Qualifying Interests

Sea lamprey

5.3.3.2 The Conservation objectives for sea lamprey are:

- To restore the favourable conservation condition of sea lamprey in the Slaney River Valley SAC, defined by distribution extent and anadromy, population structure of juveniles, juveniles density in the sediment, extent and distribution of spawning habitat, availability of juvenile habitat.

Twaite shad

5.3.3.3 The Conservation objectives for twaite shad are:

- To restore the favourable conservation condition of twaite shad in the Slaney River Valley SAC, defined by distribution, extent of anadromy, population structure-age classes, extent and distribution of spawning habitat, water quality-oxygen levels, spawning habitat quality;

Atlantic salmon

5.3.3.4 The conservation objectives for Atlantic salmon are:

- To restore the favourable conservation condition of Atlantic salmon in the Slaney River Valley SAC, defined by distribution extent of anadromy, adult spawning fish, salmon fry abundance, out migrating smolt abundance, number and distribution of redds, water quality.

Freshwater pearl mussel

5.3.3.5 The conservation objectives of freshwater pearl mussel are:

- The status of the freshwater pearl mussel as a qualifying Annex II species for the Slaney River Valley SAC is currently under review (NPWS, 2011). The outcome of this review will determine whether a site-specific conservation objective is set for this species, for the purposes of this assessment and given the link to Atlantic salmon, this feature has taken account of the conservation objectives for Atlantic salmon.

Assessment of Effects - Slaney River Valley SAC

Underwater noise (Construction, O&M and Decommissioning Phase)

5.3.3.6 Effects from underwater noise to the migratory fish features of the Slaney River Valley SAC is the only effect that has been screened in as having the potential for an adverse effect on the qualifying migratory fish interests from the project alone. Effects from underwater noise on migratory fish are most likely to occur during the construction phase with any effects during operation and maintenance and decommissioning expected to be less as there would be no piling and UXO clearance.

5.3.3.7 The screened in migratory fish features of the SAC (sea lamprey, twaite shad, and Atlantic salmon) are all anadromous species and therefore have the potential to be present within the area affected by underwater noise from Dublin Array whilst undertaking migrations or living at sea. River lamprey have been screened out of the assessment on the basis that individuals tend to remain within the estuary mouth of their natal rivers (Maitland, 2003). Therefore, no pathway for effects arises given the distance from the estuary mouth to Dublin Array.

Sea lamprey

5.3.3.8 Sea lamprey belong to hearing Group 1 because of their restricted hearing abilities and low susceptibility to pressure-related injuries given the absence of a swim bladder and other gas-filled chambers.

5.3.3.9 Potential impact ranges for the onset of mortality, recoverable injury and TTS in fish have been determined by the underwater noise modelling for both fleeing and stationary fish, as presented in the Fish and Shellfish Chapter of the EIAR. Sea lamprey are assessed within this NIS as a fleeing receptor only given their mobile nature while at sea.

Underwater noise from piling (Construction Phase)

5.3.3.10 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}) are predicted to occur less than 100 m from the noise source during piling of both monopiles (6,372 kJ hammer energy) and jacket foundations (4,695 kJ hammer energy). Instantaneous mortal or recoverable injuries during piling (SPL_{peak}) are predicted to occur less than 50 m from the installation of monopiles and jacket foundations. TTS in fleeing Group 1 receptors during piling is predicted to occur up to 8.5 km from the noise source during the installation of monopile foundations (Figure 7) and up to 9.3 km from the noise source during the piling of jacket foundations (Figure 8). 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).

5.3.3.11 As the Slaney River Valley SAC is 96 km away from Dublin Array, no mortality and potential mortal injury, recoverable injury, TTS, and behavioural reactions are predicted for sea lamprey within the SAC, and therefore the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.3.12 Information on the movement patterns and habitat requirements of sea lamprey while at sea is limited, but the species has been recorded in both shallow and deep offshore waters, with sightings as deep as 4,000 m (Kelly and King, 2001; Maitland, 2003). Consequently, sea lamprey are much more widely distributed when out of their natal rivers than other lamprey species, and it is therefore assumed that there is a higher potential for sea lamprey to be present within the areas affected by underwater noise during piling and other construction, operation and maintenance and decommissioning activities at Dublin Array.

5.3.3.13 The risk of lethal or recoverable physical injuries in sea lamprey during impact piling is assessed as low, based on the receptor's low susceptibility to pressure-related injuries. Moreover, as a mobile species, sea lamprey are considered able to move away from piling operations during soft-start procedures before sound energies reach a level that may cause injuries or death. Any behavioural responses are expected to be temporary (Popper *et al*., 2014), 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).

5.3.3.14 Current evidence suggests that sea lamprey do not exhibit homing behaviour, i.e., they do not migrate back to their natal rivers (Waldman *et al*., 2008). Instead, they are thought to return to rivers within the regional area, navigating primarily by detection of larval pheromones within shallow coastal waters to identify suitable rivers to spawn (i.e. those with pre-existing larvae) (reviewed in Hansen *et al*., 2016). This flexibility in migration behaviour, combined with the impact ranges predicted by the modelling, suggests that piling noise will not result in a barrier effect that would prevent sea lamprey from any downstream migration or accessing the SAC to breed. In addition, as identified above, the risk for lethal effects to sea lamprey from piling is low, and any potential TTS or behavioural changes are anticipated to be temporary and reversible.

5.3.3.15 Based on the above considerations and given the duration and frequency of piling (consisting of intermittent piling events over a maximum of 18 months), it is concluded that any effects on sea lamprey individuals while at sea arising from underwater noise emitted during piling will not result in an AEoI to the sea lamprey QI of the Slaney River Valley SAC.

Underwater noise from UXO clearance (Construction Phase)

5.3.3.16 Mortality and potential mortal injury in sea lamprey as a result of high order UXO clearance are predicted to occur up to 810 m from the detonation site when considering a maximum equivalent charge weight of 525 kg and an additional donor weight of 0.5 kg to initiate detonation (Underwater noise assessment). For low order clearance events, mortal injuries are likely to occur up to 65 m from the detonation site, based on a charge weight of 0.25 kg.

5.3.3.17 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, while 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).

5.3.3.18 Given the distance between the Dublin Array and the SAC (96 km), no mortality, potential mortal injury, recoverable injury, TTS and behavioural responses are predicted for sea lamprey within the SAC as a result of UXO clearance, and therefore the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.3.19 As discussed previously, the acoustic pulses generated at source during UXO detonation are expected to last only several seconds (Lepper *et al*., 2024), and while this may result in mortal and recoverable injuries to some individuals close to the detonation site, it is not anticipated to cause widespread and long-term displacement of sea lamprey from their migration routes into rivers to spawn. Any TTS or behavioural responses would be temporary, with individuals expected to be able to re-colonise areas shortly after the clearance event.

5.3.3.20 The Applicant will commit to use of avoidance and preventative measures, those relevant to fish species as defined in Section 5.3.1 which will include, soft start charges and use of bubble curtain for high order detonations. This will, through a reduction in the impact zones, reduce the potential for lethal and sub-lethal injuries in sea lamprey as well as the number of individuals at risk of TTS and behavioural reactions.

5.3.3.21 Based on the above considerations and factoring in the low susceptibility of sea lamprey to pressure-related injuries, it is concluded that underwater noise arising from high order UXO clearance at Dublin Array will not result in an AEoI to the sea lamprey QI of the Slaney River Valley SAC. It is considered that the same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated by these operations and the associated smaller scale of effects.

Underwater noise from other noise sources (Construction, O&M and Decommissioning Phase)

5.3.3.22 As outlined previously, there is currently no evidence that continuous noise sources cause mortality and potential mortal injury in fish (Popper *et al*., 2014). The risk of recoverable injuries in Group 1 fish from continuous 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).

5.3.3.23 As discussed previously, there is potential for sea lamprey to be present within the study area during the construction, operation and maintenance and decommissioning phases given their wide habitat use when at sea (Maitland, 2003). However, the flexibility of sea lamprey in migration (i.e., no homing behaviour) suggests that underwater noise will not result in a barrier effect that would prevent sea lamprey from accessing a particular river to breed. Moreover, sea lamprey have restricted hearing abilities, and any non-impulse sounds during construction, operation and maintenance and decommissioning will be intermittent and temporary, with any potential effects on the behaviour or distribution of sea lamprey anticipated to also be temporary and reversible. Moreover, as a mobile species, sea lamprey would be able to move away from harmful activities and might therefore not remain exposed to the impact for extended periods of time.

5.3.3.24 Based on the above, combined with the intermittent and temporary nature of construction, operation and maintenance and decommissioning activities at Dublin Array, it is concluded that any potential effects on sea lamprey individuals while at sea as a result of non-impulsive sounds will not result in an AEoI to the sea lamprey QI of the Slaney River Valley SAC.

EMF from cables (Operational Phase)

5.3.3.25 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 30 µV/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 field induced by subsea power cables (CMACS, 2003; Normandeau Associates *et al*., 2011).

5.3.3.26 While EMFs would be emitted constantly throughout the 35-year operational phase, they would be detectable above background levels only in close proximity to the cables (i.e., within 10 metres of the cable line), as the EMF created will rapidly attenuate away from the centre line of the cables (e.g., Hermans, 2022; Normandeau Associated *et al*., 2011). Cable burial below the sea floor and cable protection will further decrease the vertical and horizontal distance at which EMF attenuate into the marine environment (Normandeau Associated *et al*., 2011). Any potential behavioural responses of sea lamprey while at sea will therefore be localised and restricted to the immediate vicinity of the cables.

5.3.3.27 Based on the above considerations and given the distance between the Slaney estuary and the array area and Offshore ECC (96 km), it is considered that EMF from the inter-array and export cables at Dublin Array will not result in a barrier effect that would prevent sea lamprey from accessing or leaving the SAC. Therefore, it is concluded that any effects on sea lamprey arising from EMF generated during the operational phase of Dublin Array will not result in an AEoI to the sea lamprey QI of the Slaney River Valley SAC.

Twaite shad

5.3.3.28 Shad species belong to hearing Group 4 fish, as outlined in paragraph 5.3.1.32 *et seq.*, based on their high susceptibility to pressure-related injuries and wide hearing bandwith. They are therefore considered to be one of the most sensitive fish to underwater noise effects.

5.3.3.29 The magnitude of the underwater noise impacts has been determined by the underwater noise modelling for injury ranges for both fleeing and stationary fish, as presented in the Fish and Shellfish Chapter of the EIAR. Twaite shad are assessed within this NIS as a fleeing receptor only given their mobile nature while at sea.

Underwater noise from piling (Construction Phase)

5.3.3.30 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 4 fleeing receptors during the course of piling (SEL_{cum}) is predicted to occur less than 100 m from the noise source for the piling of both monopiles (6,372 kJ hammer energy) and jacket foundations (4,695 kJ hammer energy). Instantaneous mortal or recoverable injuries during piling (SPL_{peak}) may occur up to 70 m from the installation of monopiles and 60 m from the installation of jacket foundations. TTS of fleeing Group 4 receptors during piling is predicted to occur up to 8.5 km from the noise source during the installation of monopile foundations (Figure 7), and up to 9.3 km from the noise source during the piling of jacket foundations (Figure 8). The relative risk of behavioural changes is likely to be high at both near (10s of metres) and intermediate (100s of metres) distances from the piling location and moderate at far (1,000s meters) distances from piling operations (Popper *et al*., 2014).

5.3.3.31 As the Slaney River Valley SAC is 96 km away from Dublin Array, no mortality and potential mortal injury, recoverable injury, TTS and behavioural responses are predicted for twaite shad within the SAC as a result of piling, and therefore the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.3.32 Twaite shad at sea will likely be travelling and not remain exposed to underwater noise for extended periods of time. Moreover, as mobile species, twaite shad are considered able to move away from piling operations during soft-start procedures, which will reduce the likelihood of irreversible injury or death. Any behavioural responses are expected to be temporary (Popper *et al*., 2014), with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling has ceased. Effects of TTS are also expected to 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).

5.3.3.33 Based on the above considerations and given the duration and frequency of piling (consisting of intermittent piling events over a maximum period of 18 months), it is concluded that potential effects on twaite shad individuals while at sea arising from underwater noise emitted during piling will not result in an AEoI to the twaite shad QI of the Slaney River Valley SAC.

Underwater noise from UXO clearance (Construction Phase)

5.3.3.34 Mortality and potential mortal injury in twaite shad as a result of high order UXO detonation are predicted to occur up to 810 m from the detonation site when considering a maximum equivalent charge weight of 525 kg and an additional donor weight of 0.5 kg to initiate detonation (Underwater noise assessment). For low order clearance events, mortal injuries are likely to occur up to 65 m from the detonation site, based on a charge weight of 0.25 kg. The relative risk of recoverable injury, TTS and behavioural changes in Group 4 fish species is considered to be high at the near field (10s of meters) and at intermediate (100s of meters) distances from the sound source and low at far (1000s of meters) distances from the sound source (Popper *et al*., 2014).

5.3.3.35 As the Slaney River Valley SAC is 96 km away from Dublin Array, no mortality and potential mortal injury, recoverable injury, TTS and behavioural responses are predicted for twaite shad within the SAC as a result of UXO clearance, and therefore the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.3.36 UXO clearance operations could occur at any time of the year and therefore they have the potential to interact with twaite shad while at sea. However, each UXO detonation is a discrete and brief (lasting less than one day) event, with the acoustic pulses generated at source during detonation expected to last only several seconds (Lepper *et al*., 2024). While this may result in mortal and recoverable injuries to individuals close to the detonation site, it is not anticipated to cause widespread and long-term displacement of twaite shad from marine habitats and specific migration routes to and from the SAC. Any TTS or behavioural responses would be temporary, with individuals expected to be able to re-colonise areas shortly after the clearance event.

5.3.3.37 The Applicant will commit to use of avoidance and preventative measures, those relevant to fish species as defined in 5.3.1will include, soft start charges and use of bubble curtain for high order detonations. This will, through a reduction in the impact zones, reduce the potential for lethal and sub-lethal injuries in twaite shad as well as the number of individuals at risk of TTS and behavioural reactions.

5.3.3.38 Based on the above considerations including the infrequent and brief nature of the impact, the highly localised nature of potential mortal effects and the temporary nature of potential recoverable injuries, TTS or behavioural changes, it is concluded that underwater noise arising from high order UXO clearance at Dublin Array will not result in an AEoI to the twaite shad QI of the Slaney River Valley SAC. It is considered that the same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated by these operations and the associated smaller scale of effects.

Underwater noise from other noise sources (Construction, O&M and Decommissioning Phase)

5.3.3.39 As referenced in Popper *et al*. (2014), there is currently no evidence that non-impulsive sounds, such as those emitted during vessel operations, dredging and drilling, cause mortality and potential mortal injury in fish. Using the unweighted SEL_{rms} thresholds recommended by Popper *et al*. (2014), recoverable injuries and TTS in twaite shad (as a Group 4 species) are predicted to occur less than 50 m from the noise source (Underwater noise assessment), and as such these effects would be highly localised. Moreover, an animal would have to stay within the immediate vicinity of the noise source for 12 hours to induce TTS and 48 hours to incur recoverable injuries (Underwater noise assessment).

5.3.3.40 Behavioural changes in twaite shad in response to non-impulsive sounds are likely to occur at larger distances, with the relative risk of these occurring currently considered to be high near (10s of meters) the sound source, moderate at intermediate (100s of meters) distances and low at far field (1000s of meters) distances from the noise source (Popper *et al*., 2014). However, as for auditory and other sub-lethal injuries, any behavioural changes and associated changes in the distribution of twaite shad would be temporary and reversible. Moreover, given the distance between Dublin Array and the Slaney River Valley SAC (96 km), non-impulse sounds emitted during construction, operation and maintenance and decommissioning will not present a barrier for twaite shad to access or leave the SAC.

5.3.3.41 Based on the above considerations and given the intermittent nature of the impact, it is concluded that any effects on twaite shad while at sea as arising from non-impulsive sounds will not result in an AEoI to the twaite shad QI of the Slaney River Valley SAC.

EMF from cables (Operational Phase)

5.3.3.42 Information on the impact of EMFs on twaite shad is limited. Based on information on other species (e.g. Atlantic salmon), it is assumed that twaite shad may exhibit avoidance behaviours and/ or altered movement patterns close to the cables at Dublin Array. It is expected that these effects would be highly localised and temporary, as twaite shad are not expected to remain near any heightened EMF for extended periods of time. In addition, given the distance between the Slaney estuary and the array area and Offshore ECC (96 km), EMF from the inter-array and export cables at Dublin Array will not result in a barrier effect that would prevent twaite shad from accessing or leaving the SAC. Therefore, it is concluded that any effects on twaite shad arising from EMF generated during the operational phase of Dublin Array will not result in an AEoI to the twaite shad QI of the Slaney River Valley SAC.

Atlantic Salmon

5.3.3.43 The migratory process associated with Atlantic Salmon away from coastal waters to the open ocean is generally poorly understood. However, there is evidence that salmon smolts within the south-east coast of Ireland (where the river Slaney is located) head in a south-westerly direction upon leaving the estuary (Rikardsen *et al*., 2021), moving further away from Dublin Array (the source of effects) without getting closer or increasing the potential for effects, inherently decreasing the impact the noise may have on their migration.

5.3.3.44 However, given this evidence is limited to a single study, there is still a potential for individuals to be within areas affected by underwater noise during the construction and decommissioning of Dublin Array, and therefore an assessment of noise impacts on this species is still required.

5.3.3.45 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 Fish and Shellfish Chapter of the EIAR, Atlantic salmon are assessed within this NIS as a fleeing receptor only given their mobile nature while at sea.

Underwater noise from piling (Construction Phase)

5.3.3.46 Based on the noise modelling and the criteria set out in Popper *et al*. (2004), mortality and potential mortal injury and recoverable injury to Group 2 fleeing receptors during the course of impact piling (SEL_{cum}) are predicted to occur less than 100 m from the noise source for the piling of both monopiles (6,372 kJ hammer energy) and jacket foundations (4,695 kJ hammer energy). Instantaneous mortal or recoverable injuries during piling (SPL_{peak}) are predicted to occur up to 70 m from the installation of monopiles and up to 60 m from the piling of jacket foundations. TTS in fleeing Group 2 receptors during piling is predicted to occur up to 8.5 km from the noise source during the installation of monopile foundations (Figure 7), and up to 9.3 km from during the piling of jacket foundations (Figure 8). 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).

5.3.3.47 Based on the modelling results and the distance between the River Slaney estuary and the array area and Offshore ECC (96 km), no mortality or potential mortal injury, recoverable injury, TTS and behavioural changes are predicted for Atlantic salmon within the SAC. Therefore, the species is considered in the context of its presence and distribution when out at sea rather than in the SAC itself.

5.3.3.48 As discussed previously, piling activities are expected to take place over a maximum of 18 months and therefore may coincide with the peak migration periods of Atlantic salmon. Atlantic salmon belong to hearing Group 2, based on the presence of a swim bladder that is not involved in hearing, which makes them more susceptible to barotrauma when close to the noise source. However, the mobile nature of the species would enable individuals to vacate the area of impact during soft-start procedures, which would reduce the likelihood of lethal and recoverable injuries. Any TTS and behavioural responses are expected to be temporary, with affected individuals anticipated to continue their migration shortly after piling has ceased, including during piling free days. Based on this combined with the evidence that indicates a south-westerly migration of Atlantic salmon from the SAC away from the array area, it is concluded that impact piling at Dublin Array will not present a barrier for Atlantic salmon to access or leave the SAC.

5.3.3.49 Based on the above considerations and given the duration and frequency of piling (consisting of intermittent piling events over a maximum of 18 months), it is concluded that any effects on Atlantic salmon individuals while at sea arising from underwater noise emitted during piling at Dublin Array will not result in an AEoI to the Atlantic salmon QI of the Slaney River Valley SAC.

Underwater noise from UXO clearance (Construction Phase)

5.3.3.50 Mortality and potential mortal injury from high order UXO clearance in all fish receptors is predicted to occur up to 810 m from the detonation site when considering a maximum equivalent charge weight of 525 kg and an additional donor weight of 0.5 kg to initiate detonation (Underwater noise assessment). For low order clearance events, mortality and potential mortal injury are likely to occur up to 65 m from the detonation site, based on a charge weight of 0.25 kg.

5.3.3.51 The relative risk of recoverable injury and behavioural responses in Group 2 fish species, which include Atlantic salmon, 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).

5.3.3.52 UXO clearance operations could occur at any time of the year and therefore may interact with the key migration periods of Atlantic salmon. There is a low likelihood of UXO within the temporary occupation area, array area and Offshore ECC, and it has therefore been assumed that a maximum of four UXO detonations will be required based on a risk assessment. Each UXO detonation would be a discrete and brief event (lasting less than one day), with the acoustic pulses generated at source during detonation expected to only last several seconds (Lepper *et al*., 2024). While this may result in mortal and recoverable injuries to some individuals close to the detonation site, it is not anticipated to cause widespread and long-term displacement of Atlantic salmon from specific migration routes. Moreover, the risk of Atlantic salmon native to the Slaney River Valley SAC to be affected by UXO clearance operations at Dublin Array is considered to be low, based on the location and distance of the SAC from the array area and the likely south-west ward migration of salmon away from Dublin Array when leaving the SAC.

5.3.3.53 The Applicant will commit to use of avoidance and preventative measures as defined in Table 223 of this NIS which will include implementation of a mitigation zone, soft start and use of bubble curtain This will, through a reduction in the impact zones, reduce the potential for lethal and sub-lethal injuries in Atlantic salmon as well as the number of individuals at risk of TTS and behavioural reactions. As discussed previously, any TTS and behavioural responses would be temporary, with individuals expected to be able to continue their migration following the clearance event.

5.3.3.54 Based on the above considerations and given the infrequent and brief nature of the impact, it is concluded that underwater noise arising from high order UXO clearance at Dublin Array will not result in an AEoI to the Atlantic salmon QI of the Slaney River Valley SAC. It is considered that the same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated by these operations and the associated smaller scale of effects.

Underwater noise from other noise sources (Construction, O&M and Decommissioning Phase)

5.3.3.55 As referenced in Popper *et al*. (2014), there is currently no evidence that non-impulsive sounds cause mortality and potential mortal injury in fish. Using the unweighted SEL_{rms} thresholds recommended by Popper *et al*. (2014), underwater noise modelling predicts that recoverable injuries and TTS in the most noise-sensitive species (Group 3 and Group 4 fish) would occur less than 50 m from the continuous noise sources (Underwater noise assessment). For such effects occurring, an animal would have to stay within the immediate vicinity of the noise source for 12 hours to induce TTS and 48 hours to incur recoverable injuries. Atlantic salmon (Group 2 species) have a lower hearing sensitivity and as such are considered to be of lower risk to experience auditory and other sub-lethal injuries. The likelihood of behavioural responses in Atlantic salmon as a result of continuous sounds is considered to be moderate at near and intermediate distances and low at far distances from the noise source (Popper *et al*., 2014).

5.3.3.56 Given their migratory nature, Atlantic salmon are anticipated to be transient within the marine area and are therefore not expected to be exposed to non-impulse sounds for extended periods of time. Any potential effects on the behaviour and/ or distribution of Atlantic salmon are expected to be localised and temporary. Moreover, as discussed previously, tracking data (Rikardsen *et al*., 2020) indicate that Atlantic salmon associated with the Slaney River Valley SAC migrate in a south-westerly direction upon leaving the Slaney estuary, away from the Dublin Array, thereby reducing the likelihood of underwater noise effects from activities at Dublin Array.

5.3.3.57 Factoring in the considerations above together with the intermittent and temporary nature of construction, operation and maintenance and decommissioning activities at Dublin Array, it is concluded that potential effects on Atlantic salmon individuals while at sea arising from non-impulsive sounds will not result in an AEoI to the Atlantic salmon QI of the Slaney River Valley SAC.

5.3.3.58 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

EMF from cables (Operational Phase)

5.3.3.59 As discussed in paragraph 5.3.2.23 *et seq.*, EMF generated at Dublin Array may cause short-term behavioural changes in Atlantic salmon in close proximity to the cables, which, however, are unlikely to affect the migratory patterns of Atlantic salmon in the long-term. Moreover, the proximity of the cables to natal rivers will have a bearing on the potential exposure of Atlantic salmon to EMF (Gill and Bartlett, 2010). The array area and Offshore ECC lie approximately 96 km to the north of the River Slaney estuary (Figure 3), tagging data suggests that salmon native to the river Slaney migrate in a south-westerly direction upon leaving the estuary (Rikardson *et al*., 2021). It is therefore considered unlikely that Atlantic salmon associated with the Slaney River Valley SAC transit through the array area and Offshore ECC. Moreover, tagging studies indicate 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). Atlantic salmon are therefore not expected to be present in close proximity to the inter-array and export cables at Dublin Array for extended periods of time.

5.3.3.60 Based on the above considerations, it is concluded that EMFs emitted during the operational phase of Dublin Array will neither disrupt the migration of Atlantic salmon nor result in a barrier effect that would prevent Atlantic salmon from accessing or leaving the SAC. Therefore, it is concluded that any effects on Atlantic salmon arising from EMF generated during the operational phase of Dublin Array will not result in an AEoI to the Atlantic salmon QI of the Slaney River Valley SAC. The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Accidental pollution (Construction, O&M and Decommissioning Phase)

Sea lamprey, twaite shad and Atlantic salmon

5.3.3.61 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 maintenance and decommissioning activities. In addition, there is the risk of accidental spillage from equipment or collision incidents, potentially resulting in the release of pollutants such as fuel, oil and lubricants.

5.3.3.62 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP), see Section 5.2.1. The implementation of these avoidance and preventative measures will minimise the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on migratory fish.

5.3.3.63 Site-specific contaminants sampling undertaken in support of the EIA and reported in the MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations. Sediment concentrations were below lower Irish Action Levels, with the exception of arsenic levels at one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk. Moreover, sediment-bound contaminants are likely to be rapidly diluted by tidal currents, and therefore increased bioavailability that could result in adverse eco-toxicological effects to Atlantic salmon and their prey are not expected from the project alone.

5.3.3.64 Based on the above considerations, it is concluded that there is no potential for AEoI to the sea lamprey, twaite shad and Atlantic salmon QIs of the Slaney River Valley SAC as a result of accidental pollution and the release of contaminated sediments.

Introduction of invasive species (Construction, O&M and Decommissioning Phase)

Sea lamprey, twaite shad and Atlantic salmon

5.3.3.65 There is the potential for the introduction and spread of invasive species by vessel movements and the introduction of hard substrates onto the seafloor. Invasive species may affect migratory fish indirectly by changing food web dynamics or they may serve as vectors for disease that directly affect marine fish. An example is the introduction of the parasitic salmon louse (*L. salmonis*) through the expansion of aquaculture, which has been shown to negatively impact wild Atlantic salmon populations by increasing mortality rates (Vormedal, 2024).

5.3.3.66 Potential risks of the introduction or spread of IAS will be minimised by the adoption of biosecurity measures detailed in the Marine Biosecurity Plan (see PEMP) and summarised in Section 5.2.1. Adoption of these measures will minimise the likelihood of potentially harmful IAS to be released into the marine environment, thereby reducing the likelihood of effects on Atlantic salmon.

5.3.3.67 Subject to implementation of the measure included within the Marine Biosecurity Plan (contained within the PEMP) the alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

5.3.3.68 Based on the above considerations, it is concluded that there is no potential for AEoI to the sea lamprey, twaite shad and Atlantic salmon QI of the Slaney River Valley SAC as a result of invasive species.

Effects on prey (Construction, O&M and Decommissioning Phase)

Sea lamprey, twaite shad and Atlantic salmon

5.3.3.69 There is potential for indirect effects on sea lamprey, twaite shad and Atlantic salmon through effects on their prey. Atlantic salmon and twaite shad are pelagic feeders that feed on fish, fish larvae and planktonic crustaceans (Rikardsen and Dempson, 2011; Taverny and Ellie, 2001), while sea lamprey are parasitic feeders that prey on crustaceans and a variety of pelagic and demersal fishes (Kelly and King, 2001; Waldman *et al*., 2008).

5.3.3.70 Sediment plumes arising during construction, O&M and decommissioning activities at Dublin Array will be intermittent and temporary and are not predicted to significantly affect fish receptors: all sediments are predicted to have settled out of suspension and been deposited within approximately three hours following the end of the release, and the coarse fraction is predicted to fall out of suspension in the order of minutes (Physical Processes Modelling Report). Any potential disturbance and long-term loss of habitats of substrate-dependent prey (i.e., sandeel) arising from the placement of infrastructure will be localised and small in the context of available suitable substrates within the wider region. As outlined previously, fish are also vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014).

5.3.3.71 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 effects and changes at the population level. Disturbance associated with underwater noise may displace fish from a local area; however, any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling and UXO clearance have 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, activities associated with the construction, O&M and decommissioning of the offshore infrastructure are not predicted to result in significant adverse effects to prey species of migratory fish. Moreover, as outlined previously, the risk of Atlantic salmon native to the Slaney River Valley SAC to be affected by operations at Dublin Array is considered to be low, based on distance of the SAC from the array area and the likely south-westward migration of Atlantic salmon away from Dublin Array when leaving the Slaney estuary.

5.3.3.72 Based on the above considerations, it is concluded that any changes to prey will not result in an AEoI to the sea lamprey, twaite shad and Atlantic salmon QIs of the Slaney River Valley SAC.

Freshwater pearl mussel

5.3.3.73 Freshwater pearl mussel have been included in the assessment for this SAC because they live on the gills of either young Atlantic salmon or brown trout during the first year of their life cycle (Moorkens, 1999). The viability of the pearl mussel population is inherently linked to the viability of the salmon population in the SAC, and as such it is considered that the maximum potential effect on freshwater pearl mussel will be the same as that considered for Atlantic salmon, and the conclusions made to the salmon population will mirror those for freshwater pearl mussel.

5.3.3.74 As assessed in the previous sections, direct effects are not predicted for Atlantic salmon when present within the Slaney River Valley SAC, while any effects on Atlantic salmon at sea will not result in an AEoI to the Atlantic salmon QI of the SAC, Therefore, it is concluded that there will be no AEoI to the freshwater pearl mussel QI of the Slaney River Valley SAC.

5.4 Marine mammals

5.4.1 Assessment approach

5.4.1.1 The characterisation of the receiving environment for marine mammals draws on a wide range of data sources and the site-specific surveys undertaken between 2019 – 2021 and previous surveys undertaken between 2010 -2011 and 2001-2002. These are further detailed within the Marine Mammal Baseline.

5.4.1.2 Certain species of marine mammals are listed under Annex II of the Habitats Directive, which requires the designation of core areas of their habitat as European Sites (SACs). Annex II marine mammal species that occur in Irish and UK waters are bottlenose dolphin (*Tursiops truncatus*), harbour porpoise *(Phocoena phocoena*), grey seal *(Halichoerus grypus*) and harbour seal (*Phoca vitulina*). All four species were confirmed as having likely presence in the marine mammal survey area, through the data available as presented in the Marine Mammal Baseline. Consequently, this section of the NIS provides an assessment against the SAC designations for these four Annex II marine mammal species.

5.4.1.3 Further assessments of marine mammals are provided as part of this application, which complement the NIS. The Marine Mammal Chapter (Part 3 of the application, Volume 3, Chapter 5: Marine Mammals) presents an assessment of all marine mammal species likely to be present in the survey area. This includes all relevant cetacean species, which are listed In Annex IV of the Habitats Directive and so receive strict protection throughout their range. A separate assessment in respect of Annex IV marine mammal species was carried out in accordance with Article 12 and 16 of the Habitats Directive. Further information on this is available in Section 5.3.1. Furthermore, the MMMP has been developed to mitigate and minimise acoustic impacts on protected marine megafauna species, including marine mammals.

5.4.1.4 European sites designated for marine mammals have been screened in given their potential connectivity with effects associated with the offshore infrastructure and the O&M Base. Due to the mobile nature of marine mammals, the extent of the ZoI has taken consideration of the scale of movement and population structure of the relevant species. For each cetacean species (harbour porpoise and bottlenose dolphin) the area considered is defined by the appropriate Management Unit (MU), whereas for both seal species (grey seal and harbour seal) typical foraging ranges have been used, as defined in SISAA (Part 4, Habitats Directive Assessment, Volume 3 Supporting Information for Screening for Appropriate Assessment (SISAA)).

5.4.1.5 As defined in the SISAA, several potential impact pathways have been identified for consideration during the construction, decommissioning and O&M phases. These are:

- Underwater noise
  - Auditory Injury
  - Disturbance
- Collision risk (vessels)

- Vessel disturbance
- Effects on prey
- Accidental pollution
- Physical habitat loss and habitat disturbance

5.4.1.6 The site name, marine mammal QI, and the effects screened in for each stage of the project are summarised in Table 13.

5.4.1.7 To inform the assessment, determination of which option (MDO or Alternative Design Option) presents the greatest potential for AEoI on designated sites has been presented within Volume 2 of this HDA.

Table 13 SACs screened in for marine mammals

European site name	Qualifying Interest	Effects screened in for construction and decommissioning	Effects screened in for O&M
Rockabill to Dalkey Island SAC [IE003000]	Harbour Porpoise (*Phocoena Phocoena*) [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
Codling Fault Zone SAC [IE003015]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
Lambay Island SAC [IE000204]	Harbour porpoise [1351] Grey seal (*Halichoerus grypus*) [1364] Harbour seal (*Phoca vitulina*) [1365]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects of prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat Loss
North Anglesey Marine / Gogledd Môn Forol SAC [UK0030398]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Blackwater Bank SAC [IE0002953]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey

European site name	Qualifying Interest	Effects screened in for construction and decommissioning	Effects screened in for O&M
		▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Accidental pollution (Offshore infrastructure and O&M Base)
West Wales Marine / Gorllewin Cymru Forol SAC [UK0030397]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Pen Llŷn a'r / Lleyn Peninsula and the Sarnau SAC [UK0013117]	Bottlenose dolphin (*Tursiops truncatus*) [1349] Grey seal [1364]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
North Channel SAC [UK0030399]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Carnsore Point SAC [IE0002269]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Cardigan Bay SAC [UK0012712]	Bottlenose dolphin [1349]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Hook Head SAC [IE0000764]	Bottlenose dolphin [1349] Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Bristol Channel Approaches SAC [UK0030396]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)

European site name	Qualifying Interest	Effects screened in for construction and decommissioning	Effects screened in for O&M
Bunduff Lough and Machair / Trawalua / Mullaghmore SAC [IE0000625]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Kilkieran Bay and Islands SAC [IE0002111]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
West Connacht Coast SAC [IE002988]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Inishmore Island SAC [IE0000213]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Kenmare River SAC [IE0002158]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Roaringwater Bay and Islands SAC [IE000101]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Blasket Islands SAC [IE002172]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)
Belgica Mound SAC [IE0002327]	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey

European site name	Qualifying Interest	Effects screened in for construction and decommissioning	Effects screened in for O&M
		▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Accidental pollution (Offshore infrastructure and O&M Base)
Transboundary French SAC (18 sites)	Harbour porpoise [1351]	▪ Underwater noise ▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)	▪ Collision risk (vessels) ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base)

Underwater noise

5.4.1.8 The SISAA identified several activities that have the potential to introduce an effect - receptor pathway for underwater noise. It is widely documented that marine mammals are sensitive to underwater noise (Hildebrand, 2009; Nowacek *et al.,* 2007; OSPAR, 2009; Richardson *et al.,* 1995; Southall *et al.,* 2019; Southall *et al.,* 2021), with a wealth of evidence that many anthropogenic sound sources, such as vessels and related construction activity (Culloch *et al.,* 2016; Dunlop, 2016; Pirotta *et al.,* 2012; Wisniewska *et al.,* 2018), impact pile driving (Brandt *et al.,* 2011; Graham *et al.,* 2019), seismic surveys (Pirotta *et al.,* 2014; Stone *et al.,* 2017) and acoustic deterrent devices ((ADDs); Basran *et al.,* 2020; Schaffeld *et al.,* 2019) do have impacts on marine mammals.

5.4.1.9 Indirect impacts may also occur through direct impacts to prey species (Sivle *et al.,* 2021). These impacts have varying degrees of observed and / or predicted severity, ranging from changes in behaviour and masking (affecting communication and listening space, and / or locating prey; Basran *et al.,* 2020; Dunlop, 2016; Erbe *et al.,* 2016; Heiler *et al.,* 2016; Pine *et al.,* 2019; Pirotta *et al.,* 2012; Wisniewska *et al.,* 2018), to displacement and disturbance (Brandt *et al.,* 2011; Culloch *et al.,* 2016; Graham *et al.,* 2019; Pirotta *et al.,* 2014; Stone *et al.,* 2017) to injury and even mortality (Reichmuth *et al,* 2019; Schaffeld *et al,* 2019).

5.4.1.10 The severity of these potential impacts will depend, in part, on the hearing range of the species affected. It will also be dependent upon; the noise source characteristics (frequency (Hz) and amplitude (relating to the change in pressure caused by the sound wave which determines the perceived loudness of a sound)), attenuation of the noise from the source location, and the distance of the sound source from the receptor species. In addition to which, species and individual animals display variations in levels of sensitivity at different life stages and in different situations (e.g. presence of young).

5.4.1.11 The direct impacts of underwater noise on marine mammals from these activities can be summarised as:

- Physical/physiological effects (e.g. mortality, non-recoverable injury, permanent threshold shift (PTS) in hearing, temporary threshold shift (TTS) in hearing, recoverable injury); or
- Behavioural responses (e.g. stress, displacement, disturbance).

5.4.1.12 The biological significance of sound relates to how it interferes with an individual's capacity to undertake normal functional behaviours and activities, as well as their ability to reproduce and survive. Sound can impact communication and/or predator/prey detection, for example, which can result in individual and population level consequences (e.g. alterations in individual fitness, abundance, and diversity) and may affect the overall viability of a species (Popper *et al*., 2014). The greater the amplitude of the sound source and the longer the duration the receptor is exposed to it, the greater the likelihood of biological impacts arising from a behavioural disturbance (Popper *et al*., 2014).

5.4.1.13 To assess impacts of underwater noise, sound sources are typically divided into two categories, 'impulsive' and 'non-impulsive', based on attributes of the sound source:

- Impulsive sound sources, such as those produced by impact pile driving, explosives (e.g. UXO detonation), and seismic surveys, are transient and brief (less than a second). They are broadband in nature and are characterised by high peak pressure with rapid rise time and decay; and
- Non-impulsive sound sources, such as those generated by vibro-pilling, dredging, trenching, drilling, and vessel movements, can be broadband, narrowband or tonal. They may be brief or prolonged, either continuous or intermittent. Unlike impulsive sound sources, non-impulsive sources lack the high peak sound pressure and rapid rise time characteristic of impulsive sounds.

5.4.1.14 As sound travels through water, it experiences sound attenuation (where sound waves lose amplitude and intensity due to energy loss through a medium). This phenomenon affects high frequency sounds to a greater degree than lower frequencies. It is also the reason that a sound with impulsive characteristics at the source may, as a result of propagation effects, lose those characteristics (e.g. rapid pulse rise time and high peak sound pressure) and transition into a non-impulsive sound at some distance from the source (Hastie *et al.,* 2019). This distance varies depending on the noise source and the environment over which it travels. Due to the effects of propagation, the risk of auditory injury or disturbance is reduced with increasing distance from the source.

5.4.1.15 Marine mammal species have different hearing sensitivity thresholds resulting in different species detecting underwater noise at varying frequency bands (Table 14). These differences in hearing thresholds allows for the assessment of how certain noise sources will be detected, and thus affect, the marine mammal species identified in the vicinity of Dublin Array. Underwater noise can only impact marine mammal hearing if the frequency is within their hearing range. Southall *et al*. (2019[12]) categorised marine mammal Functional Hearing Groups (FHGs) of similar species to reflect the broad differences in hearing capabilities among the taxa (Table 14). Table 14 presents the FHGs for the Annex II marine mammal species likely to be present in the area.

Table 14 Marine mammal hearing groups (Southall *et al*, 2019)

Hearing Group	Generalised Hearing Range	Estimated region of peak sensitivity	Example Species
Very high-frequency cetaceans (VHF)	275 Hz – 160 kHz	12 kHz – 140 kHz	True porpoises (e.g. harbour porpoise)
High frequency cetaceans (HF)	150 Hz – 160 kHz	8.8 kHz – 110 kHz	Dolphins, toothed whales (e.g. bottlenose dolphins)
Phocid carnivores in water (PCW)	50 Hz – 86 kHz	1.9 kHz – 30 kHz	True seals (e.g. Grey and Harbour seals)

[12] Southall *et al.* (2019) is an update of Southall *et al.* (2007). The DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters was published in 2014 and therefore, the updated Southall *et al.* (2019) presents the most up to date scientific thresholds on marine mammal hearing.

5.4.1.16 Exposure to loud sounds can lead to a reduction in hearing sensitivity at frequencies, referred to as a shift in hearing threshold. With respect to noise assessments for marine mammals, using the criteria outlined in Southall *et al*. (2019), there are two types of impacts considered, a Permanent Threshold Shift (PTS) and a Temporary Threshold Shift (TTS) in hearing.

5.4.1.17 PTS-onset is defined as a permanent change in the hearing sensitivity of an individual to a specific frequency range, with the change in sensitivity associated with damage to the structures within the ear. PTS in hearing is typically regarded as auditory injury. At a Department of Business, Energy and Industrial Strategy (BEIS)-funded expert elicitation workshop in 2018, experts concluded that the magnitude and frequency band in which PTS occurs is critical to assessing the effect on marine mammal vital rates (Booth *et al.,* 2019).

5.4.1.18 TTS is a temporary change in the hearing sensitivity of an individual to a specific frequency range. TTS is therefore not regarded as injury given its temporary nature and an individual's ability to recover from the impact (i.e. hearing returns to 'normal' over time). TTS thresholds are not intended to indicate a level of impact but are used to enable the prediction of where PTS might occur; therefore, they should not be used for the basis of any assessment of impact significance. Furthermore, as there are no thresholds to determine a biologically significant effect from TTS and given that individuals recover from this temporary effect, TTS poses as an entirely negligible risk of impacting survivability and reproduction. Therefore, TTS is screened out of the assessment. Disturbance from sources of underwater noise is included as part of the quantitative assessment (which will occur over greater distances as compared to TTS).

5.4.1.19 Of relevance to the assessments and noise modelling outlined below are the project design and avoidance measures contained within the Project Description and MMMP. The Applicant has committed to a 10 dB reduction in at source noise levels for pile driving. This is a conservative estimate based on the existing types of mitigation that have been reviewed in Verfuss *et al*. (2019) and Bellman *et al*. (2020). The evidence for this reduction is provided in Annex A to the MMMP.

5.4.1.20 In addition to the implementation of at-source mitigation methods to minimise the underwater noise impacts, the Applicant has committed to a number of project design measures and avoidance and preventative measures to ensure compliance with all relevant guidance, specifically NPWS, (2014); DAHG (2014[13]); IDWG (2020). All measures are detailed within the MMMP that provides the strategy for the project, to ensure appropriate controls are in place to manage environmental risks associated with the construction of the Dublin Array offshore infrastructure on marine mammals. Of note to this assessment are the measures listed below:

- Procedures for impact piling, will include:
  - Implementation of a 1000 m mitigation zone;
  - Pre-piling Marine Mammal Observer (MMO) watches;

[13] At the time of publication updates to this guidance are still pending.

- Pre-piling Passive Acoustic Monitoring (PAM) (if required to supplement the MMO);
- Acoustic Deterrent Device (ADD), as an additional mitigation tool prior to the start of piling activities at night;
- Soft start procedure; and
- Breaks in piling procedure.

- Procedures for UXO detonation will include:
  - Implementation of a mitigation zone of 1000 m;
  - Pre-detonation MMO and PAM;
  - Soft start charges;
  - Use of bubble curtains for high order clearance UXO; and
  - Post detonation searches.
- Procedures for geophysical surveys using 3D UHRS (sparker) equipment, will include:
  - Implementation of a 1000 m mitigation zone;
  - Pre-shooting (in relation to survey start) MMO watches;
  - Delay of operations if marine mammals detected for at least 30 mins;
  - Soft start procedure;
  - Line changes longer than 40 minutes will be stopped with a pre watch of 30 mins, followed by soft start to resume;
  - Breaks in operation of between 5-10 mins will prompt a MMO watch.

5.4.1.21 A noise assessment has been undertaken by Subacoustech Environmental to assess the potential impacts on marine mammals as a result of noisy activities within the Dublin Array boundary (Volume 4, Appendix 4.3.5-7 Underwater noise assessment). Subacoustech Environmental undertook noise modelling for impact piling, and assessed the noise impact for other construction activities, operational WTG noise and UXO clearance. Auditory impact ranges for marine mammals were calculated using the Southall *et al*. (2019) criteria.

5.4.1.22 For pile driving, as noted above, at-source mitigation methods (e.g. bubble curtains) will be implemented. The Applicant has committed to a 10 dB reduction during pile-driving (5.4.1.20). All presented noise modelling results incorporate a 10 dB reduction in source level to account for noise attenuation.

5.4.1.23 A quantitative noise modelling assessment of the impact pile driving has been completed using the INSPIRE underwater noise model (Underwater noise assessment). The model is a semi-empirical noise propagation model based around a combination of numerical modelling and empirical data. It is designed to calculate the propagation of noise in shallow mixed water, typical of the conditions around Ireland and well suited for the Irish Sea.

5.4.1.24 INSPIRE considers a wide array of input parameters including variations in bathymetry and source frequency. MDO assumptions have been selected for:

- Piling hammer blow energies;
- Soft start hammer energy ramp up and strike rate;
- Total duration of piling; and
- Receptor swim speeds.

5.4.1.25 The piling modelling has been undertaken at two representative locations covering the extent of the array area. The northeast (NE) and southeast (SE) locations were chosen as they present two different water depths across the site. The NE location was chosen specifically as a worst-case location for proximity with the Rockabill to Dalkey Island SAC.

5.4.1.26 The predictive noise modelling approach used meets the requirements set by the National Physical Laboratory (NPL) Good Practice Guide 133 for underwater noise measurement (Robinson *et al*., 2014). Under certain circumstances, a simplified modelling approach is considered acceptable, particularly for noise sources that are relatively quiet compared to impact piling (e.g., cable laying and dredging) or where detailed modelling would imply an unjustified level of accuracy due to data limitations (e.g., UXO detonation). This alternative modelling approach has been applied to assess the potential impacts of non-piling construction activities, including cable laying, dredging, trenching, vessel noise, and UXO clearance. For further details on the methodology, refer to the Underwater noise assessment.

5.4.1.27 Noise exposure criteria are typically represented by dual exposure metrics for impulsive noise, including the frequency-weighted sound exposure level (SEL; expressed in dB re. µPa^{2}s) and the unweighted sound pressure level (SPL; expressed in units relative to 1 µPa in water; ISO 18405, 2017; Juretzek *et al.,* 2021). SEL is a measure of sound energy over multiple exposures (i.e. accumulated over time) and SPL is a measure of absolute exposure. Exposure criteria for non-impulsive noise sources are given in frequency weighted SEL (expressed in decibels (dB) re. µPa^{2}s). Underwater noise modelling results are expressed further by SELcum (SEL cumulative; the frequency weighted sound exposure level where the effect takes into account both the received level and duration of exposure) and SPLpeak (the unweighted zero to peak Sound Pressure Level as a measure of characterising the amplitude of a sound).

5.4.1.28 Where SELcum thresholds are required for marine mammals, a fleeing animal model has been used. As marine mammals are mobile species, this assumes that a receptor, when exposed to high noise levels will swim away from the noise source. In calculating the received noise levels during the piling event a receptor (i.e. harbour porpoise, delphinid or seal species) was assumed to flee at a swim speed of 1.5 m/s once the piling commenced. This is considered a conservative estimate based on reported sustained swimming speeds for harbour porpoises (Otani *et al.,* 2000), as marine mammals are expected to be able to swim much faster under stressed conditions (Gallon *et al.,* 2007; Hastie *et al.,* 2019; Kastelein *et al.,* 2018).

5.4.1.29 Modelling the SELcum impact ranges of PTS with a 'fleeing animal' model, as is typically used in noise impact assessments, are subject to uncertainties and the result is a highly precautionary prediction of impact ranges. As a result of these uncertainties on animal movement (responsive movement to the sound source), model parameters (such as swim speed), are generally highly conservative and, when considered across multiple parameters, the resulting predictions are very precautionary and very unlikely to be realised.

5.4.1.30 The SELcum PTS-onset ranges represent the range an animal must be at the start of the operation to exactly accrue enough noise exposure over the duration of the acoustic event to meet the exposure threshold. To model this, a starting point close to the source is chosen (1 m) and the received noise level for each noise event (e.g. pile strike) while the receptor is fleeing is recorded. These values are aggregated into a SELcum value over the entire activity.

5.4.1.31 The SELcum threshold for PTS-onset considers the sound exposure level received by an animal and the duration of exposure, accounting for the accumulated exposure over the duration of an activity within a 24-hour period. Southall *et al*. (2019) recommends the application of SELcum for the individual activity alone (i.e., not for multiple activities occurring within the same area or over the same time). To inform this impact assessment, sound modelling has considered the SELcum over a piling event.

Auditory Injury

5.4.1.32 For marine mammals, the main impact associated with the offshore infrastructure will result from underwater noise produced during the construction phase. Auditory injury in relation to construction activities (e.g. pile driving) is likely to occur where the source frequencies overlap the range of peak sensitivity for the receptor species rather than across the whole frequency hearing spectrum (Kastelein *et al.,* 2013a).

5.4.1.33 Southall *et al*. (2019) proposed weighted functions to each FHG listed in Table 15. These functions are presented across the entire frequency band of a FHG because the direct mechanical damage to the auditory system is restricted to the audible frequency range of a species.

5.4.1.34 Impact ranges relating to SELcum indicate the range in which an animal starts to flee at the start of the noisy activity where an individual is able to accumulate enough noise exposure to meet the PTS onset criteria during the period of a construction event. Impact ranges relating to SPLpeak indicate the range in which an animal can experience instantaneous injury.

5.4.1.35 With respect to undertaking a quantitative assessment, the SEL values would be calculated over the duration of a discrete noise exposure event. This would be cumulative over multiple repeated noise exposures occurring in relatively quick succession and would be weighted for the relevant FHG. Therefore, SEL can be calculated for impulsive sound sources (i.e. multiple hammer strikes during installation of a monopile within a 24-hour period) and for non-impulsive sound sources (i.e. operational noise of vessels). The PTS onset thresholds from impulsive noise used in this assessment are those presented in Southall *et al*. (2019); (Table 15).

Table 15 Noise exposure criteria from Southall *et al.* (2019) for the PTS in hearing by the FHG for both impulsive and non-impulsive sound sources.

FUNCTIONAL HEARING GROUP	SPECIES EXAMPLES	IMPULSIVE PTS SEL (weighted)in dB re 1 μ Pa^{2}s	SPL Peak (unweighted) in dB re 1 μ Pa	NON-IMPUSIVE PTS SEL weighted in dB re 1 μ Pa^{2}s
HIGH FREQUENCY (HF)	Bottlenose dolphin	185	230	198
VERY HIGH FREQUENCY (VHF)	Harbour porpoise	155	202	173
PHOCIDS IN WATER (PCW)	Harbour seal, grey seal	185	218	201

5.4.1.36 Harbour porpoises rely on sound for communication, foraging, and navigation, and are sensitive to underwater noise. Harbour porpoises have a vocal repertoire (and hearing range) ranging between 275 Hz to 160 kHz (NMFS, 2018; Southall *et al.,* 2019) which includes their very high frequency (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 thresholds for inducing PTS in harbour porpoise (VHF cetacean) hearing are presented in Table 15. Their high sensitivity to sound, coupled with harbour porpoises being the most abundant marine mammal species in Irish and UK waters, means they are often a species of concern when assessing risks of impacts from underwater noise.

5.4.1.37 Bottlenose dolphins are also dependent on sound for communication, foraging, and navigation, and are sensitive to underwater noise. Bottlenose dolphins are classified as high frequency (HF) cetaceans, with a generalised hearing range between 150 Hz and 160 kHz (NMFS, 2018; Southall *et al.,* 2019). The thresholds for PTS onset for bottlenose dolphin (HF cetacean) are presented in Table 15.

5.4.1.38 Grey seals and harbour seals are less reliant than cetaceans on sound for foraging, but sound remains an important sense to enable communication with conspecifics, especially within the breeding season of these species. Therefore, seals are sensitive to underwater noise. Southall *et al.* (2019) present both in air and in water thresholds for seals; however, only the latter, defined as phocid carnivores in water (PCW; Table 15), are relevant to the assessment of underwater noise. Impacts from in-air noises are not screened into this assessment due to the unlikely effect of airborne noise impacting hauled out seal populations for which the nearest protected area for that species is designated, Lambay Island SAC, located 19.59 km from Dublin Array (further detail of Lambay Island is included in site assessment below). Phocid seals have a generalised hearing range between 50 Hz and 86 kHz (Southall *et al.,* 2019). The thresholds for PTS onset for the grey and harbour seal (PCW) are presented in (Table 15).

5.4.1.39 Whether there are ecological consequences of PTS for marine mammals 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 harbour porpoises arising from exposure to repeated low-frequency impulsive noise such as pile driving (Booth *et al.,* 2019). The findings of the expert elicitation concluded that PTS did not mean animals were deaf and that the magnitude and frequency band in which PTS occurs are critical to assessing the effect on vital rates.

5.4.1.40 For piling noise, most energy is between ~30–500 Hz, with a peak usually between 100–300 Hz and energy extending above 2 kHz (Kastelein *et al.,* 2015; Kastelein *et al.,* 2016). Studies have shown that exposure to impulsive pile driving noise induces 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 8 kHz (Kastelein *et al.,* 2016) and centred at 4 kHz (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 2–10 kHz range (Kastelein *et al.,* 2017) and that a PTS 'notch' of 6–18 dB in a narrow frequency band in the 2–10 kHz 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."

5.4.1.41 With respect to UXO clearance, most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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 cetaceans and pinnipeds (Southall *et al.,* 2019).

5.4.1.42 For geophysical surveys[14], the published literature was used in the assessment of the risk of auditory injury as a result of pre-construction geophysical surveys. This approach also used the noise exposure criteria, and existing impact modelling for the proposed geophysical equipment. The impact of auditory injury from geophysical surveys are summarised in Table 16.

Table 16 Predicted auditory (PTS) impact ranges for geophysical survey equipment

Equipment	PTS Risk and Acoustic Characteristics
Magnetometer (MAG); Drop Down Video (DDV); Remote Operated Vehicle (ROV)	Passive sound systems; no risk of auditory injury to marine mammals.
Multi-beam Echo Sounder (MBES) & Side Scan Sonar (SSS)	Operate outside the hearing range of cetaceans (Table 14; Southall *et al.,* 2019). Considered *de minimis* and unlikely to cause auditory injury to marine mammals (Ruppel *et al.*, 2022).
Sub-bottom Imaging (SBI)	Typically deployed on an ROV or towfish, operate at a much lower source level than sub-bottom profilers. Source levels are below the PTS-onset thresholds for harbour porpoise (VHF), dolphins (HF) and seals (PCW).
Ultra-short Baseline (USBL)	Operates between 8 – 30 kHz and SLrms 189 -194 dB re 1 µPa m (CSA, 2020), overlapping with the hearing frequencies of LF, HF and VHF cetaceans. Classed as non-impulsive sound source. Transmission loss ensures SPLs drop below 200 dB re 1 µPa within a metres reducing PTS risk.
Sub-bottom Profiler (SBP)	Different SBPs vary in frequency: ▪ Shallow penetration SBP (e.g., pingers/CHIRP sonars) are non-impulsive: 0.7 – 24 kHz; and SLrms 176 – 197 dB re 1 µPa m; ▪ Parametric SPBs are non-impulsive: 60 - 115 kHz, SLrms 220 – 225 dB re 1 µPa m; and ▪ Medium penetration SBPs (boomers and sparkers) are impulsive: 0.1 – 5 kHz; SLrms 203 – 205 dB re 1 µPa m. PTS-onset distances: ▪ VHF cetaceans: 17 – 23 m at 267 dB re 1 µPa (SPL_{peak}) (BEIS, 2020). ▪ LF cetaceans: within 5 m at 220 dB re 1 µPa (SPL_{peak}) (Shell, 2017), and ▪ PCW: ~10 m (BEIS, 2019).
3D Ultra High Resolution	A type of medium penetration SBP (i.e, sparker) Classed as impulsive sound source See details above.

[14]The requirement and scope for geophysical surveys is outlined within Volume 1: Project Description

Seismic (UHRS) Profiling	Although sparkers use a seismic source, their acoustic energy is still primarily focused towards the sea floor.

5.4.1.43 Noise transmission from geophysical survey equipment is highly directional, with sound energy primarily focused on the seabed. This results in horizontal propagation, thereby reducing potential impacts across all marine mammal hearing groups and species. Any risk of auditory injury from geophysical surveys is expected to be confined to the immediate vicinity (<25 m) of the equipment and / or vessel.

5.4.1.44 Of the equipment listed in Table 16Table 16, only specific equipment, namely sub-bottom profilers (SBPs), ultra-high resolution seismic (UHRS) and ultra-short baseline (USBL), operate within the auditory bandwidth of marine mammals and therefore have the potential to cause acoustic impacts. Therefore, these sources are considered within other construction activities and assessed accordingly, as detailed below.

5.4.1.45 Non-impulsive noise (or continuous noise) sources resulting from other works during construction, including cable laying, dredging (backhoe and suction), drilling, rock placement, trenching and vessel noise, are considered much quieter and therefore produce significantly lower impact ranges than those for impact piling. (see paragraph 5.4.1.23). A precautionary scenario was assumed, with constant operations over a 24-hour period (SELcum; Underwater noise assessment). The resulting impact ranges were calculated based on PTS-onset criteria from Southall *et al.* (2019). This approach indicated that an individual marine mammal could be exposed to sound levels that could lead to cumulative PTS-onset from these activities. However, for most marine mammal hearing groups, the noise levels remain low enough that the risk of auditory injury is minimal.

Behavioural disturbance

5.4.1.46 Underwater noise has the potential to cause behavioural change in marine mammals such as stress, displacement and disturbance (Brandt *et al.,* 2011; Culloch *et al.,* 2016; Graham *et al.,* 2019; Pirotta *et al.,* 2014; Stone *et al.,* 2017) which could lead to a loss in foraging opportunities (Nabe-Nielsen *et al.,* 2018) and consequently overall fitness. A qualitative approach has been taken within each of the SAC assessments to assess the impacts of disturbance on marine mammal receptors caused by the construction and decommissioning activities (e.g. piling, dredging and vessels).

5.4.1.47 There are some studies investigating the disturbance effects on seals at an SAC whilst hauled out (e.g. for resting, moulting or breeding), for which in-air noise and visual disturbance are the typical potential pathways for impact. For example, Edrén *et al*. (2009) studied the effects of the construction and operation of an offshore wind farm located 4 km from a seal sanctuary. They reported no long-term effects on haul-out behaviour; however, short-term decreases in the number of seals hauled out was correlated during sheet pile driving within the wind farm boundary.

5.4.1.48 Teilmann *et al*. (2006) found that although the number of seals at local (within 10 km of the target offshore windfarm) haul-out sites varied in response to nearby piling activities, the construction phase as a whole was not associated with haul-out abundance. As Lambay Island SAC (19.59 km from the array area) is located further than the haul-out sites in the aforementioned studies, it is unlikely that the activities during construction, O&M and decommissioning would cause a disturbance effect to grey and/or harbour seals hauled out at SACs for which they are a QI. Therefore, in-air noise and visual disturbance are not assessed given the distance SACs with a seal species as QI are from the project infrastructure.

5.4.1.49 Since there is no guidance on the methodology that should be applied when assessing behavioural disturbance to marine mammal species in Irish or UK waters, the National Oceanic and Atmospheric Administration (NOAA) (2005) Level B harassment threshold for impulsive noise on marine mammals has been considered for quantifying behavioural disturbance on marine mammals 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 (e.g., migration, breeding, nursing, feeding, or resting). Level B harassment can occur when an individual is exposed to impulsive (e.g. impact pile driving, geophysical surveys, UXO clearance) or intermittent (e.g. non-tactical sonar) sound sources with received levels above 160 dB re dB 1µPa (unweighted root mean square sound pressure level (SPLRMS; NMFS, 2022)). Non-impulsive noise (e.g. drilling, dredging, vessels) can also cause a Level B harassment when marine mammals are exposed to noise of 120 dB re dB 1µPa (SPLRMS; NMFS, 2022) or greater. These values are therefore proposed as the basis for onset of strong behavioural reaction in this assessment. These Level B harassment thresholds are 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).

Dynamic Energy Budget modelling

5.4.1.50 Quantitative modelling was undertaken to assess the impacts on harbour porpoise as a result of disturbance caused by impact pile driving. This was done using Dynamic Energy Budget (DEB) modelling (Appendix B: Harbour porpoise bioenergetic modelling) which provides a link between disturbance and population vital rates for a species (harbour porpoise in this instance) to help better inform this assessment. DEB models have been widely used to investigate how natural and anthropogenic disturbance might affect individuals and populations of marine mammals (Harwood *et al.,* 2020). Parameters are currently provided for harbour porpoise, bottlenose dolphin, grey seals and harbour seals; however, to date, a full DEB model has only been created for harbour porpoise (Harwood *et al.,* 2020).

5.4.1.51 The DEB model predicts changes in individual body condition and predicts how changes could affect that individual's vital rates (i.e. their chances of reproduction or survival) during different life history stages (e.g. calves, juveniles and adults). The DEB model also takes into account the state of the environment (e.g., quality of the environment, presence of predators). The DEB is focused on females of the species and assesses the following vital rates: calf mortality rate, adult mortality rate and birth rate. The DEB model compares an undisturbed population and a disturbed population (i.e., inclusion of disturbance from pile driving activities).

5.4.1.52 Harbour porpoises are particularly vulnerable to disturbance. They are small cetaceans that are vulnerable to heat loss and are required to maintain a high metabolic rate with little energy remaining for fat storage (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 their income breeding strategy of fuelling pregnancy and lactation with concurrent increase in energy intake (McHuron *et al.,* 2017). It is important to note that individuals in a good quality environment (or condition) are likely to be more resilient to lost foraging opportunities than those in a poor environment (or condition).

5.4.1.53 The DEB model outputs have been used to consider the potential effect of disturbance from pile driving noise on harbour porpoise as a feature of the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC[15]. Refer to Appendix B for full details of the DEB methodology. For all other harbour porpoise SACs within the Celtic and Irish Seas MU, and SACs designated for other marine mammal species, the assessment of disturbance is based on the outputs of the noise modelling impact assessment (see Underwater noise assessment).

5.4.1.54 The results from the DEB modelling are discussed in the relevant site assessments and conclude whether disturbance resulting from pile driving at the proposed Dublin Array offshore wind farm is likely to result in significant impacts to individual harbour porpoise vital rates (i.e., survival and reproduction).

5.4.1.55 The results of the DEB are considered, alongside other information such as the Underwater noise assessment, with respect to the Disturbance attribute of the Conservation Objectives (CO; see below) for Rockabill to Dalkey Island SAC and Lambay Island and whether there is likely to be an AEoI to the harbour porpoise QIs of the SAC. The CO for harbour porpoise for Rockabill to Dalkey Island SAC was applied to Codling Fault SACs because, at the time or writing, there were no CO for harbour porpoise at the Codling Fault Zone SAC.

- Disturbance: 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.

[15] DEB modelling has been used to inform the assessment for these sites given the close proximity of the proposed Dublin Array offshore wind farm to the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC, it is predicted that some individuals that use the SAC may be disturbed. This disturbance effect 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.

Collision risk (vessels)

5.4.1.56 The area surrounding the study area already experiences a high density of vessel traffic (see Volume 3, Chapter 10: Shipping and Navigation within the EIAR for full details). The Shipping and Navigation Baseline study recorded an average of 96 unique vessels per day within the study area (defined as a 10 nm boundary around the array area) during the summer survey period (July 2019). On the busiest day of the summer survey period, 117 unique vessels were recorded (this occurred across three days of the survey), and, on the quietest day, 84 unique vessels were recorded. During the winter survey period (March, 2022), an average of 60 unique vessels per day were recorded within the study area. On the busiest day of the winter survey period, 87 unique vessels were recorded and, on the quietest day 35 unique vessels were recorded. Vessels were comprised primarily of cargo and fishing vessels during the study period, as well as a large proportion of recreational vessels during the summer.

5.4.1.57 During further surveys conducted during 2022 and 2023, there was an average of 58 unique vessels recorded per day during the winter 2022 study period across the study area. This rose to an average of 81 unique vessels recorded per day during the summer 2023 survey period. This difference in number of vessels between seasonal surveys was primarily due to a lower volume of recreational vessels present during the winter period. Vessels were comprised primarily of recreational vessels during both survey periods.

5.4.1.58 During all phases of the project, a potential source of impact to marine mammals is from increased vessel activity resulting in physical trauma and/or death from collision with a vessel. Possible injuries include blunt trauma to the body or injuries consistent with propeller strikes. The risk of collision between marine mammals and vessels is 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 animal is engaged in.

5.4.1.59 There is little evidence from marine mammals stranded and recorded in the Republic of Ireland (RoI) that vessel collisions is an important cause of mortality; however, post-mortum examinations are not regularly undertaken in RoI (McGovern *et al.,* 2016). 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 CSIP data shows that very few strandings have been attributed to vessel collisions, therefore, while there is evidence that mortality from vessel collisions can and does occur, it is not considered to be a key source of mortality highlighted from post-mortem examinations. Harbour porpoises, dolphins and seals largely avoid collision because they are relatively small, highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity. Predictable and slow vessel movement is known to be a key aspect in minimising the potential risks to marine mammals imposed by vessel traffic (Nowacek *et al.,* 2001; Lusseau, 2003; 2006).

5.4.1.60 The MDO outlines the following maximum number of vessels on site:

- Construction vessels will comprise of installation vessels and smaller support vessels. Installation vessels include those for foundation, WTG and OSP installation and cable-lay vessels. There will be the large installation vessels and associated support craft operating simultaneously with a total of 66 vessels on site at any time, with up to 813 round trips to port from construction vessels and an additional 1,825 round trips from small vessels such as Crew Transfer Vessels (CTVs) during the three-year (30 months) construction period.

- During O&M activity the MDO equates to a maximum of three daily CTV trips with the addition of up to 100 vessel trips to support schedule routine and non-routine maintenance per year over a 35-year operational period.

- For decommissioning the number of vessels will be no greater than the predicted number for the construction phase requiring decommissioning vessels over a period of three years with up to 813 round trips from port and an additional 1,825 round trips from small vessels such as CTVs.

5.4.1.61 Construction vessels are large (up to 80-100 m long), which normally stay offshore for 2-4 weeks before returning to port. They are either stationary (e.g. using dynamic positioning), jacked up or slow-moving on-site. The majority of vessels found on site will be CTVs. They are between 18 and 30+ meters in length, typically comprising of twin aluminium hulls combined with high power propulsion system to obtain high bollard push against the wind turbine for transfer procedure of technicians offshore. Vessels transiting to site have the maximum potential for collision risk with marine mammals.

5.4.1.62 Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within an environmental Vessel Management Plan (VMP) (hereafter referred to as the Environmental VMP), contained within the PEMP (Volume 7, Appendix 1). In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Vessel disturbance

5.4.1.63 Vessel disturbance is likely driven by a combination of underwater vessel noise and the physical presence of the vessel itself (e.g. Pirotta *et al.,* 2015). It is often difficult, if not impossible, to attribute the cause of disturbance to one and/or the other. Disturbance from vessels is therefore assessed in general terms separately from underwater noise assessments, covering disturbance driven by both underwater noise and vessel presence.

5.4.1.64 The presence of vessels will be a factor during all phases of the development. Disturbance from vessel noise is only likely to occur where increased noise from vessel movements 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 (Wilson *et al.,* 2007). The amount of noise that a ship produces is largely dependent on the engine revolution count and therefore the speed of the vessel, the acoustic quality of equipment on board (generators, cranes, etc.) and whether sound-reducing technologies and sound-dampening materials have been used. A key factor here is if the ship's propellor has been designed and maintained to reduce cavitation. Table outlines the noise criteria (SELcum) for relevant marine mammal FHG for non-impulsive sound sources as per Southall *et al*. (2019).

5.4.1.65 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 offshore infrastructure. Vessels and associated equipment generally emit low frequency noise, such as large vessels (up to 10 kHz), small vessels (up to 40 kHz), low-frequency sonar (<1 kHz) and mid-frequency sonar (1-10 kHz; Duarte *et al*., 2021).

5.4.1.66 The general characteristics of commercial vessel noise is 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 root mean square (rms) SPL source levels ranging 165 to 180 dB re 1µPa @1m, with the majority of energy below 1 kHz (OSPAR, 2009), whereas large commercial vessels (>100 m in length) produce relatively loud (180-190 SPLrms dB re 1µPa @1m or greater) and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz (OSPAR, 2009; Erbe *et al,* 2019). Small vessels are reported to emit source levels of 130-175 SPLrms dB 1µPa@1 m with higher frequency bands (above 1kHz) compared to large ships (Erbe *et al,* 2019). These frequencies overlap with the lower hearing sensitivity range of harbour porpoise (i.e., 275 Hz – 160 kHz), and across the hearing sensitivity range of delphinids (i.e., 150 Hz – 160 kHz) and seals in water (i.e., 50 Hz – 86 kHz; Southall *et al.,* 2019).

5.4.1.67 As for collision risk, avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP. In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Effects on prey

5.4.1.68 As marine mammals are dependent on fish prey, there is a potential for indirect effects on marine mammals as a result of direct impacts on fish species or habitats that support them. During construction activities, there is a potential for impacts upon these fish species, including underwater noise and vibration leading to mortality, injury, behavioural changes. Fish species can also be directly or indirectly influenced by the following impacts; temporary increase in SSC and sediment deposition, seabed disturbance leading to the release of sediment contaminants and / or accidental contamination (refer to Sections 5.2 and 5.3).

5.4.1.69 The loss of habitats and the loss/disturbance of invertebrate species and displacement of fish from fishing grounds (and associated effect on reproductive success and survival) could affect prey availability. The presence of WTGs may exclude fish from suitable habitat by providing a physical or perceptual barrier or producing levels of noise that result in avoidance behaviour. Whilst it is considered that alternative feeding areas may be available to marine mammals, the array area and ECC may create a net loss of available 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).

5.4.1.70 As generalist feeders, marine mammals demonstrate a varied diet and ability to adapt to changes in availability of prey types. Key species identified within the study area are herring, whiting and cod, squid, sprat and sandeel.

5.4.1.71 With regards to underwater noise and vibration on migratory fish as assessed in Section 5.3, fish are vulnerable to underwater noise associated with piling or UXO clearance with different species having varying sensitivity to construction activities (Popper *et al.,* 2014). Similar to marine mammal species, the impacts can have a range of effects including behavioural changes, TTS and recoverable injury and mortality, with the extent of impact dependent on the prey species group. Whilst underwater noise associated with piling or UXO clearance may result in localised mortality of fish (i.e. within the Zone of Impact), 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).

5.4.1.72 Furthermore, the EIAR Volume 3, Chapter 4: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Chapter) concluded no significant adverse result effects in respect of fish and shellfish ecological receptors from construction activities of the Dublin Array, resulting in no potential magnitude of impact on marine mammals.

Accidental pollution

5.4.1.73 Accidental pollution can arise from the accidental releases of fuels, oils and/or hydraulic fluids from leaks or spillages and from the resuspension of contaminants in the sediments disturbed by construction and O&M activity. There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants as a result of sediment mobilisation from construction, O&M and decommissioning activities to be released into the water column which may influence water quality and/or impact on the food chain. Therefore, accidental pollution events could lead to direct impact on marine mammals or a reduction in prey availability, either of which may affect species' survival rates.

5.4.1.74 Site-specific contaminants sampling undertaken in support of the EIA and reported in the EIAR Volume 3, Chapter 2: Marine Water and Sediment Quality Chapter provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations and are below Irish Action Levels. As such, the assessment of accidental pollution in relation to marine mammals will only focus on the potential for spillages and leaks.

5.4.1.75 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan, contained within the PEMP (Volume 7, Appendix 1), in line with the Sea Pollution Act 1991 and MARPOL convention and other similar binding rules and obligations imposed on ship owners and operators by inter alia the International Maritime Organisation as relevant. The Marine Pollution Contingency Plan will cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020). Measures include storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.

Physical habitat loss / habitat disturbance

5.4.1.76 Habitat loss and habitat disturbance has been screened in for a number of SACs (Rockabill to Dalkey Island SAC, Lambay Island SAC and Codling Fault SAC) as the marine mammal QIs may be sensitive to any loss of availability or disturbance of supporting habitat both within and outwith an SAC, where individuals associated with an SAC are likely to be using neighbouring habitat. Assessment will consider species foraging ranges from the designated SACs and connectivity of the SAC with any offshore infrastructure. Habitat loss and disturbance is intrinsically linked to other effects screened in (in particular underwater noise, vessel disturbance and changes in prey) that may cause an avoidance of the available habitat for foraging and other behaviours. As such, the assessment will draw upon conclusions from these assessments against any relevant CO with respect to habitat loss/disturbance.

5.4.2 Rockabill to Dalkey Island SAC

5.4.2.1 Rockabill to Dalkey Island SAC overlaps marginally with the offshore ECC and lies 1.8 km inshore of the array area. The following QI have been screened in for further assessment:

- Harbour porpoise (*Phocoena phocoena*).

5.4.2.2 The Rockabill to Dalkey Island SAC, covering an area of approximately 273 km^2, contains key habitat for harbour porpoises, including inshore shallow sand and mudbanks, and rocky reefs scoured by strong current flow (NPWS, 2014c). Harbour porpoises occur year-round within the SAC 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).

5.4.2.3 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.

5.4.2.4 The percentage of juveniles and calves to adult harbour porpoises was estimated to be approximately 5.5 % for this SAC (Berrow *et al.*, 2021), which is lower than reported in 2016 (15.5 %, O'Brien and Berrow, 2016) and 2013 (8.8 %, Berrow and O'Brien, 2013).

5.4.2.5 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 (Meade *et al*., 2017). Harbour porpoise densities within this area of the SAC ranging throughout 2015 to 2017 from the lowest being 0.61 porpoises/km^2 in February 2016 to a peak in 2.29 porpoises/km^2 in August 2016.

5.4.2.6 A decline in harbour porpoise presence off the southern Ireland was also observed in the Roaringwater Bay and Islands SAC, and Co Cork and Blasket Islands SAC, 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).

Conservation Objectives of Qualifying Interests

Harbour porpoise

5.4.2.7 The CO to maintain the favourable conservation condition of harbour porpoise (*Phocoena phocoena*) 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.

Technical clarifications

5.4.2.8 NPWS (2013a) have provided the following technical clarifications[16] in relation to the specific CO for harbour porpoise SACs to facilitate the assessment process.

- Access to suitable habitats: 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.
- Disturbance: 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.

[16] Only technical clarifications relevant to Irish SACs that are included in the assessments, and harbour porpoise, are expanded upon here. Whilst other technical clarifications have been provided for other sites and species e.g. bottlenose dolphins, they are relevant to attributes which are screened out of the assessment and so are not presented here.

Assessment of effects- Rockabill to Dalkey Island SAC

Underwater noise from piling (Construction Phase): Harbour Porpoise

Auditory Injury

5.4.2.9 For WTG monopile foundation installation of 13 m piles with a maximum blow energy of 6,372 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20) the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for harbour porpoise from piling was 150 m for the installation of a monopile at the NE modelling location. Considering the cumulative PTS-onset (weighted SEL_{cum}) thresholds, harbour porpoise found within 150 m from the NE monopile location at the start of piling could accumulate noise exposure in excess of the criteria. Given that the SAC lies 1.8 km inshore from the array area, these impact ranges would result in no overlap with the SAC.

5.4.2.10 While for the WTG jacket pile foundation installation of 5.75 m piles with a maximum blow energy of 4,695 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for harbour porpoise from piling was 140 m for the installation of a jacket pile at the NE modelling location. The cumulative PTS onset (weighted SEL_{cum}) from four sequential piles was predicted to occur if harbour porpoises were located less than 100 m from the NE piling location at the start of piling. Given that the SAC lies 1.8 km inshore from the array area, this means there is no predicted overlap with the SAC.

5.4.2.11 Static Passive Acoustic Monitoring (PAM) studies of harbour porpoises have reported reduced detections in the immediate vicinity of the pile driving activities prior to the commencement of piling, which has been attributed to the presence of construction vessels on site (Benhemma-Le Gall *et al*., 2021; Benhemma-Le Gall *et al*., 2023; Brandt *et al*., 2018; Rose *et al*., 2019). Therefore, it is assumed that harbour porpoises are displaced from the immediate vicinity of the pile prior to piling commencing, which would reduce the likelihood of individuals experiencing PTS.

5.4.2.12 During the installation campaigns of both Beatrice and Moray East offshore wind farms harbour porpoise detections gradually declined by up to 33% in the 48 hours before piling, (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 subsequently deterred harbour porpoises away from the works area, 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 within the potential impact ranges are likely to be fewer than the predicted baseline and the scale of the effect is thereby reduced in terms of individuals exposed.

5.4.2.13 The instantaneous and cumulative PTS onset contours for harbour porpoise as predicted by the underwater noise modelling are 150 m or less. Therefore, there is no overlap with the SAC boundary. Considering the highly mobile nature of harbour porpoise, it is possible that porpoise that use the SAC will be exposed to underwater noise from pile driving activities in the areas adjacent to the SAC. However, given the predicted distances, PTS onset is considered unlikely to occur, rather vessels arriving on site prior to pile driving occurring are more likely to displace harbour porpoise from the immediate vicinity of the piling activity.

5.4.2.14 If PTS were to occur as a result of piling noise, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts to the fitness of individual harbour porpoises, for either adults or calves (Booth *et al*., 2019).

5.4.2.15 In addition to noise abatement systems (which enable a noise reduction of at least 10 dB), the MMMP includes a number of measures listed in Paragraph 5.4.1.20 to mitigate against instantaneous injury to marine mammals associated with pile driving by ensuring no activity commences if a marine mammal is within the 1000 m mitigation zone, therefore no harbour porpoise should be within PTS ranges prior to pile driving commencement.

5.4.2.16 Consequently, given the predicted impact distances of less than 150 m, coupled with the likelihood of harbour porpoises being displaced by vessels arriving on site prior to pile driving, and considering the mitigation measures that will be in place, the risk of PTS to any individual harbour porpoise is considered negligible.

Underwater Noise from piling - Auditory Injury Assessment (Harbour porpoise)

5.4.2.17 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.18 Regarding the access to suitable habitat attribute, pile driving activities and the associated underwater noise (which could potentially cause auditory injury) will be short-term and temporary and will not permanently prevent harbour porpoises accessing the site. Furthermore, the PTS impact ranges do not overlap the SAC boundary, and so will not affect harbour porpoise within the site. Should harbour porpoise outside the site be affected by PTS, which is highly unlikely given the aforementioned mitigation and vessel displacement, it will not affect their ability to access the suitable habitat of the site.

5.4.2.19 Regarding the disturbance attribute, if an individual did experience PTS onset, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017). Therefore, pile driving activities will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.20 Furthermore, considering the specific technical clarifications of disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), the underwater noise associated with the onset of PTS 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.

5.4.2.21 Therefore, it is concluded that auditory injury (i.e. PTS) arising from pile driving will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.22 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.2.23 The predicted impact range using the Level B harassment threshold does overlap with the SAC boundary, with the impact radius predicted to extend out to a maximum distance from the NE location of 13 km considering the monopile foundation scenario, and 12 km considering the jacket pile foundation scenario (see the Underwater noise assessment for further details on the scenarios modelled).

5.4.2.24 Several studies have provided evidence that harbour porpoises are displaced from the vicinity of piling events. For example, at wind farms in the German North Sea, large declines in porpoise detections occurred close to the piling location (>90% decline at noise levels above 170 dB SEL) with decreasing effect with increasing distance from the pile (25% decline at noise levels between 145 and 150 dB SEL; Brandt *et al*., 2016). The reduction in detection rates was relatively brief (between one to three days), suggesting that displacement was short-term (Brandt *et al*., 2011; Dähne *et al*., 2013; Brandt *et al*., 2016; Brandt *et al*., 2018).

5.4.2.25 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, where detection of clicks (echolocation) and buzzing (associated with prey capture) in the short-range (2 km) did not entirely cease in response to pile driving. Furthermore, detections of both clicks and buzzing increased above baseline levels with increasing distance from the pile location, indicating increased local density whereby animals that were closer to the piling activity were displaced. Therefore, it is likely that porpoise experiencing short-term displacement due to pile driving activities can use areas nearby to compensate for any lost foraging opportunities and increased energy expenditure demand due to fleeing.

5.4.2.26 To address this CO attribute, project specific DEB models (see Appendix B of this HDA) have been undertaken to assess how disturbance from piling activities might impact porpoise at a population-level. The results from the modelling present the predicted effects of disturbance on porpoise birth rate, calf mortality rate and adult mortality rate, as compared to an undisturbed population and are discussed below.

5.4.2.27 Considering the realistic upper limits (as supported by scientific evidence; SMRU, 2024) of disturbance effect (6 hours of lost foraging time) and probability of disturbance (0.1, meaning 10% of the simulated individuals were disturbed), the model concluded no significant change in birth rate or in adult mortality, as compared to the undisturbed population. Under this realistic upper limit of disturbance scenario, the model did conclude a 1.7% increase in calf mortality, as compared to the undisturbed population.

5.4.2.28 Probability of disturbance and disturbance effect are extremely influential factors in the model; for example, if the hours (i.e. the disturbance effect) were reduced to four, and the precautionary probability disturbance remained at 0.1, there would be no significant increase in calf mortality rate, as compared to the undisturbed population. Equally, if the probability of disturbance were reduced to 0.05, and the precautionary disturbance effect remained at six hours, there would be no significant calf mortality rate. This demonstrates the result of essentially layering precaution on top of precaution when making quantitative assessments.

5.4.2.29 The DEB makes several assumptions that are conservative. With respect to the spatial element, the DEB assumes that individuals will respond to the same extent irrespective of their location relative to the piling location and to the same degree each time. This means every individual would lose the same amount of energy intake each time, which given what is known about individual variation from the perspective of state (i.e. body condition, life history stage), and how that may influence behaviour, is unlikely.

5.4.2.30 Furthermore, there are a growing number of studies providing evidence that harbour porpoise will move from the immediate vicinity of the piling activity, but that displacement is localised, and any reduction in foraging appears to be minimal, with individuals finding other suitable habitat nearby (Benhemma-Le Gall *et al*., 2021). Therefore, reductions in feeding of up to 6 hours is likely to be a precautionary estimate, even for those individuals close to the sound source. There is also some evidence to suggest that as the piling campaign goes on, the response of porpoises to the activity over space, diminishes (Graham *et al*., 2019). Therefore, assuming the same degree of response to the disturbance over the course of the piling activities is also likely to be precautionary. Consequently, the model assumptions regarding the spatial and temporal elements of disturbance in relation to the location of the sound source are also likely to be overly precautionary.

5.4.2.31 The DEB model shows that most simulations had no effect on calf mortality rate where each disturbance resulted in 1-2 hours of lost foraging opportunity. In a more extreme scenario, a disturbance which caused a 6-hour reduction in foraging resulted in an increase in calf mortality rate by 2.6%; however, this scenario was deemed highly unrealistic[17]. The DEB modelling found no significant change in calf mortality, birth rate or adult mortality rate as a result of underwater noise from piling. Whilst DEB can quantify the level of disturbance different piling scenarios could have on individuals and the population, it is important to consider the use of this model as part of a wider assessment on harbour porpoise.

17 As defined in Appendix B: DEB modelling Report to evaluate the likely duration of foraging disruptions a range of observed harbour porpoise swim speeds (1.2, 2.0 and 3.0 ms-1 (Verfuß *et al*. 2009, Kastelein *et al*. 2018)) and maximum disturbance distances were used (based on the spatial extent of responses from 2.2 -33 km summarised in Brandt *et al.* (2018); Southall *et al*. (2019); Brown *et al*. (2023)),

5.4.2.32 Carrying capacity of a population is the maximum population size of a species that can be sustained by their specific environment given that food, habitat, and resources are available. When considering the implications of disturbance on carrying capacity of a harbour porpoise population it is important to consider their foraging strategy and their movement ecology.

5.4.2.33 Foraging strategies and diet are typically displayed on a spectrum between generalists and specialists. Generalists are species which feed on a wide range of prey items, whereas specialists focus strongly on specific prey types. Harbour porpoises are considered opportunistic generalists with 40-100 different prey type observed in stomachs of stranded and bycaught animals. Even in site-specific studies where a prey item is considered dominant this rarely represents more than 50% of the prey items observed in stomachs (Wisniewska *et al*., 2016).

5.4.2.34 A population's movement ecology indicates how the population move around within the population boundaries. Keen *et al*. (2021) describes three categories of nomadic, resident and migratory movement patterns in marine mammals. The spectrum between nomadic and resident spans from individuals that range the entire population area (e.g. oceanic delphinid species, humpback whale) to individuals that show site-fidelity (e.g. sea otters). Harbour porpoises are considered highly mobile and closer to the nomadic end of the spectrum.

5.4.2.35 There are relatively few telemetry tagging studies on harbour porpoises, and none have been conducted in UK or Irish waters. Studies in other regions, such as the Bay of Fundy, Canada have reported relatively local movements ranging between 112 – 415 km^2 over shorter periods of time (days to months), whilst also traveling greater distances between 4,728 – 22,103 km^2 over the course of the five-month study (Johnston *et al*., 2005). In Danish waters, Teilmann *et al*. (2008) reported similar distances of travel, ranging between 400 km^2 and 1,600 km^2. Therefore, as the Rockabill to Dalkey Island SAC is relatively small (273 km^2 in surface area), it is likely that this SAC is being used periodically by harbour porpoise and represents only a small part of a larger range.

5.4.2.36 A further consideration is the species susceptibility to disturbance which is a product of the above factors. Typically, the animals that are observed to demonstrate the most overt response are those considered to be most sensitive to disturbance. However, Gill *et al*. (2001) highlight that for species with high availability of alternative habitat elsewhere, this allows individuals to move readily and will result in a strong decrease in numbers in disturbed sites (i.e. a greater response to move away). What this means in practical terms is that strong observed responses may not be indicative of vulnerability or sensitivity but a product of high availability of alternative habitat (i.e. there is no motivation to stay). Gill *et al*. (2001) suggest species that do not show overt responses that are of the greatest conservation concern because, when disturbed, they have no alternative habitat to move to and therefore have to stay, even in the presence of stressors.

assuming that while the animal is swimming from a starting location to a "safe distance" it is not foraging. This suggests very few animals would cease foraging for more than 6 hours and the vast majority would be disrupted for much less time. Following Benhemma-Le Gall *et al.* (2021), where at 11-12 km from the source there was no reduction in foraging probability this would suggest impacted foraging durations of only 0.46 - 2.55 hours.

5.4.2.37 When considering how the implications of disturbance on carrying capacity may apply to a species such as harbour porpoise, it is important to consider both the generalist foraging strategy of this species but also their movement ecology as being closer to nomadic and as such, this would result in more individuals being disturbed, however less frequently in comparison to species which have a resident movement ecology in which less individuals would be disturbed, but more frequently (Keen *et al*., 2021). Benhemma-Le Gall *et al*. (2021) examined the broad-scale responses of harbour porpoise to pile-driving and vessel activities during offshore windfarm construction and found that there was approximately a 5 – 25% reduction in harbour porpoise foraging activity close to piling activity (2 – 10 km) and approximately a 10 – 170% increase further way (16 – 30 km). This suggests animals were not significantly affected by this specific disturbance but rather moved away and increased foraging at locations relatively locally (i.e. close to the piling activity). With the above considered, it is assumed that individuals will be disturbed for a relatively short period of time and could (given the species' varied diet) implement prey switching if needed; therefore, the energetic consequences of disturbance and in turn any impact this may have on carrying capacity is considered less severe than that of more resident species with specialised diets.

Underwater Noise from piling – Disturbance Assessment (Harbour porpoise)

5.4.2.38 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.39 Whilst underwater noise generated from piling may result in temporary exclusion of harbour porpoise from an area, any response to this disturbance is expected to last 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 (2013a), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent harbour porpoises accessing the site.

5.4.2.40 Some individuals within or associated with the site may be disturbed and displaced by underwater noise arising from pile driving; however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) under any realistic piling scenario.

5.4.2.41 Furthermore, considering the specific technical clarifications regarding the disturbance target outlined in in paragraph 5.4.2.8 (NPWS, 2013a), the disturbance associated with underwater noise from pile driving 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.

5.4.2.42 Therefore, it is concluded that disturbance arising from piling will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.43 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise from UXO Clearance (Construction Phase): Harbour porpoise

5.4.2.44 The methods and approaches that may be used for UXO clearance are detailed in the Project Description. If clearance is required, the preference will be to use low order techniques, if this is not possible and clearance is necessary, high order techniques will be used. For high order clearance a bubble curtain will be deployed.

5.4.2.45 There is a low likelihood of UXO and it has therefore been assumed that a maximum of four UXO detonations within the array area, Offshore ECC and temporary occupation area will be required based on a risk assessment.

Auditory Injury

5.4.2.46 Explosives have the potential to cause injury or mortality in the immediate vicinity (e.g. <50 m; Danil and Leger, 2011) from either blast induced trauma (i.e. shock wave) or auditory impacts (i.e. sound wave). Most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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). A PTS in hearing is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within the frequency range of the sound. In the case of UXO clearance this would be in the low frequency component of the species hearing range, which is unlikely to significantly affect the fitness of an individual (i.e. its ability to survive and reproduce; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts on the fitness of individual harbour porpoises, for either adults or calves.

5.4.2.47 As UXO detonation is defined as a single pulse, both the weighted SELss criteria and the unweighted SPL_{peak} criteria (Southall *et al*., 2019) were considered (see Underwater noise assessment). 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 525 kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of the 'high-order' clearance technique with no at-source mitigation (e.g. bubble curtain).

5.4.2.48 Whilst the impact ranges overlap with the SAC, they are precautionary. The modelling does not consider variable bathymetry or seabed type which would positively affect attenuation of the sound wave (i.e. physical barriers will restrict or dampen sound wave propagation). The model also does not account for the variation in noise levels at different depths (i.e. temperature and pressure effect the speed of sound), which means that animals swimming near the surface could receive a lower noise level than if they experienced the noise deeper in the water column. Finally, the model does not consider that impulsive sounds dissipate through the environment and transition into non-impulsive sounds over distance (as described in Cudahy and Parvin (2001)). Hastie *et al*. (2019) demonstrate that impulsive noise (e.g. explosions, pile driving and seismic air guns) can lose its hazardous noise characteristics within 10 km of the sound source and the mean probability of this range falls around 3.5 km from the sound source. Consequently, the true impact ranges of UXO clearance are likely to be much smaller than those modelled.

5.4.2.49 Studies focused on impacts of pile driving have reported porpoise detections gradually declining by up to 33% in the 48 hours before piling, (Benhemma-Le Gall *et al.*, 2023). It is expected that a similar outcome would occur in this instance due to an increase in other construction-related activities and the increased presence of vessels prior to UXO clearance. Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity of the site at the start of UXO clearance activities. As such, the densities of harbour porpoise within the potential impact ranges are likely to be fewer than the predicted baseline and the scale of the effect thereby reduced in terms of individuals exposed.

5.4.2.50 Notwithstanding the low risk of PTS resulting in any biologically relevant effects to harbour porpoise, the MMMP includes a number of measures listed in Paragraph 5.4.1.20 to mitigate against any potential impacts to marine mammals associated with UXO detonation.

5.4.2.51 In particular, prior to any high-order detonations, at-source noise mitigation methods, such as a bubble curtain for high order detonations, will be used to minimise the potential PTS-onset range. 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. Should low order clearances methods be used, as is the preferred method for the project, then the PTS-onset range will scale with the size of the donor charge rather than the UXO, and be considerably smaller than from high order clearance. Together, these measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible.

Underwater noise from UXO – Auditory Injury Assessment (Harbour porpoise)

5.4.2.52 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.53 As UXO clearance and the associated underwater noise (which could potentially cause auditory injury) will be a short-term and temporary event (i.e. a one-off explosion), it will not permanently prevent harbour porpoises accessing the site. The avoidance and preventative measures will ensure that no harbour porpoise will be within instantaneous injury zones prior to any UXO clearance event.

5.4.2.54 In the unlikely event that individuals within or associated with the site are affected by PTS, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al.*, 2017). Therefore, any UXO clearance activities associated with the proposed development will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site

5.4.2.55 Considering the specific technical clarifications of the CO attribute, disturbance, as outlined in the conservation objectives (NPWS, 2013a), the underwater noise associated with the onset of PTS 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.

5.4.2.56 Therefore, it is concluded that auditory injury (e.g. PTS) arising from UXO clearance will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.57 The same mitigation measures included within the MMMP (outlined in paragraph 5.4.1.20) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.2.58 There is a lack of guidance on assessing behavioural impacts to marine mammals as a result of UXO clearance. Given 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.

5.4.2.59 JNCC guidance (2020) states 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, which was assessed above as having no AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC. Therefore, with a shorter duration (in most cases single pulse events), this activity is not expected to affect foraging behaviour for an extended time period (e.g. no longer than minutes).

Underwater Noise from UXO – Disturbance Assessment (Harbour porpoise)

5.4.2.60 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.61 Whilst underwater noise generated from UXO clearance may result in a startle reaction, given the nature of the activity (i.e. extremely short in duration), any displacement effect is expected to be very short term (e.g. hours). Therefore, in line with NPWS (2013a), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent harbour porpoises accessing the site.

5.4.2.62 Some individuals within, or associated with, the site may be disturbed and displaced by the underwater noise arising from UXO clearance activities; however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage). Therefore, underwater noise arising from UXO clearance activities are not expected to introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.63 Furthermore, considering the specific technical clarifications regarding disturbance outlined in paragraph 5.4.2.8 (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.

5.4.2.64 Therefore, it is concluded that disturbance arising from UXO clearance will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.65 The same mitigation measures, included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from other sources (Construction Phase): Harbour Porpoise

Auditory Injury

5.4.2.66 Non-impulsive noise (or continuous noise) sources resulting from works during construction, includes cable laying, dredging (backhoe/suction), drilling, rock placement, trenching and pre-construction surveys. The impact ranges for these noise sources are considered using a pre-cautionary assessment scenario of constant operations for 24-hours (see Underwater Noise Modelling Report).

5.4.2.67 The PTS-onset ranges with non-impulsive (i.e. excluding piling and UXO clearance) weighted SEL_{cum} thresholds would require harbour porpoises to be closer than 100 m from the continuous noise source at the start of the activity to acquire the necessary noise exposure to induce PTS. These results assume that harbour porpoises are fleeing (at 1.5 m/s) and are not stationary. It is important to note that the model resolution is such that impact ranges of less than 100 m cannot be reliably determined; therefore, values reported as <100 m may be considerably less than this.

5.4.2.68 When assuming a stationary animal, the PTS-onset ranges for all non-impulsive activities (expect dredging (suction) or rock placement) would require harbour porpoise to remain within 100 m of the activity for 24-hours. Dredging (suction) and rock placement activities were estimated to have a PTS-onset impact range of 570 m and 900 m respectively, where individuals would need to remain within these ranges of the noise source to accumulate enough noise exposure over 24-hours to induce PTS. Impact ranges for stationary animals are theoretical only and are expected to be highly conservative due to known avoidance behaviour of harbour porpoise to vessels and that the noise source itself is moving in most cases.

5.4.2.69 The energy of continuous and broadband noise from dredging activities is mainly below 1 kHz, 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 installation of foundations, export cable and inter-array cable for the proposed development.

5.4.2.70 The sound levels at the North Hoyle OWF during cable trenching activities were low (10 to 15 dB above background levels) with frequencies ranging from 100 Hz to 1 kHz (Nedwell *et al*., 2003). There are relatively few examples of monitoring noise generated by rock placement works, largely as it is expected to be negligible at worst. In one example, rock placement activities in the Yell Sound, Shetland found that relevant noise produced low frequency tonal noise from the machinery, and that those measured noise levels were within that of ambient/background noise levels (Nedwell and Howell, 2004).

5.4.2.71 As the hearing sensitivity of harbour porpoises below 1 kHz is relatively poor, considering their estimated region of peak sensitivity ranges between 12 kHz and 140 kHz (Southall *et al*., 2019) any auditory injury arising from such low frequency sounds would result in little impact to porpoise vital rates due to the impacted frequency ranges of these sound sources (as previously described in paragraph 5.4.1.40).

5.4.2.72 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 36.5 m (CSA 2020). It is expected that the displacement effect caused by the presence of the vessels used for these works (e.g. Benhemma-Le Gall *et al*., 2023) will be greater than the likelihood of individuals experiencing cumulative PTS onset from 3D UHRS (sparker) equipment and other construction activities (i.e. non-impulsive) underwater noise sources.

5.4.2.73 In addition, the MMMP includes a number of measures (outlined in Table 223) to mitigate against any potential impacts to marine mammals associated with the use of 3D UHRS (sparker) equipment.

Underwater Noise from other sources – Auditory Injury Assessment (Harbour porpoise)

5.4.2.74 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.75 As underwater noise from other construction activities sound sources will be relatively short-term and temporary, it will not permanently prevent access to the site.

5.4.2.76 PTS may affect individuals associated with the site; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017). Therefore, underwater noise from other (non-impulsive) sound sources will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.77 Considering the specific technical clarifications of CO attribute, disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), the underwater noise associated with the onset of PTS 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.

5.4.2.78 Therefore, it is concluded that auditory injury (i.e. PTS) arising from underwater noise from other construction (i.e. 3D UHRS sparker and non-impulsive) sound sources will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.79 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.2.80 There is limited information on disturbance impact from other (i.e. non-impulsive) sound sources during construction activities including cable laying, trenching, drilling and rock placement. Underwater noise generated from these activities may result in temporary exclusion of harbour porpoise from an area; however, it is expected that this will be relatively short-term (e.g. the duration of the activity), with harbour porpoise often reported to return to areas from which they were displaced after a short period of time (Todd *et al*., 2020). Relative to other activities that generate non-impulsive sound sources, there are more studies investigating dredging activities and displacement of marine mammals. These studies have reported varying displacement distances of harbour porpoises, ranging from 600 m up to 5 km from the activity, but often displacement is short-term (e.g. less than three hours; Diederichs *et al*., 2010; Verboom, 2014).

5.4.2.81 Considering the potential for disturbance from geophysical surveys, CSA (2020) present Level B harassment ranges for a wide range of geophysical survey equipment (such as impulsive sub-bottom profilers (SBPs; e.g. sparkers and boomers) and non-impulsive SBPs (e.g. compressed high-intensity radiated pulses (CHIRPs) sonar) with operating frequencies below 180 kHz and considered in the hearing ranges of marine mammals. In the absence of more widely accepted behavioural thresholds (Southall *et al*., 2019), Level B harassment ranges are often used to consider the distances within which behavioural effects could occur. Based on the modelling undertaken to inform the assessment therein, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source.

5.4.2.82 Monitoring of harbour porpoise detections and underwater noise at the Beatrice and Moray East offshore wind farms found that porpoise occurrence decreased with increased vessel traffic and underwater noise associated with pre-construction of piling, which displaced some animals from the sound source, whilst some individuals did remain nearby (Benhemma-Le Gall *et al*., 2023). Therefore, it is expected that the displacement effect relating to other (i.e. non-impulsive) sound sources during construction activities (including cable laying, trenching, drilling and rock placement) will be similar to the displacement effects caused by the presence of the vessels used for these works (e.g. Benhemma-Le Gall *et al*., 2023). Due to the nature of the offshore works, which are often mobile and intermittent, any impact is expected to be temporary and is likely to be spatially and temporally limited (i.e. constrained to a relatively small area over a brief period).

Underwater Noise from other sources – Disturbance Assessment (Harbour porpoise)

5.4.2.83 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.84 Whilst underwater noise generated from other construction activities sound sources may result in temporary exclusion of harbour porpoise from an area, it is expected that this will be relatively short-term and localised, with harbour porpoise likely to return to areas from which they were displaced after a short period of time (Pace *et al.,* 2021; Todd *et al*., 2020). Therefore, in line with NPWS (2013a), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent harbour porpoises accessing the site.

5.4.2.85 Some individuals associated with the site may be disturbed and displaced by the underwater noise arising from other (i.e. 3D UHRS and non-impulsive) sound sources; however, given the relatively short-term and localised nature of the activities, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017). Therefore, underwater noise from other construction activities sound sources are not expected to introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.86 Furthermore, considering the specific technical clarifications regarding the CO attribute disturbance, as outlined in the conservation objectives (NPWS, 2013a), the disturbance associated with underwater noise from other (non-impulsive) sound sources 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.

5.4.2.87 Therefore, it is concluded that disturbance arising from other (i.e. 3D UHRS and non-impulsive) sound sources related construction activities will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.88 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise (Decommissioning phase): Harbour Porpoise

Auditory Injury and Behavioural Disturbance

5.4.2.89 During decommissioning it is anticipated that the piled foundations, will be cut at a level below the seabed, buried cables and scour and cable protection left in situ as detailed within the Decommissioning and Restoration Plan. Should infrastructure be removed, the levels of underwater noise during decommissioning are assumed (for the purposes of this assessment) to be less than that described for the equivalent activities during the construction phase given there is no requirement for piling prior to decommissioning.

5.4.2.90 Decommissioning of offshore infrastructure for the proposed development (Offshore) may result in temporarily elevated underwater noise levels which may have effects on marine mammals. These elevated noise levels may be due to increased vessel movements and removal of the WTGs with the resulting noise levels dependant on the method used for removal of the foundation. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during the decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. It is envisaged that, where appropriate, buried assets such as cables will be left in situ when the project is decommissioned

5.4.2.91 As outlined in the Decommissioning and Restoration Plan, the exact methods to be adopted during decommissioning are yet to be confirmed; therefore, the respective impact level of PTS 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 less than those at the construction phase, given there is no requirement for piling prior to decommissioning.

5.4.2.92 If PTS were to occur as a result of activities during the decommissioning phase, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts to the fitness of individual harbour porpoises, for either adults or calves (Booth *et al*., 2019). Additionally, any disturbance would be no greater than that of the construction phase, and likely over a reduced timescale.

Underwater Noise from decommissioning – Auditory Injury and Disturbance Assessment (Harbour porpoise)

5.4.2.93 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.94 The noise resulting from wind turbine decommissioning employing abrasive cutting is unlikely to result in any injury, avoidance or significant disturbance of local marine mammals. Some short-term and temporary minor disturbance might be experienced in the immediate vicinity of the decommissioning activity; however, this will not permanently prevent harbour porpoises accessing the site.

5.4.2.95 Any auditory injury (i.e. PTS) or disturbance resulting from underwater noise associated with the decommissioning phase may affect individuals within or associated with the site; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017). Therefore, activities associated with decommissioning phase will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.96 Furthermore, considering the specific technical clarifications of the CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), the underwater noise associated with 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.

5.4.2.97 Therefore, it is concluded that underwater noise associated with activities during the decommissioning phase will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.98 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Collision Risk (Construction Phase, O&M and Decommissioning): Harbour Porpoise

5.4.2.99 The harbour porpoise is deemed to be of low vulnerability to vessel collision, based on post-mortem examinations of stranded animals and given the species is small and highly mobile, individuals are expected to be able to avoid collision with vessels. However, should a collision event occur, this has the potential to kill the animal.

5.4.2.100 As outlined in paragraph 5.4.1.61, construction vessels are large, slow moving and stationary for long periods, with the most frequent movements being from CTVs and support vessels transiting between the site and port. Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP. In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Vessel Collision Assessment (Harbour porpoise)

5.4.2.101 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.102 Individuals within or associated with the site could in theory be at risk of vessel collision; however with the implementation of a code of conduct within the environmental VMP vessel movements to and from construction sites and ports will, where feasible, follow existing routes, together with the slow speed of the vessels when on site, the risk of vessel collision is limited to the footprint of the vessel and reduces risk of fatalities. Harbour porpoise are also sensitive to vessel noise and the physical structure of vessels moving in the water which further reduces the risk of vessel collision. As vessels will only be on site temporarily, they should not restrict access to suitable habitat and will not be an artificial barrier.

5.4.2.103 The presence of vessels associated with the project will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.104 Furthermore, considering the specific technical clarifications of CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), the risk of vessel collision is not expected to change from the baseline; therefore, it 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.

5.4.2.105 Therefore, it is concluded that collision risk arising from vessel presence will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.106 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance (Construction, O&M and Decommissioning): Harbour Porpoise

5.4.2.107 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). As it is often difficult, if not impossible, to attribute whether individuals are responding to the noise of the vessel and/or the presence of the vessel, both are considered within the assessment of vessel disturbance.

5.4.2.108 Several 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 4 km of construction vessels. Therefore, whilst a localised reduction of harbour porpoise density from the presence of vessels is to be expected, this is spatially and temporally limited and is not considered to significantly constrain the foraging option for this species (e.g. Benhemma-Le Gall *et al*., 2021; 2023).

5.4.2.109 A behavioural study of harbour porpoises in relation to vessel traffic in Swansea Bay reported that 26% of observed negative porpoise behaviour (e.g. porpoises moving away from sound source or exhibited prolonged diving) was significantly correlated with the number of vessels present (Oakley *et al*., 2017). 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 and in predefined and predictable routes than these types of small, motorised vessels (e.g. jet ski, speed boat, small fishing vessels), it is expected that the behavioural response would not be as severe.

5.4.2.110 While porpoise may be sensitive to disturbance from other vessels, there is evidence to suggest that they are able to compensate for any short-term local displacement (e.g. Benhemma-Le Gall *et al*., 2021), and thus it is not expected that individual vital rates would be negatively impacted. As the area surrounding the proposed development 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.

5.4.2.111 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance Assessment (Harbour porpoise)

5.4.2.112 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.113 Vessel presence will be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Individuals within, or associated with, the site may be disturbed by the presence of vessels; however, vessel presence (given the temporary and localised nature of the activities) will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise.

5.4.2.114 Furthermore, considering the specific technical clarifications of the CO attribute disturbance, as outlined in paragraph 5.4.2.8 (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.

5.4.2.115 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.

5.4.2.116 The same mitigation measures included within the environmental VMP, (see 5.4.1) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Effects on Prey (Construction Phase, O&M and Decommissioning)

5.4.2.117 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. The prey species of harbour porpoise 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 in paragraph 5.4.1.715.4.1.71, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014).

Effects on Prey Assessment (Harbour Porpoise)

5.4.2.118 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.119 Any changes to the fish communities that harbour porpoise depend on will be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Any potential changes to prey as a result of activities relating to the construction, O&M and decommissioning phases will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.120 Furthermore, considering the specific technical clarifications of the CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), any small-scale, localised changes to the fish communities is not predicted to result in any significant negative impacts on harbour porpoises 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.

5.4.2.121 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.

5.4.2.122 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Accidental Pollution (Construction, O&M, Decommissioning and O&M Base): Harbour Porpoise

5.4.2.123 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.

5.4.2.124 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (see Table 223). With these avoidance and preventative 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.

Accidental Pollution Assessment (Harbour Porpoise)

5.4.2.125 As outlined in paragraph 5.4.2.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.126 Any accidental pollution event, should one occur, is expected to be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Given the temporary and localised nature of such an event, it will not result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.127 Furthermore, considering the specific technical clarifications of the CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), any small-scale, localised impact which may occur from a pollution incident 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.

5.4.2.128 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.

5.4.2.129 The Applicant will implement the measures contained within the Marine Pollution Contingency Plan (see Table 223) With these avoidance and preventative 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.

5.4.2.130 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Habitat Disturbance (Construction and Decommissioning) and Habitat Loss (O&M): Harbour Porpoise

5.4.2.131 Habitat loss and habitat disturbance has been screened in for harbour porpoise at Rockabill to Dalkey Island SAC given the slight overlap with the offshore ECC and given the likelihood of individuals associated with the SAC using adjacent habitat.

5.4.2.132 There is some uncertainty identified within NPWS (2013a) regarding size, community structure and distribution or habitat use of harbour porpoise inhabiting Rockabill to Dalkey Island SAC. In acknowledging limitations in the understanding of aquatic habitat use by the species it should be noted that all suitable aquatic habitat is considered relevant to the species range and ecological requirements at the site and is therefore of potential use by harbour porpoises.

5.4.2.133 As habitat disturbance and/or loss is intrinsically linked to other effects screened in that may cause an avoidance of the available habitat for foraging and other behaviours this assessment will draw upon conclusions from these assessments against any relevant CO with respect to habitat loss/disturbance.

Habitat Disturbance and Habitat Loss Assessment (Harbour Porpoise)

5.4.2.134 As outlined in paragraph 5.4.2.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

5.4.2.135 Long-term subtidal habitat loss (for the duration of the 25–35-year O&M phase) will occur under all foundation structures, associated scour protection and any required cable protection. This has the potential to result in indirect effects on marine mammals by impacting fish and shellfish; however, the proportion of habitat affected within the proposed development is small. 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.

5.4.2.136 Increased SSC could occur as a result of any of the proposed activities that physically disturb the seabed (e.g. site investigation works, turbine foundation installation, from the repair or reburial of the inter array and offshore export cables). Whilst elevated levels of SSC arising during construction and maintenance activities may decrease light availability in the water column and produce turbid conditions, the maximum impact range is expected to be localised with sediments rapidly dissipating over one tidal excursion. This may lead to short term avoidance of affected areas by sensitive fish and shellfish species, although many species are considered to be tolerant of turbid environments and regularly experience changes in the SSC due to the natural variability in the Irish Sea. Additionally, marine mammals are known to forage in turbid waters with low visibility levels (Pierpoint, 2008; Marubini *et al*., 2009; Hastie *et al*., 2016), indicating that suspended sediments are not likely to significantly impact foraging behaviour of marine mammals. This is because most marine mammals rely on hearing instead of vision for navigation, foraging and socialising, such as the use of echolocation (Hanke *et al*., 2010; Hanke and Dehnhardt, 2013; Hanke *et al*., 2013).

5.4.2.137 As established in the assessments of associated impact pathways (in particular underwater noise, vessel disturbance and changes to prey), whilst the proposed activities may result in temporary exclusion of harbour porpoise from a localised area during construction, any response to this disturbance is expected to last for the period of activity, with harbour porpoise returning to areas from which they were displaced within 1 – 2 days (Brandt *et al*., 2016). Therefore, in line with NPWS (2013a), it is not considered to present a permanent barrier to the use of the site (due to the temporary nature) and as such will not affect harbour porpoise access to the site.

5.4.2.138 As established in the assessments of associated impact pathways (in particular underwater noise, vessel disturbance and changes to prey), individuals within or associated with the site may be disturbed and/or displaced by activities. However, the impact pathways that may lead to habitat disturbance and/or loss, will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.2.139 Furthermore, considering the specific technical clarifications of the CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), habitat disturbance and/or loss 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.

5.4.2.140 Therefore, it is concluded that habitat disturbance and habitat loss will not result in an AEoI to the harbour porpoise QI of the Rockabill to Dalkey Island SAC.

5.4.2.141 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

5.4.3 Lambay Island SAC

5.4.3.1 Lambay Island is 19.6 km from the array area and 26 km from the offshore ECC. The following QI have been screened in for further assessment:

- Grey seal;
- Harbour seal; and
- Harbour porpoise.

5.4.3.2 Harbour and grey seals are present within Lambay Island SAC throughout the year during all aspects of their annual life cycle covering breeding, moulting, non-breeding, foraging and resting (NPWS, 2024).

5.4.3.3 A recent study assessed the use of seal haul-out sites in Dublin Bay and adjacent coastal waters, particularly during increased construction activity at Dublin Port (Berrow et al., 2024). Ten haul-out sites were surveyed, with grey seals being more abundant than harbour seals. Consistently used sites for grey seals included Lambay Island, St Patrick's Island, Ireland's Eye, and Dalkey Island, while harbour seals were mainly observed at Rush Head, Lambay Island and North Bull Island. Lambay Island SAC was found to be used consistently by both grey and harbour seals throughout all essential life cycle stages, including breeding, moulting and resting.

5.4.3.4 At-sea density estimates obtained from telemetry data used to generate habitat preference maps (Carter *et al*., 2022) are applied here to assess seal abundances at and around Lambay Island SAC. These telemetry data are from harbour and grey seals tagged around the UK and Ireland. The at-sea usage maps present predicted at-sea density of both seal species on 5x5 km grid cells. The estimated relative density gives the percentage of the British Isles at-sea population (excluding hauled-out individuals) estimated to be present in each grid cell at any one time during the main foraging season. These can then be applied spatially to give an estimated absolute abundance for grid cells to help inform impact assessments. Density estimates were obtained by considering the values of the two density grid cells overlapping most with the Lambay Island SAC, as all of the overlapped grid cells cover less than 50% area of the SAC. The highest abundance/count and density estimates of grey seals (252 grey seals and 0.17 grey seals/km^2) and harbour seals (47 harbour seals and 0.19 harbour seals/km^2) were considered for further impact assessment.

Grey seal

5.4.3.5 Lambay Island SAC supports the principal breeding colony of grey seals on the east coast of Ireland, with a minimum population estimate of between 196 and 252 grey seals of all ages (NPWS, 2024). The majority of grey seal pups are born within the bays largely along the south coast of the island during the breeding season, which occurs between August to December. The breeding season is followed by moulting, which occurs between December to April, with individuals typically using the west and southwest coast of the island. Whilst hauled out for resting, grey seals are typically found along the northeast and northwest coast of the island (NPWS, 2013k).

5.4.3.6 Berrow *et al*. (2024) surveyed Lambay Island on four occasions from July 2023 to January 2024. While both grey and harbour seals were observed, grey seals were significantly more abundant and frequently recorded across the Island. Grey seals were primarily observed along the northeast and southern sides of the Island, with peak numbers occurring in October 2023, coinciding with the peak of the pupping season, during which 77 pups were recorded.

5.4.3.7 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 limited telemetry data in Irish waters (full details outlining the data sources for pinnipeds can be found within Volume 4, Appendix 4.3.5-1 Technical Baseline Report - Marine Mammals). Telemetry data for grey seals tagged in UK waters have shown connectivity between the east coast of the RoI, Northern Ireland, Wales, Southwest England and the southwest coast of Scotland (Carter *et al*., 2022).

5.4.3.8 Based on a meta-analysis of telemetry data from the UK and RoI, the average at-sea density of grey seals within and around the Lambay island SAC is estimated to be 0.17 seals/km^2 (extracted from Carter *et al*., 2020).

Harbour seal

5.4.3.9 The SAC also contains regionally significant numbers of harbour seal, of which up to 47 individuals have been counted at the site (NPWS, 2024). Harbour seal breeding occurs at sites primarily along the west coast of the island between May to July, which is then followed by moulting between August to September, when individuals typically use the west and south coast of the island. Whilst hauled out for resting, harbour seals are typically along the west coast of the island (NPWS, 2013k).

5.4.3.10 During surveys conducted by Berrow *et al*. (2024) around Lambay Island SAC, 25 harbour seals were recorded (13 adults and 12 juveniles) around the harbour and northern beaches of the Island. However, only three individuals were observed in July, and none were recorded in October or November. No pups were observed during any of the surveys.

5.4.3.11 Whilst there have been several studies on harbour seal abundance and distribution at haul outs around Ireland, there have been no harbour seal tagging studies conducted in the RoI to date (full details outlining the data sources for pinnipeds can be found within Marine Mammals Baseline). Telemetry data for harbour seals utilised within Carter *et al.* (2022) is based off tagging events in Strangford Lough in Northern Ireland and indicates limited movement into the Republic of Ireland EEZ in the Irish Sea, with most tracks remaining in the vicinity of Strangford Lough as well as out into the UK part of the Irish Sea. The areas around Lambay Island, Strangford Lough, and Murlough (all of which are SACs with harbour seal as a qualifying feature) do have higher densities predicted, but these are localised, and are still low when compared to key regions for this species, such as the west of Scotland and The Wash in southeast England (Carter *et al*., 2022).

5.4.3.12 Based on a meta-analysis of telemetry data from the UK and RoI, 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*., 2020). 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*., 2020).

Harbour porpoise

5.4.3.13 Harbour porpoises were included as a QI of Lambay Island SAC in March 2024 (NPWS, 2024). Harbour porpoise are the most widespread and frequently recorded species off the east coast of the Republic of Ireland, sighted throughout the year with an increased presence in July and August (Ó Cadhla *et al*., 2004; Berrow *et al*., 2010; Wall *et al*., 2013; Kavanagh *et al.,* 2017; Rogan *et al.,* 2018). Although no site-specific surveys have been conducted for harbour porpoise surrounding Lambay Island, it is located within the northern half of Rockabill to Dalkey Island SAC which are subject to regular boat-based line transect surveys. This area is highlighted as an important habitat for harbour porpoise (NPWS, 2014c). Surveys have recorded higher densities of harbour porpoise north of Howth and surrounding Lambay Island (Berrow and O'Brian, 2013; Berrow *et al*., 2021). Harbour porpoise densities between Howth Head and Lambay Island between 2015 and 2017 ranged from 0.61 porpoises/km^2 in February 2016 to a peak in 2.29 porpoises/km^2 in August 2016 (Meade *et al*., 2017).

Conservation Objectives of Qualifying Interests

Grey seal and harbour seal

5.4.3.14 The CO to maintain the favourable conservation condition of grey seal and harbour seal are defined by the following attributes and targets:

- Access to suitable habitats: Species range within the site should not be restricted by artificial barriers to site use;
- Breeding behaviour: the breeding sites should be maintained in a natural condition;
- Moulting behaviour: the moult haul-out sites should be maintained in a natural condition;
- Resting behaviour: the resting haul out sites should be maintained in a natural condition; and
- Disturbance: human activities should occur at levels that do not adversely affect the grey/harbour seal population at the site.

5.4.3.15 Attributes including breeding, moulting or resting behaviour are all relevant to impacts on haul-out sites at the SAC. As the development is situated ca. 18.4 km from the Lambay Island SAC at its nearest point there is no pathway for an impact. Consequently, the assessment only considers access to suitable habitats and disturbance.

Harbour porpoise

5.4.3.16 In March 2024, NPWS added cetacean QIs to a number of existing SACs, including adding harbour porpoise to Lambay Island SAC, with site-specific COs provided in December 2024. The CO to maintain the favourable condition of harbour porpoise at Lambay Island SAC are defined by the following list of targets and technical clarifications (NPWS, 2024):

- Access to suitable habitat: 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.
- Disturbance: 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.

5.4.3.17 These objectives align with those assessed within the Rockabill to Dalkey Island SAC, as well as the subsequent technical clarifications designated for harbour porpoise (NPWS, 2024) previously outlined in paragraph 5.4.2.8.

Assessment of effects -Lambay Island SAC

5.4.3.18 It should be noted that the assessment of the harbour porpoise QI of Lambay Island SAC draws upon the information presented for Rockabill to Dalkey Island SAC, as both sites share the same COs. This assessment is summarised in a standalone section at the end of this appropriate assessment of Lambay Island SAC (see paragraph 5.4.3.130). Hence, the following detailed sections consider only grey seal and harbour seal and their respective impacts.

Underwater noise from piling (construction phase): grey seal and harbour seal

Auditory injury

5.4.3.19 The predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for grey seals and harbour seals resulting from WTG monopile foundation installation (13 m piles with a maximum blow energy of 6,372 kJ with piling mitigation measures in place (see paragraph 5.4.1.20), was less than 50 m at all locations modelled. The cumulative PTS-onset (weighted SEL_{cum}) during a single monopile event was predicted to occur if grey or harbour seals were located less than 100 m from both the NE and SE locations at the start of piling. Given that the SAC lies 19.6 km from the array area, this means there is no predicted overlap with the SAC.

5.4.3.20 While for the WTG jacket pile foundation installation of 5.75 m piles with a maximum blow energy of 4,695 kJ, and piling mitigation measures in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for grey and harbour seals was less than 50 m at the NE modelling location. Cumulative PTS onset from four sequential piles was predicted to occur if grey or harbour seals were located less than 100 m from both NE and SE modelling locations at the start of piling. Given that the SAC lies 19.6 km from the array area, this means there is no predicted overlap with the SAC.

5.4.3.21 The offshore infrastructure lies within the typical foraging range for both grey and harbour seals at Lambay Island SAC (100 km and 50 km respectively; Carter *et al.,* 2022). Whilst seals use sound both in air and water for communication, predator avoidance, and reproductive interactions, they are less dependent on hearing for foraging compared to cetaceans (Deecke *et al*., 2002). In certain conditions, seals may listen to sounds produced by vocalising fish whilst hunting for prey, but they also have very well developed tactile sensory systems used for foraging (Dehnhardt *et al*., 2001; Schulte-Pelkum *et al*., 2007).

5.4.3.22 If PTS were to occur as a result of piling noise, it is expected to result in a “notch” of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; see paragraph 5.4.1.40).

5.4.3.23 In addition to noise abatement systems (which enable a noise reduction of at least 10 dB), the MMMP includes a number of measures listed in Table 223 to mitigate against instantaneous injury to marine mammals associated with pile driving by ensuring no activity commences if a marine mammal is within the 1000 m mitigation zone, therefore no harbour porpoise should be within PTS ranges prior to pile driving commencement.

5.4.3.24 Consequently, given the predicted impact distances are less than 100 m (<50 m for instantaneous PTS onset and <100 m starting flee distance at the start of the piling sequence), and considering the mitigation measures that will be in place, the risk of PTS to any individual grey seal or harbour seal is considered negligible.

Underwater Noise from Piling – Auditory Injury Assessment (grey seal and harbour seal)

5.4.3.25 As outlined in paragraph 5.4.3.145.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.26 Pile driving activities and the associated underwater noise (which could potentially cause auditory injury) will be short-term and temporary; therefore, it will not permanently prevent grey seals and/or harbour seals accessing the site.

5.4.3.27 If an individual did experience PTS onset, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, pile driving activities will not result in a significant impact on individuals and/or the population of grey seal and/or harbour seal within the site, or indeed, connected to the site.

5.4.3.28 Therefore, it is concluded that auditory injury (i.e. PTS) arising from pile driving will not result in an AEoI to the grey seal and/or harbour seal QIs of the Lambay Island SAC.

5.4.3.29 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural disturbance

5.4.3.30 The predicted impact range using the Level B harassment threshold does not overlap with the SAC boundary, with the impact radius predicted to extend out to a maximum distance from the NE location of 13 km considering the monopile foundation scenario, and 12 km considering the jacket pile foundation scenario (see Underwater noise assessment for further details on the scenarios modelled).

5.4.3.31 Russell *et al.* (2016) studied telemetry tagged harbour seals in The Wash, England, to investigate at-sea behaviour during pile-driving activities in 2012. During this time, Lincs OWF (which is located 8 km off Skegness on the east coast of England) was under construction and another, Sheringham Shoal OWF (located between 17 and 23 km off the North Norfolk coast) was partially operational. During the tagging study, Lincs OWF installed 27 monopiles, where 70% of monopiles were each driven within a 24-h period. On average, piles reached penetration depth after 2,887 blows and blow energies ranged from 100 to 2,000 kJ. Russell *et al.* (2016) found that there was no significant displacement during construction as a whole; however, seal abundance was significantly reduced up to 25 km from a pile during piling activities (displaced at predicted received SPLs between 166 and 178 dB re 1 µPa and at SELs between 142 and 151 dB re 1 µPa). During pile-driving there was a 19 to 83% (95% confidence intervals) decline in abundance compared to during breaks in piling (Russell *et al*., 2016). This response to piling appears similar to that of harbour porpoises in response to pile driving as recorded in Tougaard *et al*., (2009). The duration of the displacement was only short-term as harbour seals returned to non-piling distributions within two hours after the end of a pile-driving event (Russell *et al.,* 2016).

5.4.3.32 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 are not available.

5.4.3.33 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.

5.4.3.34 In the Wadden Sea 20 grey seals were telemetry tagged to quantify their behavioural responses to pile driving at two offshore wind farms (Luchterduinen in 2014 and Gemini in 2015; Aarts *et al*., 2018). The grey seals showed varying responses to 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 45 km from the pile location, while other grey seals showed no response within 12 km. Differences in responses could be attributed to differences in hearing sensitivity between individuals, differences in sound transmission with environmental conditions, and/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 shortly (between 0-4 hours) after pile driving ceased (Aarts *et al*., 2018).

5.4.3.35 At an expert elicitation workshop in 2018 (Booth *et al*. 2019), experts 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.

Underwater noise from piling – disturbance assessment (Grey seal and Harbour seal)

5.4.3.36 As outlined in paragraph 5.4.3.145.4.3.14, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.37 Whilst underwater noise generated from piling may result in temporary exclusion of grey seal or harbour seal from an area, any response to this disturbance is expected to last for the period of piling, with both species likely to return to areas from which they were displaced shortly (e.g. hours) after the event (Russell *et al.,* 2016; Aarts *et al.,* 2018). Therefore, in line with NPWS (2013k), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent grey seals and/or harbour seals accessing the site.

5.4.3.38 Some individuals within or associated with the site may be disturbed and displaced by underwater noise arising from pile driving; however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) under any realistic piling scenario.

5.4.3.39 Therefore, it is concluded that disturbance arising from underwater noise generated by piling will not result in an AEoI to the grey seal and/or harbour seal QIs of the Lambay Island SAC.

5.4.3.40 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from UXO clearance (construction phase): Grey seal and Harbour seal

5.4.3.41 The methods and approaches that may be used for UXO clearance are detailed in the Project Description (Volume 1: Project Description). If clearance is required, the preference will be to use low order techniques, however, if this is not possible and clearance is necessary, high order techniques will be used. For high order clearance a bubble curtain will be deployed.

5.4.3.42 There is a low likelihood of UXO within the array area, offshore ECC and temporary occupation area, and it has therefore been assumed that a maximum of four UXO detonations will be required based on a risk assessment.

Auditory Injury

5.4.3.43 Explosives have the potential to cause injury or mortality in the immediate vicinity (e.g. <50 m; Danil and Leger, 2011) from either blast induced trauma (i.e. shock wave) or auditory impacts (i.e. sound wave). Most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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). These frequencies overlap with the lower end of the seal's hearing frequencies (e.g. low frequency growls ranging between 100 to 500 Hz and social sounds ranging between 100 to 3kHz; Asselin *et al.,* 1993; Hocking *et al.,* 2020). Therefore, if PTS were to occur within this low frequency range, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within the frequency range of the sound and could affect the seals ability to communicate during the breeding season but it is unlikely to result in any significant impact to vital rates (i.e. an individual would be able to navigate and forage; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts on the fitness of individual grey seals and/or harbour seals, for either adults or pups.

5.4.3.44 As UXO detonation is defined as a single pulse, both the weighted SEL_{ss} criteria and the unweighted SPL_{peak} criteria (Southall *et al*., 2019) were considered (Underwater noise assessment). The maximum PTS impact range of UXO clearance on grey seal and harbour seal is 2.5 km when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525 kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of the 'high-order' clearance technique and no at-source mitigation (e.g. bubble curtain). As Lambay Island is 19.59 km away, the impact range for PTS-onset as a result of UXO clearance works (i.e. 2.5 km) is not predicted to overlap with the SAC.

5.4.3.45 Whilst modelling aims to provide estimations of impact ranges, they are considered precautionary as conditions included in the modelling are often more simple than real world scenarios. For example, the modelling does not consider variable bathymetry or seabed type which would positively affect attenuation of the sound wave (i.e. physical barriers will restrict or dampen sound wave propagation). The model also does not account for the variation in noise levels at different depths (i.e. temperature and pressure effect the speed of sound), which means that animals swimming near the surface could receive a lower noise level than if they experienced the noise deeper in the water column. Finally, the model does not consider that impulsive sounds dissipate through the environment and transition into non-impulsive sounds over distance (as described in Cudahy and Parvin (2001)). Hastie *et al*. (2019) demonstrate that impulsive noise (e.g. explosions, pile driving and seismic air guns) can lose its hazardous noise characteristics within 10 km of the sound source and the mean probability of this range falls around 3.5 km from the sound source. Consequently, the true impact ranges of UXO clearance are likely to be much smaller.

5.4.3.46 Notwithstanding the low risk of PTS resulting in any biologically relevant effects to grey seals and/or harbour seals, the MMMP includes a number of preventive and avoidance measures (listed in outlined in Table 223) to mitigate against any potential impacts to marine mammals associated with UXO detonation.

5.4.3.47 In particular, prior to any high-order detonations, at-source noise mitigation methods such a bubble curtain will be used to minimise the potential PTS-onset range. 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. Should low order clearances methods be used, as is the preferred method for the project, then the PTS-onset range will scale with the size of the donor charge rather than the UXO, and be considerably smaller than from high order clearance. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual grey seal and/or harbour seal to negligible.

Underwater noise from UXO – auditory injury assessment (Grey seal and Harbour seal)

5.4.3.48 As outlined in paragraph 5.4.3.14, 5.4.3.14the CO for the Lambay Island SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.49 As UXO clearance and the associated underwater noise (which would potentially cause auditory injury) will be short-term and temporary (i.e. a one-off explosion) and will not permanently prevent grey and/or harbour seals from accessing the site. Avoidance and preventative measures will ensure that no seal will be within instantaneous injury zones prior to any UXO clearance event.

5.4.3.50 PTS may affect individuals within or associated with the site, however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, any UXO clearance activities associated with the proposed development will not result in a significant impact on individuals and/or the populations of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.51 Therefore, it is concluded that auditory injury (e.g. PTS) arising from UXO clearance will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC.

5.4.3.52 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural disturbance

5.4.3.53 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. Therefore, considering the lack of guidance, 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.

5.4.3.54 JNCC (2020) guidance states 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, which was assessed above as having no AEoI to the grey or harbour seal QI of Lambay Island SAC. Therefore, with a shorter duration (in most cases, single pulse events), is not expected that disturbance from a single UXO detonation would result in any significant impacts for a time period extending beyond minutes. Consequently, it is very unlikely that noise from UXO clearance would impact adult, juvenile or pup survival or reproductive rates to the extent to alter the grey or harbour seal population trajectory.

Underwater noise from UXO – disturbance assessment (grey seal and harbour seal)

5.4.3.55 As outlined in paragraph 5.4.3.14, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.56 Whilst underwater noise generated from UXO clearance may result in a startle reaction, given the nature of the activity (i.e. extremely short duration) it is unlikely to cause displacement, but if it did, it is expected to be very short-term (e.g. hours). Therefore, in line with NPWS (2013k), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent grey and/or harbour seals from accessing the site.

5.4.3.57 Some individuals within or associated with the site may be disturbed or displaced by the underwater noise arising from UXO clearance activities, however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage). Therefore, underwater noise arising from UXO clearance activities are not expected to introduce man-made energy at levels that could result in a significant impact on individuals and/or the population of grey and/or harbour seals within, or indeed, connected to the site.

5.4.3.58 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.

5.4.3.59 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from other noise sources (Construction Phase): Grey Seal and Harbour Seal

Auditory Injury

5.4.3.60 Non-impulsive noise (or continuous noise) sources resulting from works during construction, includes cable laying, dredging (backhoe/suction), drilling, rock placement, trenching and pre-construction surveys. The impact ranges for these noise sources are considered using a pre-cautionary assessment scenario of constant operations for 24-hours (see Underwater noise assessment).

5.4.3.61 The PTS- onset ranges with non-impulsive (i.e. excluding piling and UXO clearance) weighted SEL_{cum} thresholds would require grey or harbour seals to be closer than 100 m from the continuous noise source at the start of the activity to acquire the necessary noise exposure to induce PTS. These results assume that seals are fleeing (at 1.5 m/s) and are not stationary. It is important to note that model resolution is such that impact ranges of less than 100 m cannot be reliably determined; therefore, values reported <100 m may be considerably less than this.

5.4.3.62 The hearing sensitivity of grey and harbour seals below 1 kHz is relatively poor, considering its estimated region of peak sensitivity ranges between 1.9 kHz and 30 kHz (Southall *et al*., 2019), any auditory injury arising from such low frequency sounds would result in little impact to pinniped vital rates due to the nature of the notch of PTS which may be caused by these sound sources (as discussed in paragraph 5.4.1.40).

5.4.3.63 CSA (2020) presented modelled impact ranges for a wide range of geophysical survey equipment, based on the 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 36.5 m (CSA, 2020). It is expected that the displacement effect caused by the presence of the vessels used for these works (e.g. Benhemma-Le Gall *et al*., 2023). will be greater than the likelihood of individuals experiencing cumulative PTS-onset from 3D UHRS and other construction activities (i.e. non-impulsive) underwater noise sources.

5.4.3.64 In addition, the MMMP includes a number of preventive and avoidance measures (outlined in Table 223) to mitigate against any potential impacts to marine mammals associated with the use of 3D UHRS (sparker) equipment.

Underwater Noise from other sources – Auditory Injury Assessment (Grey seal and Harbour seal)

5.4.3.65 As outlined in paragraph 5.4.3.14, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.66 As underwater noise from other sound sources (which could potentially cause auditory injury) will be relatively short-term and temporary, it will not permanently prevent access to the site.

5.4.3.67 PTS may affect individuals within, or associated with, the site; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, underwater noise from other (non-impulsive) sound sources will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the populations of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.68 Therefore, it is concluded that auditory injury arising from underwater noise from other construction (3D UHRS sparker and non-impulsive) sound sources will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC.

5.4.3.69 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.3.70 According to the generic threshold of pinniped behavioural avoidance (140 dB re 1 µPa SPL; Southall *et al*., 2007), modelling results demonstrated that behavioural disturbance from dredging activity could extend out from 400 m to 5 km 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.

5.4.3.71 There is a lack of information on disturbance impact from other (i.e. non-impulsive) sound sources during 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. Due to the nature of the offshore work, they are often mobile and intermittent, therefore the impact within any specific area will be very temporally limited.

5.4.3.72 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 extend up to 141 m from the source. It is expected that the displacement effect caused by the presence of the vessels used for these works (e.g. Benhemma-Le Gall *et al*., 2023) will be greater than the disturbance effects of (other) underwater noise sources relating to the construction-related activities in which the vessels are engaged in.

5.4.3.73 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.

5.4.3.74 The Berrow *et al.* (2024) study examined seal haul-out site usage in Dublin Bay and adjacent coastal waters during periods of increased construction activity at Dublin Port. The construction works included capital dredging, quay wall construction, basin infilling, and increased vessel traffic. Despite ongoing construction, the study found no significant decline in seal numbers or changes in haul-out site usage. Grey and harbour seals continued to use key haul-out sites, including Lambay Island SAC, throughout the construction period. Notably, Bull Island, one of the closest to Dublin Port, even showed an increase in seal presence during the study period. These findings indicate that seals exhibit a degree of resilience to certain levels of construction disturbance, particularly vessel traffic and port-related construction.

Underwater Noise from other sources – Disturbance Assessment (Grey seal and Harbour seal)

5.4.3.75 As outlined in paragraph 5.4.3.14, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.76 Whilst underwater noise generated from other construction activities sound sources may result in temporary exclusion of grey and/or harbour seals from an area; however, it is expected to be relatively short-term and localised, with seals likely to return to areas from which they were displaced after a short period of time (Pace *et al.,* 2021; Todd *et al*., 2020). Therefore, in line with NPWS (2013k), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent grey and/or harbour seals from accessing the site.

5.4.3.77 Some individuals associated with the site may be disturbed and displaced by the underwater noise arising from other (i.e. 3D UHRS and non-impulsive) sound sources; however, given the relatively short-term and localised nature of the activities, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, underwater noise from other construction activities sound sources are not expected to introduce man-made energy at levels that could result in a significant impact on individuals and/or the populations of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.78 Therefore, it is concluded that disturbance arising from other (i.e. 3D UHRS and non-impulsive) sound sources related construction activities will not result in an AEoI to the grey or harbour seal QI of the Lambay Island SAC.

5.4.3.79 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise (Decommissioning phase): Grey seal and Harbour seal

Auditory Injury and Behavioural Disturbance

5.4.3.80 Decommissioning of offshore infrastructure for the proposed development (Offshore) may result in temporarily elevated underwater noise levels which may have effects on marine mammals. These elevated noise levels may be due to increased vessel movements and removal of the WTGs with the resulting noise levels dependant on the method used for removal of the foundation. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during the decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. It is envisaged that, where appropriate, buried assets such as cables will be left in situ when the project is decommissioned.

5.4.3.81 As outlined in the Decommissioning and Restoration Plan, the exact methods to be adopted during decommissioning are yet to be confirmed; therefore, the respective impact level of PTS 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 less than those at the construction phase, without the requirement for piling.

5.4.3.82 If PTS were to occur as a result of activities during the decommissioning phase, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017; see paragraph 5.4.1.40). Specifically, any auditory injury 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.

Underwater Noise from Decommissioning Assessment (Grey seal and Harbour seal)

5.4.3.83 As outlined in paragraph 5.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.84 Any auditory injury (i.e. PTS) or disturbance as a result of underwater noise associated with the decommissioning phase will be short-term and temporary and will not permanently prevent grey and/or harbour seals from accessing the site. It is also unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, activities associated with decommissioning phase will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the populations of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.85 Therefore, it is concluded that underwater noise associated with activities during the decommissioning phase will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

5.4.3.86 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Collision Risk (Construction phase, O&M and decommissioning): Grey seal and Harbour Seal

5.4.3.87 Grey seal and harbour seal are deemed to be of low vulnerability to vessel collision, based on post-mortem examinations of stranded animals and given the species is small and highly mobile, individuals are expected to be able to avoid collision with vessels. However, should a collision event occur, this has the potential to kill the animals.

5.4.3.88 As outlined in paragraph 5.4.1.61, construction vessels are large, slow moving and stationary for long periods, with the most frequent movements being from CTVs and support vessels transiting between the site and the port. Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP. In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Vessel Collision Assessment (Grey seal and Harbour Seal)

5.4.3.89 As outlined in paragraph 5.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.90 Individuals within or associated with the site could in theory be at risk of vessel collision; however, with the implementation of predefined vessel routes and the slow speed of the vessels when on site (as stipulated in the VMP), the risk of vessel collision is limited to the footprint of the vessel and reduces risk of fatalities. Additionally, as vessels will only be on site temporarily, they should not restrict access to suitable habitat and will not be an artificial barrier.

5.4.3.91 Therefore, it is concluded that collision risk arising from vessel presence will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

5.4.3.92 The same mitigation measures included within the environmental VMP would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance (Construction phase, O&M and decommissioning): Grey seal and Harbour Seal

5.4.3.93 Vessel 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). As it is often difficult, if not impossible, to attribute whether individuals are responding to the noise of the vessel and/or the presence of the vessel, both are considered within the assessment of vessel disturbance.

5.4.3.94 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.

5.4.3.95 The Berrow *et al.* (2024) study assessed seal haul-out site usage in Dublin Bay and adjacent coastal waters during periods of increased construction activity at Dublin Port. The study found that the Dublin Bay area experience a high level of vessel movements, with 7,228 ship arrivals to Dublin Port in 2023. Despite ongoing construction and elevated vessel presence, both grey and harbour seals continued to use haul-out sites, including Lambay Island SAC, with no significant displacement or reduction in seal numbers observed. These findings suggest that seals at Lambay Island SAC may have exhibit resilience to vessel traffic, given their continued presence at haul-out sites in Dublin Bay under increased construction activity.

5.4.3.96 Vessel disturbance studies on seals have demonstrated flushing of seals (Jansen *et al*., 2015) in response to large vessels occurring out as far as 1 km (Young *et al*., 2014), and alertness in seals at haul outs increased when small vessels are within 300 m of a seal (Henry and Hammill, 2001). It is noted that the SAC is situated more than 1 km away from the ECC and the landfall site at Bremore; indeed it is 19.6 km away. 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, 2021), 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.

5.4.3.97 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.

5.4.3.98 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 four beats per minute (bpm) as a result of incidental vessel traffic, and an increase of five bpm 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).

5.4.3.99 As a precautionary approach, a 1 km disturbance range of vessel presence has been used to determine the magnitude of impact. It is estimated that no grey seal or harbour seal within 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.

5.4.3.100 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 (183 dB re 1 μPa^2). Despite the spatial overlap with the vessel disturbance (especially within 50 km 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).

5.4.3.101 As outlined in paragraph 5.4.1.61, construction vessels are large, slow moving and stationary for long periods, with the most frequent movements being from CTVs and support vessels transiting between the site and the port. Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP (see Table 223). In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Vessel Disturbance Assessment (Grey seal and Harbour seal)

5.4.3.102 As outlined in paragraph 5.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.103 Vessel presence will be temporary and localised and will not permanently prevent grey and/or harbour seals accessing the site. Individuals within, and/or associated with the site may be disturbed 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 and so is therefore not expected to impact on the populations at the site.

5.4.3.104 Vessel presence will be temporary and localised within the proposed development and transit corridors. Therefore, vessels associated with the proposed development will not permanently prevent grey and harbour seals from maintaining their natural range within the site.

5.4.3.105 Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the grey seal and harbour seal QIs of the Lambay Island SAC.

5.4.3.106 The same mitigation measures included within the environmental VMP (see Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Effects on prey (Construction phase, O&M and decommissioning): Grey seal and Harbour Seal

5.4.3.107 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 seals diet, grey seals in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

5.4.3.108 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 octopi 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.

5.4.3.109 As noted in paragraph 5.4.1.71, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014). Not all seal prey species are sensitive to underwater noise, and so the prey community as a whole is unlikely to be affected by underwater noise impacts. As for grey and harbour seals, their prey species are highly mobile and are therefore able to avoid the majority of impacts associated with seabed disturbance and/sediment plumes. They are unlikely to have significant mortality associated with general construction activities.

Effects on Prey Assessment (Grey seal and Harbour seal)

5.4.3.110 As outlined in paragraph 5.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.111 Any changes to the fish communities that grey and/or harbour seals depend on will be temporary and localised and will not permanently prevent grey and/or harbour seals accessing the site. Any potential changes to prey as a result of activities relating to the construction, O&M and decommissioning phases will not result in a significant impact on individuals and/or the population of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.112 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.

5.4.3.113 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Accidental Pollution (Construction phase, O&M, decommissioning and O&M Base): Grey seal and Harbour seal

5.4.3.114 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.

5.4.3.115 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan for both the offshore infrastructure and the O&M Base in Dún Laoghaire Harbour (contained within the PEMP) (see Table 223). With these avoidance and preventative 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.

Accidental Pollution Assessment (Grey seal and Harbour seal)

5.4.3.116 As outlined in paragraph 5.4.3.14, the relevant COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.117 Any accidental pollution event, should one occur, is expected to be temporary and localised and will not permanently prevent grey and/or harbour seals from accessing the site. Individuals associated with the site may be impacted by an accidental pollution event, should one occur, however, given the temporary and localised nature of such an event, it will not result in a significant impact on individuals and the population of grey and/or harbour seals within the site, or indeed, connected to the site. Similarly, it is not expected to significantly affect the prey species of grey and/or harbour seal in the site or wider region.

5.4.3.118 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.

5.4.3.119 The same mitigation measures regarding the Marine Pollution Contingency Plan would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Habitat Disturbance (Construction and decommissioning phase) and Habitat Loss (O&M): Grey seal and Harbour Seal

5.4.3.120 The physical presence of an OWF array infrastructure has the potential to either displace grey and/or harbour seals through an effective loss of habitat, and/or create barrier effects, whereby the regular movements of a particular species are impacted by the presence of the wind farm (Onoufriou *et al.*, 2021).

5.4.3.121 Lambay Island SAC does not overlap with any section of the proposed development and therefore, there will be no direct influence on the site's habitat. However, its effect has been screened in given the likelihood of individuals associated with the SAC using adjacent habitat which extends to the array area.

5.4.3.122 As habitat disturbance and/or loss is intrinsically linked to other effects screened in that may cause an avoidance of the available habitat for foraging and other behaviours this assessment will draw upon conclusions from these assessments against any relevant CO with respect to habitat loss/disturbance.

Habitat Disturbance and Habitat Loss Assessment (Grey seal and Harbour Seal)

5.4.3.123 As outlined in paragraph 5.4.3.14, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the grey seal and/or harbour seal population at the site (disturbance).

5.4.3.124 It is expected that grey and harbour seals are able to move between and around the wind turbine and OSP foundations at all depths of the proposed development. Therefore, in line with NPWS (2013k), it is not considered to present a permanent barrier to the use of the site and as such will not affect grey and/or harbour seal access to the site.

5.4.3.125 Long-term subtidal habitat loss (for the duration of the 25–35-year O&M phase) will occur under all foundation structures, associated scour protection and any required cable protection. This has the potential to result in indirect effects on marine mammals by impacting fish and shellfish; however, the proportion of habitat affected within the proposed development is small. It is concluded that changes to prey will not result in an AEoI to the grey and harbour seal QI of the Lambay Island SAC.

5.4.3.126 Increased SSC could occur as a result of any of the Proposed Activities that physically disturb the seabed (e.g. site investigation works, turbine foundation installation, from the repair or reburial of the inter array and offshore export cables). Whilst elevated levels of SSC arising during construction and maintenance activities may decrease light availability in the water column and produce turbid conditions, the maximum impact range is expected to be localised with sediments rapidly dissipating over one tidal excursion. This may lead to short term avoidance of affected areas by sensitive fish and shellfish species, although many species are considered to be tolerant of turbid environments and regularly experience changes in the SSC due to the natural variability in the Irish Sea. Additionally, marine mammals are known to forage in turbid waters with low visibility levels (Pierpoint, 2008; Marubini *et al.*, 2009; Hastie *et al.*, 2016), indicating that suspended sediments are not likely to significantly impact foraging behaviour of marine mammals.

5.4.3.127 As established in the assessments of associated impact pathways (in particular specifically underwater noise, vessel disturbance and effects on prey), individuals within or associated with the site may be disturbed or displaced by the proposed activities; however, habitat disturbance and/or loss will not result in a significant impact on individuals and the population of grey and/or harbour seals within the site, or indeed, connected to the site.

5.4.3.128 Therefore, it is concluded that habitat disturbance and habitat loss will not result in an AEoI to the grey and/or harbour seal QI of Lambay Island SAC.

5.4.3.129 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

All impact pathways Assessment (Harbour porpoise)

5.4.3.130 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 the site-specific COs for harbour porpoise at Lambay Island match those of Rockabill to Dalkey Island SAC, the conclusions of the latter assessment are applicable to Lambay Island SAC.

5.4.3.131 The assessment of Rockabill to Dalkey Island SAC (which overlaps with the offshore ECC and lies 1.8 km inshore of the array area) concluded no AEoI on harbour porpoise QIs for all impacts screened in. Given that Lambay Island SAC is farther located from the proposed development, it is considered that the potential for AEoI is the same or reduced for this site.

5.4.3.132 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.

5.4.4 Hook Head SAC

5.4.4.1 The Hook Head SAC is 123 km from the array and 120 km from the offshore ECC. The following QI have been screened in for further assessment:

- Harbour porpoise; and
- Bottlenose dolphin.

5.4.4.2 The site features an exposed to moderately exposed intertidal reef community with patches of sand, gravel and boulders (NPWS, 2011). Harbour porpoise and bottlenose dolphin were added as QI of Hook Head SAC in March 2024. At the time of writing this NIS, no publicly available data were available to inform abundance estimates of these species at the site; however, cetacean surveys covering the entire Irish coast have sighted both harbour porpoise and bottlenose dolphin off the Hook Head Peninsula (Rogan *et al.,* 2018).

5.4.4.3 Harbour porpoise occur in the Irish Sea and coastal areas around Hook Head year-round, with an increased abundance recorded in the summer months (Rogan *et al.,* 2018); however, sightings predominantly occurred to the north-west of Hook Head peninsula in the Irish Sea compared to the more exposed area to the south of the peninsula.

5.4.4.4 Two different ecotypes of bottlenose dolphin occur commonly within Irish and UK waters: a coastal ecotype and an offshore ecotype (Berrow *et al.,* 2013; Hague *et al.,* 2020; Wall *et al.,* 2013). Coastal ecotypes comprise semi-resident populations in coastal areas, such as the Shannon Estuary, and show high site fidelity (Ingram and Rogan, 2002; Rogan *et al.,* 2018). Whereas, photographic identification studies have found that offshore bottlenose dolphins are highly mobile and capable of travelling large distances, with the same individuals undertaking movements around the entire Irish coast (O'Brien *et al.,* 2010), as well as evidence of movement through potential corridors linking SACs in the Shannon Estuary, Cardigan Bay, and the Moray Firth, and confirming individual exchange between previously considered discrete populations in the UK and Ireland (Robinson *et al.,* 2012). Therefore, it must be considered that the bottlenose dolphin population along the West coast of Ireland may demonstrate connectivity to individuals found on the East coast of the UK. Within the surrounding waters off Hook Head SAC, bottlenose dolphins have been recorded year-round with an increased abundance in winter months compared to summer (Rogan *et al.*, 2018). Most coastal sightings around Ireland fall within 10 km from shore (O'Brien *et al.*, 2010; Robinson *et al.,* 2012).

Conservation Objectives of Qualifying Interests

5.4.4.5 In March 2024, NPWS added cetacean QI to a number of existing SACs, including adding bottlenose dolphin and harbour porpoise to Hook Head SAC, with site-specific COs provided in January 2025.

Harbour porpoise

5.4.4.6 The CO to maintain the favourable condition of harbour porpoise at Hook Head SAC are defined by the following list of targets and technical clarifications (NPWS, 2025):

- Access to suitable habitat: 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.
- Disturbance: 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.

Bottlenose dolphin

5.4.4.7 The CO to maintain the favourable condition of bottlenose dolphin at Hook Head SAC are defined by the following list of targets and technical clarifications (NPWS, 2025):

- Access to suitable habitats: 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 bottlenose dolphin 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.

- Disturbance: Human activities should occur at levels that do not adversely affect the bottlenose dolphin population 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 population of bottlenose dolphins 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 bottlenose dolphins 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 bottlenose dolphin population at the site.

Assessment of effects -Hook Head SAC

5.4.4.8 It should be noted that the assessment of the harbour porpoise QI of Hook Head SAC draws upon the information presented for Rockabill to Dalkey Island SAC, as both sites share the same COs. This assessment is summarised in a standalone section at the end of this appropriate assessment of Hook Head SAC (see paragraph 5.4.4.95). Hence, the following detailed sections consider only bottlenose dolphin and their respective impacts.

Underwater noise from piling (Construction Phase): Bottlenose dolphin

Auditory injury

5.4.4.9 For the WTG monopile foundation installation of 13 m piles with a maximum blow energy of 6,372 kJ, with piling mitigation in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for bottlenose dolphin from piling was less than 50 m for the installation of a monopile at the NE modelled location. Considering the cumulative PTS-onset (weighted SEL_{cum}) thresholds, bottlenose dolphin found within 100 m from the NE monopile location at the start of piling could accumulate noise exposure in excess of the criteria. Given that the SAC lies 123 km away from the array area, these impact ranges would result in no overlap with the SAC.

5.4.4.10 While for the WTG jacket pile foundation installation of 5.75 m piles with a maximum blow energy of 4,695 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for bottlenose dolphins was less than 50 m at all modelling locations. Cumulative PTS-onset from four sequential piles was predicated to occur if bottlenose dolphins were located less than 100 m from either of the NE and SE modelling locations at the start of piling. Given that the SAC lies 123 km away from the array area, this means there is no predicted overlap with the SAC.

5.4.4.11 Static PAM studies of bottlenose dolphins have reported that although individuals were not excluded from the sites in the vicinity of impact piling or vibration piling during harbour construction works in northeast Scotland, they did spend a reduced period of time in the vicinity of the construction works (Graham *et al*., 2017). This period of time lasted up until a couple of hours after the piling works.

5.4.4.12 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. However, it is possible that individuals or pods of bottlenose dolphin could use the proposed development site which could expose them to this impact. If PTS were to occur as a result of piling noise, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts to the fitness of individual bottlenose dolphins, for either adults or calves (Booth *et al*., 2019).

5.4.4.13 In addition to noise abatement systems (which enable a noise reduction of at least 10 dB), the MMMP includes a number of preventive measures (listed in Table 223) to mitigate against instantaneous injury to marine mammals associated with pile driving by ensuring no activity commences if a marine mammal is within the 1000 m mitigation zone, therefore no harbour porpoise should be within PTS ranges prior to pile driving commencement.

5.4.4.14 Consequently, given the predicted impact distances are less than 100 m, and considering the mitigation measures that will be in place, the risk of PTS to any individual bottlenose dolphin to considered negligible.

Underwater Noise from piling – Auditory Injury Assessment (Bottlenose dolphin)

5.4.4.15 As outlined in paragraph 5.4.4.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.16 Pile driving activities and the associated underwater noise (which could potentially cause auditory injury) will be short-term and temporary. Hook Head SAC is also located beyond the zone of influence of impacts from underwater noise originating from the proposed development; therefore, piling within the proposed development region will not permanently prevent bottlenose dolphins accessing the site. If an individual did experience PTS onset, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, pile driving activities will not result in significant impact on individuals and/or the population of bottlenose dolphin within the site, or indeed, connected to the site.

5.4.4.17 Therefore, it is concluded that auditory injury (i.e. PTS) arising from pile driving will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.18 The same mitigation measures included within the MMMP (as outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.4.19 The predicted impact range of using the Level B harassment threshold is predicted to occur out to a maximum distance of 13 km from the NE location considering the monopile foundation scenario, and 12 km from the NE location considering the jacket-pile foundation scenario (see the Underwater noise assessment). As Hook Head SAC is 123 km away from the array area, it is expected that no bottlenose dolphin within the SAC will be impacted by behavioural disturbance from piling noise. Any disturbance effects will be limited to mobile individuals found outside of the SAC.

5.4.4.20 PAM studies of bottlenose dolphin response to impact and vibratory piling (where the median peak-to-peak source level estimated for impact piling was 240 dB re 1 µPa (single-pulse sound SEL 198 dB re 1 µPa2^{s}), and the root mean square source level for vibration piling was 192 dB re 1 µPa) were conducted near the project site of the Nigg Energy Park in Cromarty Firth (Graham *et al.*, 2017). This study found that bottlenose dolphins were not excluded from the vicinity of the piling site, but rather spent a reduced portion of time (i.e. hours) within the vicinity of the construction work (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.

Underwater Noise from piling – Disturbance Assessment (Bottlenose dolphin)

5.4.4.21 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.22 Whilst underwater noise generated from pile driving may result in temporary exclusion of bottlenose dolphin from an area, any response to this disturbance is expected to last for the period of piling, with bottlenose dolphins likely to return to areas from which they were displaced shortly (e.g. hours) after the event (Graham *et al.,* 2017). Therefore, in line with NPWS (2012b), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent bottlenose dolphins accessing the site. As Hook Head SAC is 123 km away from the array area, it is expected that no bottlenose dolphin within the SAC will be impacted by behavioural disturbance from piling noise.

5.4.4.23 Therefore, it is concluded that disturbance arising from underwater noise generated by piling will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.24 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from UXO clearance (Construction Phase): Bottlenose dolphin

5.4.4.25 The methods and approaches that may be used for UXOs clearance are detailed in the Project Description (Volume 1: Project Description). If clearance is required, the preference will be to use low order techniques, if this is not possible and clearance is necessary, high order techniques will be used. For high order clearance a bubble curtain will be deployed.

5.4.4.26 There is a low likelihood of UXO, and it has therefore been assumed that a maximum of four UXO detonations within the array area, Offshore ECC and temporary occupation area will be required based on a risk assessment.

Auditory Injury

5.4.4.27 Explosives have the potential to cause injury or mortality in the immediate vicinity (e.g. <50 m; Danil and Leger, 2011) from either blast induced trauma (i.e. shock wave) or auditory impacts (i.e. sound wave). Most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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). A PTS in hearing is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within the frequency range of the sound. In the case of UXO clearance this would be in the low frequency component of the species hearing range, which is unlikely to significantly affect the fitness of individuals (i.e. it's ability to survive and reproduce; see paragraph 5.4.1.40).

5.4.4.28 As UXO detonation is defined as a single pulse, both the weighted SEL_{ss} criteria and the unweighted SPL_{peak} criteria (Southall *et al*., 2019) were considered (see Underwater noise assessment). The maximum PTS impact range of UXO clearance on bottlenose dolphins is estimated to be 730 m, when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525 kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of the 'high-order' clearance technique with no at-source mitigation (e.g. bubble curtain).

5.4.4.29 These impact ranges are considered to be precautionary due to limitations in the modelling parameters. The modelling does not consider variable bathymetry or seabed type which would positively affect attenuation of the sound wave (i.e. physical barriers will restrict or dampen sound wave propagation). The model also does not account for the variation in noise levels at different depths (i.e. temperature and pressure effect the speed of sound), which means that animals swimming near the surface could receive a lower noise level than if they experienced the noise deeper in the water column.

5.4.4.30 Notwithstanding the low risk of PTS resulting in any biologically relevant effects to bottlenose dolphins, the MMMP includes a number of preventive and avoidance measures (listed in Table 223) to mitigate against any potential impacts to marine mammals associated with UXO detonation.

5.4.4.31 In particular, prior to any high-order detonations, at-source noise mitigation methods, such as a bubble curtain, will be used to minimise the potential PTS-onset range. 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. Should low order clearances methods be used, as is the preferred method for the project, then the PTS-onset range will scale with the size of the donor charge rather than the UXO and be considerably smaller than from high order clearance. Together, these measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin to negligible.

Underwater Noise from UXO – Auditory Injury Assessment (Bottlenose dolphin)

5.4.4.32 As outlined in paragraph 5.4.4.7, the CO for the Hook Head SAC are to maintain species range within the site (access to suitable habitat) and to maintain human activities below levels which would adversely affect the bottlenose population at the site (disturbance).

5.4.4.33 As UXO clearance and the associated underwater noise (which would potentially cause auditory injury) will be short-term and temporary (i.e. a one-off explosion) it will not permanently prevent bottlenose dolphins from accessing the site. Due to the distance between the proposed development and the SAC there will be no impact on the habitat use or disturbance within the SAC.

5.4.4.34 PTS may affect individuals associated with the site that are found within the vicinity of the proposed development; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive or reproduce). Therefore, UXO clearance activities at the proposed development will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the population of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.35 Therefore, it is concluded that auditory injury (e.g. PTS) arising from UXO clearance will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.36 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.4.37 There is a lack of guidance on assessing behavioural impacts to marine mammals as a result of UXO clearance. Given 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.

5.4.4.38 JNCC guidance (2020) states 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 would be expected to be significantly less than that associated with piling which was assessed above as having no AEoI to bottlenose dolphin QI of Hook Head SAC. Therefore, with a shorter duration (in most cases single pulse events), this activity is not expected to affect foraging behaviour for an extended time period (e.g. no longer than minutes).

Underwater Noise from UXO – Disturbance Assessment (Bottlenose dolphin)

5.4.4.39 As outlined in paragraph 5.4.4.7, the CO for the Hook Head SAC are to maintain species range within the site (access to suitable habitat) and to maintain human activities below levels which would adversely affect the bottlenose population at the site (disturbance).

5.4.4.40 Whilst underwater noise generated from UXO clearance may result in a startle reaction, given the nature of the activity (i.e. extremely short in duration) it is unlikely to cause displacement, but if it did, it is expected to be very short term (e.g. hours). Therefore, in line with NPWS (2012b), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity) and as such will not permanently prevent bottlenose dolphins assessing the site.

5.4.4.41 Some individuals within, or associated with, the site may be disturbed and displaced by the underwater noise arising from UXO clearance activities; however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage). Therefore, underwater noise arising from UXO clearance activities are not expected to introduce man-made energy at levels that could result in a significant impact on individuals and/or the population of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.42 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.

5.4.4.43 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from other noise sources (Construction Phase): Bottlenose dolphin

Auditory Injury

5.4.4.44 Non-impulsive noise (or continuous noise) sources resulting from works during construction, including cable laying, dredging (backhoe/suction), drilling, rock placement and trenching and pre-construction surveys. There is limited information on the response of bottlenose dolphin to non-impulsive noise sources, with most studies focusing on impulsive noise sources such as pile driving and seismic surveys using airguns. The impact ranges for non-impulsive noise sources are considered using a pre-cautionary assessment scenario of constant operations for 24-hours (see Underwater noise assessment).

5.4.4.45 The PTS-onset ranges with non-impulsive (i.e. excluding piling and UXO clearance) weighted SEL_{cum} thresholds would require bottlenose dolphins to be closer than 100 m from the continuous noise source at the start of the activity to acquire the necessary noise exposure to induce PTS. These modelling results assume that bottlenose dolphins are either fleeing (at 1.5 m/s) or stationary. It is important to note that model resolution is such that impact ranges of less than 100 m cannot be reliably determined; therefore, values reported <100 m may be considerably less than this.

5.4.4.46 The hearing sensitivity of bottlenose dolphins below 1 kHz is relatively poor, considering its estimated region of peak sensitivity ranges between 8.8 kHz and 110 kHz (Southall *et al*., 2007). Any auditory injury arising from such low frequency sounds would result in little impact to cetacean vital rates due to the impacted frequency ranges from these sound sources (as discussed in paragraph 5.4.1.40).

5.4.4.47 A study analysing the impacts of dredging on bottlenose dolphins, found that higher intensities of dredging caused bottlenose dolphin to spend less time in the area; however, this effect was only temporary (Pirotta *et al*, 2013). Another study determined that response varied depending on the site, with dolphins either remaining or being absent (Marley *et al.,* 2017), which suggests that the response may be context specific (i.e. some sites being ecologically more important than others).

5.4.4.48 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 36.5 m (CSA 2020). It is expected that the displacement effect caused by the presence of the vessels used for these works (e.g. Benhemma-Le Gall *et al*., 2023) will be greater than the likelihood of individuals experiencing cumulative PTS onset from 3D UHRS (sparker) equipment and other construction activities (i.e. non-impulsive) underwater noise sources.

5.4.4.49 In addition, the MMMP includes a number of preventative and avoidance measures (listed in Table 223) to mitigate against any potential impacts to marine mammals associated with the use of 3D UHRS (sparker) equipment.

Underwater Noise from other sources – Auditory Injury Assessment (Bottlenose dolphin)

5.4.4.50 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities which would adversely affect the bottlenose dolphin populations at the site (disturbance).

5.4.4.51 As underwater noise from other construction activities sound sources (which could potentially cause auditory injury) will be relatively short-term, temporary and has a small ZoI (<100 m), it will not permanently prevent access to the site.

5.4.4.52 PTS may affect individuals associated with the site; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, underwater noise form other (non-impulsive) sound sources will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the population of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.53 Therefore, it is concluded that auditory injury (i.e. PTS) arising from underwater noise from other construction activities (i.e. 3D UHRS and non-impulsive) sound sources will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.54 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.4.55 There is limited information on disturbance impacts from other (i.e. non-impulsive) sound sources during construction activities including cable laying, trenching, drilling and rock placement. However, construction activities are expected to operate at frequencies within the hearing range of bottlenose dolphins (Southall *et al.,*2019). Due to the nature of the offshore works, they are often mobile and intermittent; therefore, the impact within any specific area will be very temporally limited.

5.4.4.56 A review of potential effects of various cable types and installation methods including burial ploughs, machines, ROVs and sleds and the burial methods themselves including jetting, rock ripping, and dredging, used in the offshore wind farm industry concluded that it would be “highly unlikely that cable installation would produce noise at a level that would cause a behavioural reaction in marine mammals” (BEER and DEFRA 2008). Considering this, the area of disturbance as a result of the project activities identified above is considered to be small in relation to the localised range of impact of the proposed development (spatially and temporally), mobile nature of the receptor and large distribution range of the bottlenose dolphin populations within the Irish Sea MU.

5.4.4.57 Pirotta *et al*. (2013) found that higher intensities of dredging at Aberdeen Harbour (Scotland) caused bottlenose dolphin to spend less time in the area. Initially, bottlenose dolphins were absent from the area for a period up to five weeks; however, over the course of dredging works lasting three years, the disturbance effect reduced and this effect was only temporary towards the end of the construction period. Subsequent studies by Pirotta *et al*. (2015) assumed that dredging activities excluded dolphins from a 1 km radius from the dredging site.

Underwater Noise from other sources – Disturbance Assessment (Bottlenose dolphin)

5.4.4.58 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin populations at the site (disturbance).

5.4.4.59 Whilst underwater noise generated from other (i.e. non-impulsive) sound sources may result in temporary exclusion of bottlenose dolphins from an area, Hook Head SAC is located significantly further than any ZoI from non-impulsive noise sources. Therefore, in line with NPWS (2012b), this would not be considered a permanent barrier to the use of the site (due to the temporary nature of the activity and distance between the site and the proposed development) and as such will not permanently prevent bottlenose dolphin access to the site.

5.4.4.60 Some individuals associated with the site may be disturbed or displaced by underwater noise arising from other (i.e. 3D UHRS and non-impulsive) sound sources within the proposed development boundary; however, given the relatively short-term and localised nature of the activities, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, underwater noise form other (non-impulsive) sound sources will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the population of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.61 Therefore, it is concluded that disturbance arising from other (i.e. 3D UHRS and non-impulsive) sound sources related construction activities will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.62 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise (Decommissioning Phase): Bottlenose dolphin

Auditory Injury and Behavioural Disturbance

5.4.4.63 Decommissioning of offshore infrastructure for the proposed development (Offshore) may result in temporarily elevated underwater noise levels which may have effects on marine mammals. These elevated noise levels may be due to increased vessel movements and removal of the WTGs with the resulting noise levels dependant on the method used for removal of the foundation. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during the decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. It is envisaged that, where appropriate, buried assets such as cables will be left in situ when the project is decommissioned.

5.4.4.64 As outlined in the Decommissioning and Restoration Plan, the exact methods to be adopted during decommissioning are yet to be confirmed; therefore, the respective impact level of PTS 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 less than those at the construction phase, given there is no requirement for piling prior to decommissioning.

Underwater Noise from Decommissioning Assessment (Bottlenose dolphin)

5.4.4.65 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.66 Auditory injury (i.e. PTS) and disturbance as a result of underwater noise associated with the decommissioning phase will be short-term and temporary and will not permanently prevent bottlenose dolphins from accessing the site. Should any auditory injury or disturbance occur to bottlenose dolphins associated with Hook Head SAC, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce). Therefore, activities associated with decommissioning phase will not introduce man-made energy at levels that could result in a significant impact on individuals and/or the populations of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.67 Therefore, it is concluded that underwater noise from activities during the decommissioning will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.68 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Collision risk (Construction phase, O&M and decommissioning): Bottlenose dolphin

5.4.4.69 Bottlenose dolphins are deemed to be of low vulnerability to vessel collision, based on post-mortem examinations of stranded animals and given the species is small and highly mobile, individuals are expected to be able to avoid collision with vessels. However, should a collision event occur, this has the potential to kill the animal.

5.4.4.70 As outlined in paragraph 5.4.1.61, construction vessels are large, slow moving and stationary for long periods, with the most frequent movements being from CTVs and support vessels transiting between the site and the port. Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP. In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals.

Vessel Collision Assessment (Bottlenose dolphin)

5.4.4.71 As outlined in paragraph 5.4.4.7, the COs for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.72 Individuals within the SAC have no risk of vessel collision with vessels associated with the proposed development as it does not lie within proposed transit routes; however, individuals associated with the site could in theory be at risk of collision. With the implementation of a code of conduct within the environmental VMP vessel movements to and from construction sites and ports will, where feasible, follow existing routes, with the implementation of predefined vessel routes and the slow speed of the vessels when on site (as stipulated in the environmental VMP), the risk of vessel collision is limited to the footprint of the vessel and reduces risk of fatalities. As vessels will only be on site temporarily, they should not restrict access to suitable habitat and will not be an artificial barrier. Therefore, the presence of vessels associated with the project will not result in a significant impact on individuals and/or the populations of bottlenose dolphins within the site, or indeed, connected to the site.

5.4.4.73 Therefore, it is concluded that collision risk arising from vessel presence will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.74 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance (Construction, O&M and decommissioning): Bottlenose dolphins

5.4.4.75 Vessel disturbance to marine mammals is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta *et al*., 2015). As it is often difficult, if not impossible, to attribute whether individuals are responding to the noise of the vessel and/or the presence of the vessel, both are considered within the assessment of vessel disturbance.

5.4.4.76 Studies on the interactions of bottlenose dolphins with vessels have shown various responses. In the Moray Firth, a passive acoustic monitoring study showed that the presence of vessels resulted in a short-term reduction in foraging activity by 49%, with animals resuming foraging after the vessel had travelled through the area, suggesting that disturbance was limited to the time the vessel was physically present (Pirotta *et al*., 2015). This was the first study to conclusively show that boat physical presence, not just noise, plays a large role in disturbance of bottlenose dolphins. A number of studies have shown behavioural effects from vessel disturbance to include disruption of socialisation and resting behaviours and changes in vocalisation patterns (Koroza and Evans, 2022; Lusseau, 2003; Pellegrini *et al.,* 2021; Pirotta *et al*., 2015). Repeated disruptions may result in an overall reduced energy intake.

5.4.4.77 In a modelling study by Lusseau *et al.* (2011), it was predicated that increased vessel movements associated with offshore wind development in the Moray Firth did not have a negative effect on the local population of bottlenose dolphins, although it did note that foraging may be disrupted by disturbance from vessels.

5.4.4.78 Bottlenose dolphin can tolerate vessel disturbance, particularly in areas where vessel traffic has always been high (Pirotta *et al*., 2013). For example, during the construction works of an oil pipeline in Broadhaven Bay, northwest Ireland, the presence of bottlenose dolphin was positively correlated with overall vessel number (Anderwald *et al*., 2013). However, it was unclear whether the bottlenose dolphins were attracted to the vessels themselves or to particularly high prey concentrations within the study area at the time (Anderwald *et al.,* 2013).

5.4.4.79 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).

Vessel Disturbance Assessment (Bottlenose dolphin)

5.4.4.80 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.81 Vessel presence will be temporary and localised within the proposed development and transit corridors. Therefore, vessels associated with the proposed development will not permanently prevent bottlenose dolphins from accessing the site. If vessels do disturb bottlenose dolphin associated with the site, it 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.

5.4.4.82 Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.83 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Effects on prey (Construction, O&M and decommissioning Phase): Bottlenose dolphins

5.4.4.84 The key prey species of bottlenose dolphins in Ireland include bottom dwelling fish or larger pelagic fish such as salmon, plaice, eels, small sharks, rays, hermit crabs, shrimps and mullet (Berrow *et al.,* 2010). Bottlenose dolphins in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species.

5.4.4.85 As noted in paragraph 5.4.1.71, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014). 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.

Effects on Prey Assessment (Bottlenose dolphin)

5.4.4.86 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.87 Any changes to the fish communities that bottlenose dolphins depend on will be temporary and localised and will not permanently prevent bottlenose dolphins from accessing the site. Any potential changes to prey as a result of activities relating to the construction, O&M and decommissioning phases will not result in a significant impact on individuals and/or the population of bottlenose dolphin within the site, or indeed, connected to the site.

5.4.4.88 Therefore, it is concluded that changes in prey will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.89 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Accidental Pollution (Construction, O&M, decommissioning and O&M Base): Bottlenose dolphin

5.4.4.90 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP) and detailed in Table 223. With these avoidance and preventative 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.

Accidental Pollution Assessment (Bottlenose dolphin)

5.4.4.91 As outlined in paragraph 5.4.4.7, the CO for the SAC are to maintain species range within the site (access to suitable habitat) and maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

5.4.4.92 Any accidental pollution event, should one occur, is expected to be temporary and localised and will not permanently prevent bottlenose dolphins from accessing the site. Individuals associated with the site may be impacted by an accidental pollution event, should one occur; however, given the temporary and localised nature of such an event, it will not result in a significant impact on individuals and the population of bottlenose dolphin within the site, or indeed, connected to the site.

5.4.4.93 Therefore, it is concluded that accidental pollution will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

5.4.4.94 The same mitigation measures regarding the Marine Pollution Contingency Plan (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

All impact pathways Assessment (Harbour Porpoise)

5.4.4.95 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 the site-specific COs for harbour porpoise at Hook Head are the same as those for Rockabill to Dalkey Island SAC, the conclusions of the latter assessment are applicable to Hook Head SAC.

5.4.4.96 The assessment of Rockabill to Dalkey Island SAC (which overlaps with the offshore ECC and lies 1.8 km inshore of the array area) concluded no AEoI on harbour porpoise QIs for all screened-in impacts. Given that Hook Head SAC is farther located from the proposed development, it is considered that the potential for AEoI is the same or reduced for this site.

5.4.4.97 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.

5.4.5 Pen Llŷn a'r Sarnau SAC

5.4.5.1 Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC (hereafter referred to as the Pen Llŷn a'r Sarnau SAC) is 78 km across the Irish Sea from the array area and 82 km from the offshore ECC. The following QI have been screened in for further assessment:

- Bottlenose dolphin; and
- Grey seal.

Bottlenose dolphin

5.4.5.2 Bottlenose dolphins within the Irish Sea Management Unit, within the Pen Llŷn a`r Sarnau SAC, have an estimated abundance of 293 dolphins (95% CI: 108 – 793, CV: 0.54; estimated using data from SCANS III and ObSERVE; IAMMWG 2023).

5.4.5.3 The bottlenose dolphins within the Pen Llŷn a`r Sarnau SAC are considered of significant importance within the site but do not appear to form a semi-resident group and should be seen as part of a wider population that ranges across waters of the Irish Sea and includes the Cardigan Bay SAC. It is also clear that connectivity between Cardigan Bay, the Llŷn Peninsula, around Anglesey and east towards Liverpool Bay exists. Within the SAC itself, activity appears focused in Tremadog Bay, at the entrances to estuaries and close to some of the Sarnau reefs, indicating that the catchments of the freshwater tributaries entering the site together with the offshore reefs contribute to the overall site integrity for the species. Food resources appear to be a primary factor in determining movements and site fidelity in bottlenose dolphins, with the SAC containing important potential feeding areas (NRW, 2018).

Grey Seal

5.4.5.4 Grey seals present within the site at any one time do not form a discrete population and are considered part of the SW England and Wales MU (NRW, 2018). This population itself is not isolated but extend from SW Scotland to SW England and SE Ireland. Individuals have been photographically recaptured among these regions, and satellite tracked individuals have been tracked to/from France, west coast of Scotland and Ireland (Cronin, 2011).

5.4.5.5 The SAC contains a number of important pupping sites for the grey seals concentrated around the north-west of the SAC including Bardsey Island and a high proportion within caves and secluded coves. There is currently only limited information available on annual pup production within the SAC, with the main period of pup production in North Wales ranging from early August to December. Seals haul-out in small groups in undisturbed locations within the site with some overlap of pupping and non-pupping haul-out sites. Moulting and resting haul-out sites are distributed throughout the SAC and non-pupping seals are present year-round (NRW, 2018).

5.4.5.6 Grey seals range throughout the open coasts of the site but are more commonly observed within the SAC around the Llŷn, Bardsey Island and the islands along the south Llŷn coast. In 2002 grey seal numbers were tentatively estimated at 365 based on pup data and calculations. However, the number of grey seals present in the waters of North Wales at all haul-out sites was, at all times, greater than this, with no less than 700-750 seals in winter and the maximum figure (June, July, August) at around 800 (NRW, 2018).

Conservation Objectives of Qualifying Interests

5.4.5.7 As the Pen Llŷn a’r Sarnau SAC is located in the UK the CO for bottlenose dolphin and grey seal differ from the sites located in Ireland. The CO to maintain the favourable conservation condition of the bottlenose dolphin and grey seal within the Pen Llŷn a’r Sarnau SAC, are defined by the following list of attributes and targets (NRW, 2018):

- Populations: The bottlenose dolphin and grey seal populations are maintained on a long-term basis as viable components of their natural habitat. Important elements include:
    - Population size;

- Structure/production;
- Condition of the species within the site;
- Ensuring contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression; and
- Specifically, for grey seal populations should not be reduced as a consequence of human activity.

- Range: 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 for both bottlenose dolphin and grey seal,
  - 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.
- Supporting habitats and species: The presence, abundance, condition and diversity of habitats and species required to support both these 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.
- Restoration and Recovery: Specifically for bottlenose dolphin, populations should be increasing.

Assessment of effects -Pen Llŷn a`r Sarnau SAC

Underwater noise from piling (Construction phase): Bottlenose dolphin

Auditory Injury

5.4.5.8 For the WTG monopile foundation installation of 13 m piles with a maximum blow energy of 6,372 kJ, with piling mitigation in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury PTS-onset impact range for bottlenose dolphin and grey seal from mitigated piling was less than 50 m for the installation of a monopile at both the NE and SE modelling locations. Considering the cumulative PTS-onset (weighted SEL_{cum}) thresholds, individuals within 100 m from the NE monopile location at the start if piling, could accumulate noise exposure in excess of the criteria. Given that the SAC lies 78 km away from the array area, these impact ranges would result in no overlap with the SAC.

5.4.5.9 While for the WTG jacket pile foundation installation of 5.75 m piles with a maximum blow energy of 4,695 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20), the maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for bottlenose dolphin and grey seal was less than 50 m for the installation of a pin piles at both the NE and SE modelling locations. Cumulative PTS onset from four sequential piles is predicted to occur if individuals were located less than 100 m from either of the NE and SE modelling locations. Given the SAC lies 78 km away from the array area, this means there is no predicted overlap with the SAC.

5.4.5.10 Given that the range of available habitat for bottlenose dolphin and grey seal is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. However, it is possible that individuals or groups of bottlenose dolphin or grey seal could use the proposed development site which could expose them to this impact. If PTS were to occur as a result of piling noise, it is expected to result in a “notch” of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts to the fitness of individual bottlenose dolphins, for either adults or calves (Booth *et al*., 2019).

5.4.5.11 In addition to noise abatement systems (which enable a noise reduction of at least 10 dB), the MMMP includes a number of preventive and avoidance measures (outlined in Table 223) to mitigate against instantaneous injury to marine mammals associated with pile driving by ensuring no activity commences if a marine mammal is within the 1000 m mitigation zone, therefore no harbour porpoise should be within PTS ranges prior to pile driving commencement.

5.4.5.12 Consequently, given the predicted impact distances are less than 100 m, and considering the mitigation measures that will be in place, the risk of PTS to any individual bottlenose dolphin to considered negligible.

Underwater Noise from piling – Auditory Injury Assessment (Bottlenose dolphin)

5.4.5.13 As outlined in paragraph 5.4.5.7, the CO for the SAC relevant to impacts from underwater noise for bottlenose dolphin are related to their population range within the site and the management of activities likely to adversely affect species.

5.4.5.14 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 6 dB PTS in the frequency range between 2 and 10 kHz (Booth *et al.*, 2019).

5.4.5.15 PTS 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 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. Additionally, it is not predicted to adversely affect bottlenose dolphin in such a way that maintaining it as favourable condition in the long term would be impacted. It is considered that there will be no impact to the bottlenose dolphin QI of the SAC from underwater noise.

5.4.5.16 Therefore, it is concluded that auditory injury (i.e. PTS) arising from pile driving will not result in an AEoI to the bottlenose dolphin QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.17 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise from piling – Auditory Injury Assessment (Grey Seal)

5.4.5.18 As outlined in paragraph 5.4.5.7, the CO for the SAC relevant to impacts from underwater noise for grey seal are related to their population, population range within the site and the management of activities likely to adversely affect species.

5.4.5.19 The proposed development lies within the typical foraging range for grey seals as detailed above (paragraph 5.4.5.4). However, 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. It is likely that grey seals within the array area and offshore ECC have greatest connectivity to Lambay Island SAC, the nearest SAC with grey seals as a QI, compared to the more distant SACs.

5.4.5.20 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). 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 6 dB PTS in the range of 2 to 10 kHz (Booth *et al.*, 2019).

5.4.5.21 Due to their similar physiology, both grey and harbour seals are assessed under the same hearing range and are therefore presumed to have the same impact range for auditory injury.

5.4.5.22 As identified above, the relevant CO for the SAC for impacts arising from underwater noise is population, population range within the site and the management of activities likely to adversely affect species. PTS 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 population at the site. Specifically, the onset of PTS 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 grey seal QIs of the SAC from underwater noise.

5.4.5.23 Therefore, it is concluded that auditory injury arising from piling will not result in an AEoI to the grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.24 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.5.25 The impact range of Level B harassment threshold is predicted to occur out to a maximum distance of 13 km at NE location considering the monopile foundation scenario, and 12 km at NE location considering the pin-pile foundation scenario, as listed in Underwater noise assessment. As Pen Llŷn a'r Sarnau SAC is 78 km away from the array area, it is expected that no bottlenose dolphin or grey seal within the SAC will be impacted by behavioural disturbance from piling noise. Any disturbance effects will be limited to mobile individuals found outside of the SAC.

5.4.5.26 In view of the limited data available for assessing behavioural disturbance from piling noise on marine mammals, the NOAA (2005) Level B harassment threshold for impulsive noise on marine mammals has been considered for quantifying such disturbance effect on this SAC. 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 160 dB re1µPa (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).

5.4.5.27 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).

5.4.5.28 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 45 km from the pile location, while other grey seals showed no response within 12 km. 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.

5.4.5.29 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.

Underwater Noise from piling – Disturbance Assessment (Bottlenose dolphin)

5.4.5.30 Impacts from underwater noise are only considered relevant for the COs on population range within the site and the management of activities likely to adversely affect species.

5.4.5.31 Disturbance may affect individuals 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 underwater noise.

5.4.5.32 Therefore, it is concluded that disturbance arising from piling will not result in an AEoI to the bottlenose dolphin QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.33 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise from piling – Disturbance Assessment (Grey seal)

5.4.5.34 Impacts from underwater noise are only considered relevant for population range within the site and disturbance by human activity.

5.4.5.35 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, 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 seal QIs of the SAC from underwater noise.

5.4.5.36 Therefore, it is concluded that disturbance arising from piling will not result in an AEoI to the grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.37 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from UXO clearance (Construction phase)

Auditory Injury

5.4.5.38 Explosives have the potential to cause injury or mortality in the immediate vicinity (e.g. <50 m; Danil and Leger, 2011) from either blast induced trauma (i.e. shock wave) or auditory impacts (i.e. sound wave). Most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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). A PTS in hearing is expected to result in a “notch” of reduced hearing sensitivity in exposed individuals within the frequency range of the sound. In the case of UXO clearance this would be in the low frequency component of the species hearing range, which is unlikely to significantly affect the fitness of individuals (i.e. it’s ability to survive and reproduce; see paragraph 5.4.1.40).

5.4.5.39 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 (Underwater noise assessment). The maximum PTS impact range of UXO clearance on bottlenose dolphins is estimated to be 0.73 km, when considering the unweighted SPL_{peak} criteria, with maximum equivalent charge weights of 525 kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of ‘high-order’ clearance technique. The maximum PTS impact range of UXO clearance on grey seal is 2.5 km. There is no spatial overlap between this SAC and the PTS-onset impact ranges of UXO clearance works on bottlenose dolphins and grey seal. These impact ranges are considered to be precautionary due to limitations in the modelling parameters.

5.4.5.40 Notwithstanding the low risk of PTS resulting in any biologically relevant effects to bottlenose dolphin and grey seal, the MMMP includes a number of preventive and avoidance measures (outlined in Table 223) to mitigate against any potential impacts to marine mammals associated with UXO detonation.

5.4.5.41 In particular, prior to any high-order detonations, at-source noise mitigation methods, such as a bubble curtain, will be used to minimise the potential PTS-onset range. 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. Should low order clearances methods be used, as is the preferred method for the project, then the PTS-onset range will scale with the size of the donor charge rather than the UXO, and be considerably smaller than from high order clearance. Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual bottlenose dolphin and/or grey seals to negligible.

Underwater Noise from UXO clearance – Auditory Injury Assessment (Bottlenose dolphin)

5.4.5.42 The relevant COs 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.

5.4.5.43 PTS 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 population at the site. Specifically, PTS-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 UXO clearance.

5.4.5.44 Therefore, it is concluded that auditory injury arising from UXO clearance will not result in an AEoI to the bottlenose dolphin QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.45 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise from UXO – Auditory Injury Assessment (Grey seal)

5.4.5.46 As identified above, the relevant CO for the SAC for impacts arising from underwater noise is population, population range within the site and the management of activities likely to adversely affect species.

5.4.5.47 PTS 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, the onset of PTS 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 grey seal QIs of the SAC from underwater noise.

5.4.5.48 Therefore, it is concluded that auditory injury arising from UXO clearance will not result in an AEoI to the grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.49 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.5.50 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, or a fixed 26 km range (e.g. JNCC, NE, and DEARA, 2022), although the 26 km range was specifically focused on harbour porpoise and so may not be relevant to bottlenose dolphin and grey seal. However, considering the highly mobile nature of these 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.

5.4.5.51 The Pen Llŷn a`r Sarnau SAC is greater than 26 km from the proposed development, therefore there is predicted to be no spatial overlap between disturbance from UXO activity and the site. Nonetheless, bottlenose dolphin and grey seal may still be affected by disturbance from UXO clearance outside their site boundary.

5.4.5.52 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 dolphin and grey seal.

Underwater Noise from UXO – Disturbance Assessment (Bottlenose dolphin)

5.4.5.53 Impacts from underwater noise from UXO are only considered relevant for bottlenose dolphin population range within the site and disturbance by human activity.

5.4.5.54 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 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 UXO clearance.

5.4.5.55 Therefore, it is concluded that disturbance arising from UXO clearance will not result in an AEoI to the bottlenose dolphin QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.56 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise from UXO – Disturbance Assessment (Grey seal)

5.4.5.57 Impacts from underwater noise from UXO are only considered relevant for grey seal population range within the site and disturbance by human activity.

5.4.5.58 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, disturbance from underwater noise generated by UXO clearance 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 grey seal QIs of the SAC from UXO clearance.

5.4.5.59 Therefore, it is concluded that disturbance arising from UXO clearance will not result in an AEoI to the grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.60 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise (Decommissioning Phase)

Auditory Injury and Behavioural Disturbance

5.4.5.61 Decommissioning of offshore infrastructure for the proposed development (Offshore) may result in temporarily elevated underwater noise levels which may have effects on marine mammals. These elevated noise levels may be due to increased vessel movements and removal of the WTGs with the resulting noise levels dependant on the method used for removal of the foundation. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during the decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. It is envisaged that, where appropriate, buried assets such as cables will be left in situ when the project is decommissioned.

5.4.5.62 As outlined in the Decommissioning and Restoration Plan, the exact methods to be adopted during decommissioning are yet to be confirmed; therefore, the respective impact level of PTS 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 less than those from construction, given there is no requirement for piling prior to decommissioning.

5.4.5.63 If PTS were to occur as a result of activities during the decommissioning phase, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; Kastelein *et al.*, 20175.4.1.40). Specifically, any auditory injury 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. As such the risk of auditory injury (i.e. PTS) and disturbance to any individual grey and/or harbour seals is considered **negligible** during noise-generating activities undertaken during the decommissioning phase.

Underwater Noise from Decommissioning Assessment (Bottlenose dolphin and Grey seal)

5.4.5.64 As identified above, the relevant COs for the SAC for impacts arising from underwater noise is to the population is maintained, population range within the site and managing effects from human activity. PTS 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 population at the site. Specifically, the onset of PTS 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.

5.4.5.65 Therefore, it is concluded that auditory injury by underwater noise from decommissioning will not result in an AEoI to the bottlenose dolphin and grey seal feature of the Pen Llŷn a`r Sarnau SAC.

5.4.5.66 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Collision Risk (Construction phase, O&M and decommissioning)

5.4.5.67 Impacts from vessels are only considered relevant for the population CO (addressing the risk of injury). Vessels do not have the potential to impact bottlenose dolphin and grey seal within the site, and so affect the range CO, due to the distance between the proposed development and the SAC.

5.4.5.68 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 RoI to suggest that vessel collisions 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.

5.4.5.69 The bottlenose dolphin and grey seal are 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.

5.4.5.70 The majority of construction, O&M and decommissioning 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. Avoidance and preventative measures in the form of a code of conduct will be implemented by all vessel operators when encountering marine species. The code of conduct will be referenced within the environmental VMP. In addition, vessel movements to and from construction sites and ports during the lifetime of the project will, where feasible, follow existing routes to reduce the risk of injury and disturbance to marine mammals

Vessel Collision Assessment (Bottlenose dolphin and Grey seal)

5.4.5.71 The population CO addresses the risk of injury. The increase in number of vessels during all phases (and the relevant project mitigation) and the increased vessel traffic associated with construction (and decommissioning) of the project is insufficient to result in an increase in the risk of mortality or injury in marine mammals as a result of collisions. That assessment applies equally to bottlenose dolphin and grey seal associated with the Pen Llŷn a`r Sarnau SAC, given the localised nature of any effect together with the location of that effect relative to the SAC.

5.4.5.72 Individuals within or associated with the site could in theory be at risk of vessel collision; however with the implementation of a code of conduct within the environmental VMP vessel movements to and from construction sites and ports will, where feasible, follow existing routes, with the implementation of predefined vessel routes and the slow speed of the vessels when on site (as stipulated in the environmental VMP), the risk of vessel collision is limited to the footprint of the vessel and reduces risk of fatalities.

5.4.5.73 Therefore, it is concluded that collision risk arising from vessel presence will not result in an AEoI to bottlenose dolphin or grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.74 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance (Construction, O&M and decommissioning): Bottlenose dolphin and Grey seal

5.4.5.75 Vessel disturbance to marine mammals is driven by a combination of underwater noise and the physical presence of the vessel itself (e.g. Pirotta *et al*., 2015). As it is often difficult, if not impossible, to attribute whether individuals are responding to the noise of the vessel and/or the presence of the vessel, both are considered within the assessment of vessel disturbance.

5.4.5.76 Studies on the interactions of bottlenose dolphins with vessels have shown various responses. In the Moray Firth, a passive acoustic monitoring study showed that the presence of vessels resulted in a short-term reduction in foraging activity by 49%, with animals resuming foraging after the vessel had travelled through the area, suggesting that disturbance was limited to the time the vessel was physically present (Pirotta *et al*., 2015). However, dolphin behavioural disturbance was temporary and foraging activities quickly resumed as boats moved away This was the first study to conclusively show that boat physical presence, not just noise, plays a large role in disturbance of bottlenose dolphins. A number of studies have shown behavioural effects to include disruption of socialisation and resting behaviours and changes in vocalisation patterns (Koroza and Evans, 2022; Lusseau, 2003; Pellegrini *et al.,* 2021; Pirotta *et al*., 2015). Repeated disruptions may result in an overall reduced energy intake.

5.4.5.77 In a modelling study by Lusseau *et al.* (2011), it was predicated that increased vessel movements associated with offshore wind development in the Moray Firth did not have a negative effect on the local population of bottlenose dolphins, although it did note that foraging may be disrupted by disturbance from vessels.

5.4.5.78 Bottlenose dolphin can tolerate vessel disturbance, particularly in areas where vessel traffic has always been high (Pirotta *et al*., 2013). For example, during the construction works of an oil pipeline in Broadhaven Bay, northwest Ireland, the presence of bottlenose dolphin was positively correlated with overall vessel number (Anderwald *et al*., 2013). However, it was unclear whether the bottlenose dolphins were attracted to the vessels themselves or to particularly high prey concentrations within the study area at the time (Anderwald *et al.,* 2013).

5.4.5.79 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)

5.4.5.80 Vessel disturbance studies on seals have demonstrated flushing of seals (Jansen *et al*., 2015) in response to large vessels occurring out as far as 1 km (Young *et al*., 2014), and alertness in seals at haul outs increased when small vessels are within 300 m of a seal (Henry and Hammill, 2001). It is noted that the SAC is situated more than 1 km 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, 2021), 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 present around the SAC.

5.4.5.81 In addition, grey 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.

5.4.5.82 As a precautionary approach, a 1 km disturbance range of vessel presence has been used to determine the magnitude of impact. It is estimated that no grey seal within this SAC will experience disturbance from vessel presence as the 1 km impact range does not overlap with the SAC; though animal associated with the SAC, outside the boundary, may be affected. 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.

5.4.5.83 As part of the construction phase of the project, vessel management procedures will be implemented, which will comprise defined routes for construction 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.

Vessel Disturbance Assessment (Bottlenose dolphin and Grey seal)

5.4.5.84 The first two COs are relevant to the risk of disturbance from vessels, in that it may affect the population or range of the features. CO 3 is focused on maintaining the supporting habitats and processes, together with availability of prey, within the Pen Llŷn a'r Sarnau SAC. Disturbance from vessel presence does not have the potential to affect such habitats or processes.

5.4.5.85 Vessel presence will be temporary and localised and will not permanently prevent bottlenose dolphin or grey seal accessing the site. Individuals associated with the site may be disturbed by the presence of vessels; however, vessel presence (given the temporary and localised nature of the activities) will not result in a significant impact on individuals and/or the community of bottlenose dolphin or grey seal.

5.4.5.86 Furthermore, 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.

5.4.5.87 Vessel presence will be temporary and localised within the proposed development and transit corridors. Therefore, vessels associated with the proposed development will not permanently prevent bottlenose dolphins and grey seals from maintaining their natural range within the site.

5.4.5.88 Therefore, it is concluded that vessel disturbance from the project alone during construction, O&M and decommissioning will not result in an AEoI to the bottlenose dolphin or grey seal for the Pen Llŷn a'r Sarnau SAC.

5.4.5.89 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Effects on prey (Construction Phase, O&M and decommissioning)

5.4.5.90 The key prey species of bottlenose dolphins in Wales include mackerel, seabass, herring and whiting (Pesante *et al*., 2008; Nuuttila *et al.,* 2017). Bottlenose dolphins in this assessment are considered to be generalist feeders and are thus not reliant on a single prey species. 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 bottlenose dolphin and seals diet, in this assessment they are considered to be generalist feeders and are thus not reliant on a single prey species.

5.4.5.91 As noted in paragraph 5.4.1.71, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014). Not all prey species are sensitive to underwater noise, and so the prey community as a whole is unlikely to be affected by underwater noise impacts. As for bottlenose dolphin and grey seal, 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.

Effects on Prey Assessment (Bottlenose dolphin and Grey Seal)

5.4.5.92 Conservation Objective 3 is focused on maintaining the supporting habitats and processes, together with availability of bottlenose dolphin and grey seal prey, within Pen Llŷn a'r Sarnau SAC.

5.4.5.93 Any changes to the fish communities that bottlenose dolphin or grey seal depend on will be temporary and localised and will not permanently prevent individuals range within the site. Any potential changes to prey as a result of activities relating to the construction, O&M and decommissioning phases will not result in a significant impact on individuals and/or the community of bottlenose dolphin or grey seal within the site, or indeed, connected to 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.

5.4.5.94 Therefore, it is concluded that changes in prey will not result in an AEoI to the bottlenose dolphin or grey seal feature of the Pen Llŷn a'r Sarnau SAC.

5.4.5.95 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative design option scenario would not give rise to an effect which is more significant than has been assessed herein.

Accidental Pollution (Construction, O&M, decommissioning and O&M Base)

5.4.5.96 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.

5.4.5.97 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (see Table 223). With these avoidance and preventative 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.

Accidental Pollution Assessment (Bottlenose dolphin and Grey seal)

5.4.5.98 The relevant COs for the SAC are to maintain the species population, range, and supporting habitats in the site. All the COs may be affected directly or indirectly through accidental pollution events.

5.4.5.99 Accidental pollution has the potential to possibly indirectly result in changes to prey if an incident occurred. However, 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 marine mammals depend on or cause death or injury to individuals to an extent that may ultimately affect the bottlenose dolphin and grey seal prey population within the site. It is considered that there will be no impact to the bottlenose dolphin and grey seal feature of the SAC from accidental pollution.

5.4.5.100 Any accidental pollution event, should one occur, is expected to be temporary and localised and will not permanently prevent bottlenose dolphin or grey seals from accessing the site. Individuals within or associated with the site may be impacted by an accidental pollution event, should one occur, however, given the temporary and localised nature of such an event, it will not result in a significant impact on individuals and the population of bottlenose dolphin or grey seals within the site, or indeed, connected to the site.

5.4.5.101 Therefore, it is concluded that accidental pollution will not result in an AEoI to the bottlenose dolphin and grey seal QI of the Pen Llŷn a`r Sarnau SAC.

5.4.5.102 The same mitigation measures regarding the Marine Pollution Contingency Plan would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

5.4.6 North Anglesey Marine SAC

5.4.6.1 North Anglesey Marine SAC is 42.7 km from the array area and 38.2 km from the offshore ECC. The following QI have been screened in for further assessment:

- Harbour porpoise.

Conservation Objectives of Qualifying Interests

5.4.6.2 As the North Anglesey Marine SAC is located in the UK the CO for harbour porpoise differ from the sites located in Ireland.

5.4.6.3 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.

5.4.6.4 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.

Assessment of effects -North Anglesey Marine SAC

Underwater noise from piling (Construction phase): Harbour Porpoise

Auditory Injury

5.4.6.5 The JNCC Advice notes the following relevant points as regards to harbour porpoise population, numbers and viability within the site:

'The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent deterioration of harbour porpoise presence in the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU)' and

'The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.'

5.4.6.6 Together with the final point, perhaps most pertinently, made under the description of the first CO (which deals with viability and therefore injury risk):

'Unacceptable levels can be defined as those having an impact on the Favourable Conservation Status (FCS) of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG 2015).'

5.4.6.7 Therefore, the number of animals that may be at risk to onset of PTS (as presented above) has not been compared to any population attributed to the North Anglesey SAC, because the number of harbour porpoise using the site naturally varies. Rather, the assessment considers whether any such PTS risk could impact on the FCS of the MU population (which in the context of the first conservation objective refers to measures that *'restrict the survivability and reproductive potential of harbour porpoise using the site'*).

5.4.6.8 For WTG monopile foundation installation of 13 m piles with a maximum blow energy of 6,372 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for harbour porpoise from piling was 150 m for the installation of a monopile at the NE modelling location. Considering the cumulative PTS-onset (weighted SEL_{cum}) thresholds, harbour porpoise found within 150 m from the NE monopile location at the start of piling could accumulate noise exposure in excess of the criteria. Given that the SAC lies 42.7 km from the array area, these impact ranges would result in no overlap with the SAC.

5.4.6.9 While for the WTG jacket pile foundation installation of 5.75 m piles with a maximum blow energy of 4,695 kJ, with piling mitigation measures in place (see paragraph 5.4.1.20), the predicted maximum instantaneous auditory injury (unweighted SPL_{peak} for PTS-onset) impact range for harbour porpoise from piling was 140 m for the installation of a jacket pile at the NE modelling location. The cumulative PTS onset (weighted SEL_{cum}) from four sequential piles was predicted to occur if harbour porpoises were located less than 100 m from the NE piling location at the start of piling. Given that the SAC lies 42.7 km from the array area, this means there is no predicted overlap with the SAC.

5.4.6.10 Static PAM studies of harbour porpoises have reported reduced detections in the immediate vicinity of the pile driving activities prior to the commencement of piling, which has been attributed to the presence of construction vessels on site (Benhemma-Le Gall *et al*., 2021; Benhemma-Le Gall *et al*., 2023; Brandt *et al*., 2018; Rose *et al*., 2019). Therefore, it is assumed that harbour porpoises are displaced from the immediate vicinity of the pile prior to piling commencing, which would reduce the likelihood of individuals experiencing PTS.

5.4.6.11 During the installation campaigns of both Beatrice and Moray East offshore wind farms harbour porpoise detections gradually declined by up to 33% in the 48 hours before piling, (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 subsequently deterred harbour porpoises away from the works area, 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 within the potential impact ranges are likely to be fewer than the predicted baseline and the scale of the effect is thereby reduced in terms of individuals exposed.

5.4.6.12 The instantaneous and cumulative PTS onset contours for harbour porpoise as predicted by the underwater noise modelling are 150 m or less. Therefore there is no overlap with the SAC boundary. Considering the highly mobile nature of harbour porpoise, it is possible that porpoise that use the SAC will be exposed to underwater noise from pile driving activities in the areas adjacent to the SAC. However, given the predicted distances, PTS onset is considered unlikely to occur, rather vessels arriving on site prior to pile driving occurring are more likely to displace harbour porpoise from the immediate vicinity of the piling activity.

5.4.6.13 If PTS were to occur as a result of piling noise, it is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within a frequency range that is unlikely to significantly affect the fitness of individuals (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts to the fitness of individual harbour porpoises, for either adults or calves (Booth *et al.*, 2019).

5.4.6.14 In addition to noise abatement systems (which enable a noise reduction of at least 10 dB), the MMMP includes a number of preventative and avoidance measures (outlined in Table 223) to mitigate against instantaneous injury to marine mammals associated with pile driving by ensuring no activity commences if a marine mammal is within the 1000 m mitigation zone, therefore no harbour porpoise should be within PTS ranges prior to pile driving commencement.

5.4.6.15 Consequently, given the predicted impact distances of less than 150 m, coupled with the likelihood of harbour porpoises being displaced by vessels arriving on site prior to pile driving, and considering the mitigation measures that will be in place, the risk of PTS to any individual harbour porpoise is considered negligible.

Underwater Noise from piling – Auditory Injury Assessment (Harbour porpoise)

5.4.6.16 As outlined above, the relevant CO for the SAC for auditory injury impacts arising from underwater noise is the first CO.

5.4.6.17 Given that the MMMP will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour porpoise during pile driving to a level considered not significant with that conclusion drawn with respect to the MU population, it is concluded that the proposed development alone does not have the potential to restrict the survivability and reproductive potential of harbour porpoise using the site.

5.4.6.18 Therefore, it is concluded that auditory injury (i.e. PTS) arising from pile driving will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.19 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.6.20 The predicted impact range using the Level B harassment threshold does not overlap with the SAC boundary, with the impact radius predicted to extend out to a maximum distance from the NE location of 13 km considering the monopile foundation scenario, and 12 km considering the jacket pile foundation scenario (see the Underwater noise assessment for further details on the scenarios modelled).

5.4.6.21 Another method that can be used to determine whether there is a potential overlap from the noise at the proposed development and the SAC is the 26 km fixed disturbance range for monopile pile-driving (JNCC, NE, and DEARA, 2022). This method is specifically advised for assessing the overlap between a noisy activity and an SAC with harbour porpoise as a feature, in the context of assessing significant disturbance. Using this approach, the impact range also does not overlap with the SAC boundary.

5.4.6.22 Several studies have provided evidence that harbour porpoises are displaced from the vicinity of piling events. For example, at wind farms in the German North Sea, large declines in porpoise detections occurred close to the piling location (>90% decline at noise levels above 170 dB SEL) with decreasing effect with increasing distance from the pile (25% decline at noise levels between 145 and 150 dB SEL; Brandt *et al*., 2016). The reduction in detection rates was relatively brief (between one to three days), suggesting that displacement was short-term (Brandt *et al*., 2011; Dähne *et al*., 2013; Brandt *et al*., 2016; Brandt *et al*., 2018).

5.4.6.23 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, where detection of clicks (echolocation) and buzzing (associated with prey capture) in the short-range (2 km) did not entirely cease in response to pile driving. Furthermore, detections of both clicks and buzzing increased above baseline levels with increasing distance from the pile location, indicating increased local density whereby animals that were closer to the piling activity were displaced. Therefore, it is likely that porpoise experiencing short-term displacement due to pile driving activities can use areas nearby to compensate for any lost foraging opportunities and increased energy expenditure demand due to fleeing.

Underwater Noise from piling – Disturbance Assessment (Harbour porpoise)

5.4.6.24 The second CO for the North Anglesey Marine SAC refers to 'no significant disturbance of the species', and so is relevant to assessing the impact from underwater noise disturbance.

5.4.6.25 There is no predicted overlap between the areas of disturbance and the SAC boundary. However, should underwater noise generated from piling may result in temporary exclusion of harbour porpoise from an area, any response to this disturbance is expected to last for the period of piling, with harbour porpoise returning to areas from which they were displaced within 1 – 2 days (Brandt *et al*., 2016).

5.4.6.26 Some individuals within or associated with the site may be disturbed and displaced by underwater noise arising from pile driving; however, this is not predicted to result in any significant change to individual fitness or reproductive success (of any life stage) under any realistic piling scenario.

5.4.6.27 Therefore, it is concluded that there will not be an AEoI in relation to disturbance on the second CO for harbour porpoise for the North Anglesey Marine SAC as a result of pile driving from Dublin Array alone during construction under any pile driving scenario and therefore, subject to natural change, in the long-term, there will be no significant disturbance of harbour porpoise.

5.4.6.28 Therefore, it is concluded that disturbance arising from piling will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.29 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater noise from UXO clearance (Construction phase)

5.4.6.30 The methods and approaches that may be used for UXOs clearance are detailed in the Project Description (Volume 1: Project Description). If clearance is required, the preference will be to use low order techniques, if this is not possible and clearance is necessary, high order techniques will be used. For high order clearance a bubble curtain will be deployed.

5.4.6.31 Full details about the methods to address if UXOs are found within the vicinity of Dublin Array during construction are outlined in paragraph 5.4.2.44.

Auditory Injury

5.4.6.32 Explosives have the potential to cause injury or mortality in the immediate vicinity (e.g. <50 m; Danil and Leger, 2011) from either blast induced trauma (i.e. shock wave) or auditory impacts (i.e. sound wave). Most of the acoustic energy produced by a high-order UXO detonation is below a few hundred Hz, and there is a pronounced decline in energy levels above 5 to 10 kHz (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). A PTS in hearing is expected to result in a "notch" of reduced hearing sensitivity in exposed individuals within the frequency range of the sound. In the case of UXO clearance this would be in the low frequency component of the species hearing range, which is unlikely to significantly affect the fitness of an individual (i.e. its ability to survive and reproduce; see paragraph 5.4.1.40). As such, current scientific understanding is that PTS would not result in significant impacts on the fitness of individual harbour porpoises, for either adults or calves.

5.4.6.33 As UXO detonation is defined as a single pulse, both the weighted SEL_{ss} criteria and the unweighted SPL_{peak} criteria (Southall *et al.,* 2019) were considered (Underwater noise assessment). 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 525 kg (and an additional donor weight of 0.5 kg to initiate detonation) and the adoption of the 'high-order' clearance technique with no at-source mitigation (e.g. bubble curtain). This impact range does not overlap the SAC boundary.

5.4.6.34 Notwithstanding the low risk of PTS resulting in any biologically relevant effects to harbour porpoise, the MMMP includes a number of preventive and avoidance measures (listed in Table 223) to mitigate against any potential impacts to marine mammals associated with UXO detonation.

5.4.6.35 In particular, prior to any high-order detonations, at-source noise mitigation methods will be used to minimise the potential PTS-onset range from high order detonations. 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. Should low order clearances methods be used, as is the preferred method for the project, then the PTS-onset range will scale with the size of the donor charge rather than the UXO, and be considerably smaller than from high order clearance. However, it is likely to be notably smaller than the 12 km calculated for the MDO.

5.4.6.36 Together, these mitigation measures are considered sufficient to reduce the risk of PTS to any individual harbour porpoise to negligible.

Underwater Noise from UXO – Auditory Injury Assessment (Harbour porpoise)

5.4.6.37 As outlined above, the relevant CO for the SAC for auditory injury impacts arising from underwater noise is the first CO.

5.4.6.38 Given that the anticipated requirement for a MMMP will provide for appropriate mitigation to minimise the risk of injury or mortality in harbour porpoise during UXO clearance (with prior approval by the regulator), it is concluded that the proposed development alone does not have the potential to restrict the survivability and reproductive potential of harbour porpoise using the site.

5.4.6.39 Therefore, it is concluded that auditory injury arising from UXO clearance will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.40 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Behavioural Disturbance

5.4.6.41 There is a lack of guidance on assessing behavioural impacts to marine mammals as a result of UXO clearance. Given 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.

5.4.6.42 Another method that can be used to determine whether there is a potential overlap from the noise at the proposed development and the SAC is the 26 km fixed disturbance range for high order UXO clearance (JNCC *et al*., 2022). This method is specifically advised for assessing the overlap between a noisy activity and an SAC with harbour porpoise as a feature, in the context of assessing significant disturbance. Using this approach, the impact range also does not overlap with the SAC boundary.

5.4.6.43 JNCC guidance (2020) states 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, which was assessed above as having no AEoI to the harbour porpoise feature of the North Anglesey Marine SAC. Therefore, with a shorter duration (in most cases single pulse events), this activity is not expected to affect foraging behaviour for an extended time period (e.g. no longer than minutes).

Underwater Noise from UXO – Disturbance Assessment (Harbour porpoise)

5.4.6.44 The second CO for the North Anglesey Marine SAC refers to 'no significant disturbance of the species', and as highlighted above that disturbance is assessed here through the application of the 26 km EDR.

5.4.6.45 The array area is more than 26 km from the boundary of the North Anglesey Marine SAC at its closest point. As such, any noisy activity within the project array area would not overlap with the SAC, and not contribute to disturbance within the site. No further assessment of disturbance is required.

5.4.6.46 Therefore, it is concluded that there will be no AEoI in relation to disturbance on the second CO for harbour porpoise for the North Anglesey Marine SAC as a result of underwater noise from UXO clearance.

5.4.6.47 The same mitigation measures included within the MMMP (outlined in Table 223) would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Underwater Noise (Decommissioning Phase)

Auditory Injury and Behavioural Disturbance

5.4.6.48 Decommissioning of offshore infrastructure for the proposed development (Offshore) may result in temporarily elevated underwater noise levels which may have effects on marine mammals. These elevated noise levels may be due to increased vessel movements and removal of the WTGs with the resulting noise levels dependant on the method used for removal of the foundation. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. It is anticipated that piled wind turbine foundations would be cut below seabed level, and the protruding section will be removed during the decommissioning phase. Typical current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. It is envisaged that, where appropriate, buried assets such as cables will be left in situ when the project is decommissioned.

5.4.6.49 As outlined in the Decommissioning and Restoration Plan, the exact methods to be adopting during decommissioning are yet to be confirmed, therefore the respective impact level of PTS 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 less than those from construction, given there is no requirement for piling prior to decommissioning. Specifically, any PTS 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.

Underwater Noise from Decommissioning - Assessment (Harbour porpoise)

5.4.6.50 As outlined above, the relevant CO for the SAC for auditory injury impacts arising from underwater noise from decommissioning are the first and second COs.

5.4.6.51 Any auditory injury (i.e. PTS) or disturbance resulting from underwater noise associated with the decommissioning phase may affect individuals associated with the site; however, it is unlikely that this would significantly affect the fitness of the individual (i.e. its ability to survive and reproduce; Kastelein *et al*., 2017). Any underwater noise produced during decommissioning activities will have smaller impact ranges than that assessed for construction, particularly given that no piling is required prior to decommissioning and therefore the conclusion regarding no spatial overlap with the North Anglesey Marine SAC is also applicable to decommissioning activities. Therefore, activities associated with decommissioning phase will not result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.6.52 Therefore, it is concluded that underwater noise during decommissioning of the proposed development will not result in an AEoI on the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.53 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Collision Risk (Construction phase, O&M and decommissioning)

5.4.6.54 Impacts from vessels are only considered relevant for the viable component CO (addressing the risk of injury). Vessels does not have the potential to impact harbour porpoise within the site, and so affect the disturbance or supporting habitats, processes and prey COs, due to the distance between the proposed development and the SAC.

5.4.6.55 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 RoI that vessel collisions 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 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.

5.4.6.56 The majority of construction, O&M and decommissioning 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 Vessel Management Plan, part to the PEMP. 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).

5.4.6.57 Construction vessels are not expected to travel through this SAC as it is 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.

Vessel Collision Assessment (Harbour porpoise)

5.4.6.58 The first two COs address risk of injury and disturbance.

5.4.6.59 The increase in number of vessels during all phases (and the relevant project mitigation) and the increased vessel traffic associated with construction (and decommissioning) of the project is insufficient to result in an increase in the risk of mortality or injury in marine mammals as a result of collisions. That assessment applies North Anglesey SAC, given the localised nature of any effect together with the location of the effect relative to the SAC.

5.4.6.60 Individuals within the site could in theory be at risk of vessel collision; however with the implementation of a code of conduct within the environmental VMP vessel movements to and from construction sites and ports will, where feasible, follow existing routes, with the implementation of predefined vessel routes and the slow speed of the vessels when on site (as stipulated in the environmental VMP), the risk of vessel collision is limited to the footprint of the vessel and reduces risk of fatalities.

5.4.6.61 Therefore, it is concluded that collision risk arising from vessel presence will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.62 The same mitigation measures included within the environmental VMP (see Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Vessel Disturbance (Construction, O&M and decommissioning): Harbour porpoise

5.4.6.63 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). As it is often difficult, if not impossible, to attribute whether individuals are responding to the noise of the vessel and/or the presence of the vessel, both are considered within the assessment of vessel disturbance.

5.4.6.64 Several 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 4 km of construction vessels. Therefore, whilst a localised reduction of harbour porpoise density from the presence of vessels is to be expected, this is spatially and temporally limited and is not considered to significantly constrain the foraging option for this species (e.g. Benhemma-Le Gall *et al*., 2021; 2023).

5.4.6.65 A behavioural study of harbour porpoises in relation to vessel traffic in Swansea Bay reported that 26% of observed negative porpoise behaviour (e.g. porpoises moving away from sound source or exhibited prolonged diving) was significantly correlated with the number of vessels present (Oakley *et al*., 2017). 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 and in predefined and predictable routes than these types of small, motorised vessels (e.g. jet ski, speed boat, small fishing vessels), it is expected that the behavioural response would not be as severe.

5.4.6.66 While porpoise may be sensitive to disturbance from other vessels, there is evidence to suggest that they are able to compensate for any short-term local displacement (e.g. Benhemma-Le Gall *et al*., 2021), and thus it is not expected that individual vital rates would be negatively 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.

Vessel Disturbance Assessment (Harbour porpoise)

5.4.6.67 The first two COs address risk of injury and disturbance.

5.4.6.68 Vessel presence will be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Individuals within, or associated with, the site may be disturbed by the presence of vessels; however, vessel presence (given the temporary and localised nature of the activities) will not result in a significant impact on individuals and/or the community of harbour porpoise.

5.4.6.69 Furthermore, 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.

5.4.6.70 Therefore, it is concluded that disturbance arising from vessel presence will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.71 The same mitigation measures included within the environmental VMP (outlined in Table 223) would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Effects on prey (Construction Phase, O&M and decommissioning)

5.4.6.72 The key prey species of harbour porpoises which are present in Wales include small cod (*Trisopterus* spp.), whiting, sandeel and ling (Santos *et al.,* 2004). 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. The prey species of harbour porpoise 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 in paragraph 5.4.1.71, fish are vulnerable to underwater noise, with different species having varying sensitivity (Popper *et al*., 2014).

Effects on Prey Assessment (Harbour porpoise)

5.4.6.73 The third CO addresses impacts to the supporting processes, habitats, and prey species of the harbour porpoise feature.

5.4.6.74 Any changes to the fish communities that harbour porpoise depend on will be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Any potential changes to prey as a result of activities relating to the construction, O&M and decommissioning phases will not result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.6.75 Therefore, it is concluded that changes to prey will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.76 The same mitigation measures would be applied to alternative design options; therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Accidental Pollution (Construction, O&M, decommissioning and O&M Base)

5.4.6.77 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.

5.4.6.78 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (see Table 223). With these avoidance and preventative 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.

Accidental Pollution Assessment (Harbour porpoise)

5.4.6.79 The relevant COs of the SAC for the assessment of accidental pollution are the first and third COs, which address impacts to harbour porpoise as a viable component to the site, and impacts to supporting processes, habitat and prey.

5.4.6.80 Accidental pollution has the potential to indirectly result in changes to prey if an incident occurred. However, 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 prey population within the site.

5.4.6.81 Any accidental pollution event, should one occur, is expected to be temporary and localised and will not permanently prevent harbour porpoises accessing the site. Given the temporary and localised nature of such an event, it will not result in a significant impact on individuals and/or the community of harbour porpoise within the site, or indeed, connected to the site.

5.4.6.82 Therefore, it is concluded that accidental pollution will not result in an AEoI to the harbour porpoise feature of the North Anglesey Marine SAC.

5.4.6.83 The same mitigation measures regarding the Marine Pollution Contingency Plan would be applied to alternative design options, therefore, as this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

5.4.7 Other Sites with Harbour Porpoise

5.4.7.1 This section highlights all remaining SACs within the Celtic and Irish Sea MU where harbour porpoise is listed as QI or feature. Sites are listed depending on their distance to the proposed development and which jurisdiction they are designated within. Full details for each site-specific CO can be found within Appendix A of this NDA.

Irish sites

5.4.7.2 Eleven additional Irish sites have been screened in for further assessment:

- Codling Fault SAC lies 14.5 km from the array area and 18.3 km from the Offshore ECC;
- Blackwater Bank SAC lies 75.7 km from the array area and 70.5 km from the Offshore ECC;
- Carnsore Point SAC lies 102.5 km from the array area and 107.8 km from the Offshore ECC;
- Bunduff Lough SAC lies 201.3 km from the array area and 204.6 km from the Offshore ECC;
- Kilkieran Bay and Islands SAC lies 229.7 km from the array area and 239.6 km from the Offshore ECC;
- Inishmore Island SAC lies 232.3 km from the array area and 243.1 km from the Offshore ECC;
- West Connacht Coast SAC lies 250.2 km from the array area and 258.9 km from the Offshore ECC;
- Kenmare River SAC lies 285.4 km from the array area and 280.1 km from the Offshore ECC;
- Roaringwater Bay and Islands SAC lies 291.9 km from the array area and 295.2 km from the Offshore ECC;
- Blasket Islands SAC lies 318.7 km from the array area and 326.5 km from the Offshore ECC; and
- Belgica Mound SAC lies 424.3 km from the array area and 431.3 km from the Offshore ECC.

Conservation Objectives

5.4.7.3 The site-specific COs to maintain the favourable condition of harbour porpoise are defined by the following attributes at several sites:

- Access to suitable habitat: 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.

5.4.7.4 These objectives apply to the following SACs:

- Codling Fault SAC[18];
- Blackwater Bank SAC[19];
- Carnsore Point SAC[20];
- Inishmore Island SAC[21];
- West Connacht Coast SAC[22];
- Roaringwater Bay and Islands SAC[23];
- Blasket Islands SAC[24]; and
- Belgica Mound Province SAC[25].

5.4.7.5 In March 2024 NPWS added cetacean QIs to a number of existing SACs, including some of the sites listed above. However, for some of these recently designates sites, no site-specific COs for harbour porpoise are included in the publicly available conservation objectives series documents. In the absence of published COs, the CO for Rockabill to Dalkey Island SAC (see paragraph 5.4.2.7), which is also designated for harbour porpoise, have been assumed as a proxy due to its proximity to the proposed development (NPWS, 2013a):

- Bunduff Lough SAC;
- Kilkieran Bay SAC; and
- Kenmare River SAC.

Assessment of effects

5.4.7.6 Given that the range of habitat for harbour porpoise available is extensive, the likelihood and/or severity of any localised effects is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI, has matching site-specific COs, and is located nearer to the proposed development. This assessment of Rockabill to Dalkey Island SAC concluded no AEoI on harbour porpoise QI for all screened in impacts. Given the greater distance of the above sites, 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 no greater for these sites.

[18] https://www.npws.ie/protected-sites/sac/003015
[19] https://www.npws.ie/protected-sites/sac/002953
[20] https://www.npws.ie/protected-sites/sac/002269
[21] https://www.npws.ie/protected-sites/sac/000213
[22] https://www.npws.ie/protected-sites/sac/002998
[23] https://www.npws.ie/protected-sites/sac/000101
[24] https://www.npws.ie/protected-sites/sac/002172
[25] https://www.npws.ie/protected-sites/sac/002327

5.4.7.7 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development

UK Sites

5.4.7.8 Three additional UK sites have been screened in for further assessment:

- West Wales Marine SAC (Wales) lies 81.9 km from the array area and 75.8 km from the Offshore ECC;
- North Channel SAC[26] (Northern Ireland) lies 110.0 km from the array area and 100.9 km from the Offshore ECC; and
- Bristol Channel Approaches SAC (Wales/England) lies 185.5 km from the array area and 178.5 km from the Offshore ECC.

Conservation Objectives

5.4.7.9 Across UK SACs, COs are set to ensure the site contributes to achieving favourable conservation status of the designated feature by ensuring that the integrity of the site is maintained. 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.

Assessment of effects

5.4.7.10 Given that the range of available habitat for harbour porpoise is extensive, the likelihood and severity of the effect of all the screened in impacts experienced locally is considered to be negligible. Consideration is given to the assessment for North Anglesey Marine SAC, which is designated for the same QI and is located nearer to the proposed development. The assessment for North Anglesey SAC concluded no AEoI on harbour porpoise QI for all screened in impacts. Given the greater distance of the above sites 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 these sites.

5.4.7.11 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development.

French Sites

5.4.7.12 Eighteen French sites have been screened in for further assessment:

[26] Note: Pieces Reef Complex SAC overlaps with North Channel SAC. Harbour porpoises are listed as present but not considered a feature of the site.

- Nord Bretagne DH lies 431.2 km from the array area and 424.4 km from the Offshore ECC;
- Mers Celtiques – Talus du golfe de Gascogne SAC lies 455.5 km from the array area and 449.5 km from the Offshore ECC;
- Récifs et landes de la Hague SAC lies 471.4 km from the array area and 464.6 km from the Offshore ECC;
- Anse de Vauville SAC lies 479.2 km from the array area and 472.3 km from the Offshore ECC;
- Côte de Granit Rose-Sept Iles SAC lies 488.4 km from the array area and 481.6 km from the Offshore ECC;
- Banc et récifs de Surtainville SAC lies 496.3 km from the array area and 489.4 km from the Offshore ECC;
- Tregor Goëlo SAC lies 496. 3 km from the array area and 489.4 km from the Offshore ECC;
- Baie de Morlaix SAC lies 510.3 km from the array area and 503.5 km from the Offshore ECC;
- Abers – Côte des Légendes SAC lies 511.9 km from the array area and 505.3 km from the Offshore ECC;
- Baie du Mont Saint-Michel SAC lies 511.9 km from the array area and 505.3 km from the Offshore ECC;
- Ouessant-Molène SAC lies 524.1 km from the array area and 517.7km from the Offshore ECC;
- Cap d'Erquy-Cap Fréhel SAC lies 539.1 km from the array area and 532.1 km from the Offshore ECC;
- Chausey SAC lies 544.4 km from the array area and 537.5 km from the Offshore ECC;
- Côtes de Crozon SAC lies 555.5 km from the array area and 505.3 km from the Offshore ECC;
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC lies 568.7 km from the array area and 561.8 km from the Offshore ECC;
- Baie de Saint-Brieuc – Est SAC lies 573.2 km from the array area and 566.3 km from the Offshore ECC;
- Chaussée de Sein SAC lies 573.8 km from the array area and 567.4 km from the Offshore ECC; and

- Estuaire de la Rance SAC lies 579.5 km from the array area and 572.6 km from the Offshore ECC.

Conservation Objectives

5.4.7.13 As no site-specific Conservation Objectives (SSCOs) have been identified for SACs within French waters, and given the limited available information and the absence of management plans, the approach has been taken to align with those of similar Irish and UK sites with the same QIs, such as the Rockabill to Dalkey Island SAC and North Anglesey Marine / Gogledd Môn Forol SAC.

5.4.7.14 The overall CO for all SACs within French waters has been assessed against the following CO:

- To ensure the integrity of the site is maintained and that it makes the best possible contribution to maintain the qualifying interests in a favourable condition within EU waters.

Assessment of effects

5.4.7.15 Given that the range of habitat for harbour porpoise available is extensive, the likelihood and or severity of the effect of all the screened in impacts listed are experienced locally is considered to be negligible. Consideration is given to the assessment for Rockabill to Dalkey Island SAC and North Anglesey Marine SAC, which is designated for the same QI and is located nearer to the proposed development. As Rockabill to Dalkey Island SAC concluded no AEOI on harbour porpoise QIs for all screened in impacts, given the greater distance of the above sites 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 these sites and subject to natural change, the designated sites will be maintained in the long term.

5.4.7.16 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development.

5.4.8 Other Sites with Bottlenose Dolphin

5.4.8.1 This section highlights all remaining SACs within the Irish Sea MU where bottlenose dolphin are listed as QI or feature. Full details of site-specific CO can be found within Appendix A of this HDA).

UK Sites

5.4.8.2 Additional Welsh sites[27] within the Irish Sea MU and with bottlenose dolphin listed as a QI have been screened in for further assessment:

[27] Note: Pieces Reef Complex SAC is located in the Irish Sea MU, bottlenose dolphin are not listed as present and therefore not considered a feature of the site but have been observed in the vicinity

- Cardigan Bay SAC lies 124 km from the Offshore ECC and lies 119 km across the Irish Sea from the array.

Conservation objectives

5.4.8.3 This site includes CO to maintain the favourable conservation status of the bottlenose dolphin and are defined by the following list of attributes and targets:

- The bottlenose dolphins 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.

Assessment of effects

5.4.8.4 Given that the range of habitat for bottlenose dolphin available is extensive, the likelihood and or severity of the effect of all the screened in impacts listed are experienced locally is considered to be negligible. Consideration is given to the assessment for Pen Llŷn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC, which is designated for the same QI and is located nearer to the proposed development. As the assessment for Pen Llŷn a`r Sarnau concluded no AEoI on bottlenose dolphin QIs for all screened in impacts, given the greater distance to the Cardigan Bay SAC 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.

5.4.8.5 Therefore, it is concluded that there is no AEoI from any impacts on the bottlenose dolphin QI of any of this site from the proposed development.

5.4.9 Derogation licence application

5.4.9.1 The Applicant has decided to make an application to NPWS on a precautionary basis for a derogation licence in respect of Annex IV marine mammal species, pursuant to Regulation 54 of the Birds and Natural Habitats Regulations 2011 (transposing Article 16 of the Habitats Directive). The application has been submitted to NPWS and a copy is included in the planning application (Part 3 of the application: Volume 4, Appendix 4.3.5-8).

5.4.9.2 This application has been submitted on a precautionary basis because it is the Applicant's view that this is not required in respect of the proposed development. As detailed within the EIAR, Part 3: Volume 2, Chapter 2, (Consents, Legislation, Policy and Guidance), the revised Renewable Energy Directive (EU) 2023/2413 (RED III) is materially relevant to any consideration of whether a derogation licence is required for the construction and operation of a renewable infrastructure project. This inserted Article 16b into the 2018 recast Renewable Energy Directive (Directive 2018/2001) which states that where a renewable energy project has adopted necessary mitigation measures, any killing or disturbance of the species protected under Article 12(1) of Directive 92/43/EEC and Article 5 of Directive 2009/147/EC shall not be considered to be 'deliberate'. The Applicant is satisfied that the proposed development incorporates the necessary mitigation measures and, therefore, any killing or disturbance of species protected by the Habitats Directive is not 'deliberate', within the meaning of those Directives, such that there is no requirement for a derogation licence.

5.4.9.3 Furthermore, Article 3 of the 2022 Temporary Renewable Energy Regulation (Regulation (EU) No.2022/2577) states that the planning, construction and operation of plants and installations for the production of energy from renewable sources, and their connection to the grid, the related grid itself and storage assets shall be presumed as being in the overriding public interest and serving public health and safety when balancing legal interests in the individual case and expressly refers to Article 16 of the Habitats Directive. This is amended by Council Regulation (EU) 2024/223. This is also relevant to any application for a derogation licence.

5.4.9.4 A copy of the submitted derogation licence application is included with this planning application so that ABP can take it into account, to the extent considered necessary. The Applicant will write to ABP to confirm the outcome of the derogation licence process. If NPWS grants the derogation licence, the Applicant will provide a copy to ABP for consideration, and public consultation if required, so that ABP can reflect the granting of the licence in its reasoned conclusion on the EIA and AA and as part of its assessment of compliance with Biodiversity Policy 4 of the NMPF.

5.5 Onshore ecology

5.5.1.1 The Wicklow Mountains SAC has been screened in for further assessment for QI otters. Due to the high mobility of this feature, effects could manifest on individuals from SAC population that have left the confines of the site and are present within the Shanganagh River catchment, Dublin Bay or within Dún Laoghaire Harbour.

5.5.1.2 Otter foraging could experience impacts during construction works, particularly at dusk or dawn and for works near watercourses or during river crossing. Otters move along established paths between open-water habitats, including freshwater sites near the coast and are sensitive to activities that cause obstructions to these routes. Disturbances (noise and visual) during construction, and any knock-on effects from or to prey species, habitat loss (due to direct loss of riparian habitat, or holts) or through fragmentation where impacts (pollution or noise barriers) restrict access to up-river watercourses could result in the exclusion of otter from foraging habitat, a holt or otter shelter. There are potential pathways for otters from the SAC, so impacts cannot be discounted without further information on their range and behaviour.

5.5.1.3 All other onshore European sites have been screened out of further assessment because no impact pathways were identified at Stage 1 screening.

5.5.1.4 The sites and effects screened in for onshore are summarised in Table 17 with a summary of each effect and the key information relied upon provided below. The inclusion of the Wicklow Mountains SAC has taken into account the home range of the otter and the hydrological connections between the project and any SAC/European site.

Table 17 SACs screened in for onshore receptors

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
Wicklow Mountains SAC [IE002122]	Otter	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey ▪ Habitat loss ▪ Habitat disturbance ▪ Underwater noise-	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey

5.5.2 Assessment approach

Disturbance and Displacement

5.5.2.1 Otters are well distributed across Ireland and will even utilise urban environments (Mason and Macdonald, 1986; Kruuk 1995 and Durbin *et al*. 1996). However, despite this tolerance for urban conditions for foraging, several studies suggest otters can be adversely affected by disturbance, usually as a result of human activities caused by housing, horticulture applications and recreative intrusions by anglers (e.g., Tüzün and Albayrak, 2005). Tolrà *et al*. (2024) suggest that human disturbance is emerging as a potential threat to otters, along with land intensification and breeding otters can favour less productive habitats to avoid human-dominated landscapes. However, Tüzün and Albayrak (2005) suggest that while otters can be strongly affected by large-scale human accessibility to rivers, they can also be unaffected when these impacts are limited to localised areas.

5.5.2.2 Due to the risk of disturbance, current guidelines for the treatment of otters (NRA, 2008) state that no works should be undertaken within 150 m of any holts at which breeding females or cubs are present unless consultation with NPWS and mitigation measures are put in place. Moreover, non-breeding holts should be protected through a minimum of 15 m buffer (and 20 m for vehicles).

Accidental pollution

5.5.2.3 Pollution is often considered an important factor in cause of the decline in otter populations (Mason 1989; Broekhuizen 1989; Voogt *et al*. 1994, Smit *et al*. 1998; Gutleb 2000; Christensen *et al*. 2010). However, otter populations are known to still exist even in polluted rivers (MacDonald and Mason, 1983). For example, Macdonald and Mason (1982) recorded otters in sewage-polluted rivers in Portugal. The decline in otter populations across Europe since the 1960s has coincided with increasing levels of pollution in the environment, chiefly organochlorine pesticides. Otter populations recovered during the 1990s once this particular type of pollution was no longer used (Lammertsma and van den Brink, 2012).

5.5.2.4 Lammertsma and van den Brink (2012) suggest that otters may be more resilient to pollutants than initially estimated, with otters dwelling in river systems likely accessing adjacent waters which have a better water quality with less contaminated fish and thus avoiding at least some of the impacts of accidental pollution. However, the evidence is unclear and water pollution cannot be discounted as a threat to otter populations. Reid *et al*. (2013) lists it as one of three main threats to this species and Tüzün and Albayrak (2005) found that otters in Turkey were affected by heavy pollution, which formed a barrier to otter activity at the downstream site of the Kızılırmak River within the study area.

5.5.2.5 The biggest risk of pollutants affecting otters are those that threaten their food supply. It is anticipated that only oil spills are likely to impact otters directly (Chanin, 2000).

Habitat loss and habitat disturbance

5.5.2.6 Otters are widespread in Ireland; however, they exhibit a low-density distribution and are therefore susceptible to habitat loss and fragmentation (NRA, 2008). Habitat destruction and degradation is one of the main threats to otter populations (Reid *et al*., 2013).

5.5.2.7 Habitat losses, particularly any unmitigated riparian habitat loss, will reduce potential holt creating opportunities for otter. Otters often rely on mature bankside trees for holt locations (MacDonald & Mason, 1983; Mason, 1995). Even if these habitats are replanted, there will likely be a reduction to the habitat complexity in the long-term, and secure holt sites are likely to be a scarce resource in any heavily managed habitat (MacDonald & Mason, 1983).

5.5.2.8 Weinberger *et al*. (2019) indicates that otter resting site selection is strongly associated with high riparian vegetation cover. Although Tolrà *et al*. (2024) found that otters might be more flexible in their requirements for vegetation cover. Another study found that sites with better riparian habitat quality was used for resting compared to sites with more disturbances (i.e. angling, horticulture, housing) (Tüzün and Albayrak, 2005).

Underwater noise (construction & decommissioning)

5.5.2.9 Underwater noise can change otter behaviour and potentially result in habitat exclusion. For example, Stepien, *et al*. (2024) found that otters diving behaviour and time to extract food progressively increased as sound intensity increased for all tested sound levels. With otters showing a clear behavioural response through an increased diving behaviour and time required to extract food progressively increasing to increased sound intensity to both 1 and 14 kHz underwater sounds at 105 – 145 dB.

Effects on prey (construction, decommissioning & O&M)

5.5.2.10 Underwater noise and habitat loss could negatively affect prey species such as salmonids as well, which could have a knock-on effect on foraging otter due to reduced prey biomass. Several studies demonstrate a negative association between noise pollution and fish either through their development, physiology and/or behaviour (e.g., Kunc *et al*., 2016) or through increased stress, potential hearing loss, or impacted immunity (e.g., Masud *et al*., 2020).

5.5.2.11 One study in Cork, Ireland found that the predominant food category was fish (mainly salmonids and European eels) (Ottino and Giller, 2004). Therefore, any adverse effects to these prey species are likely to lead to an overall reduction of prey for otter and cause a knock-on effect to otters, with the likely reduction in otter population as a result.

5.5.3 Wicklow Mountains SAC

5.5.3.1 Wicklow Mountains SAC lies onshore, 18.4 km from the array area, 11.8 km from the O&M Base, and 8.1 km from the Offshore ECC, the SAC has been screened in for potential connectivity via rivers and watercourses to Dublin Bay. The only QI that has been screened in for further assessment relating to this SAC is otter. The conservation objectives for this QI are detailed below:

Conservation objectives of the qualifying interests: Otters

5.5.3.2 The CO for the Wicklow Mountains SAC QI otter is to maintain the favourable conservation condition of otters in Wicklow Mountains SAC, as defined by the following six site-specific CO attributes and NPWS (2017) targets which apply within the SAC:

- Distribution: there is no significant decline in the percentage of survey sites occupied by otters
- Extent of terrestrial habitat: there is no significant decline in the extent of terrestrial habitat area critical for otters;
- Extent of freshwater (river habitat): there is no significant decline in the length of river habitat for otters;
- Couching and holt sites: there is no significant decline in the number of couching and holt sites used by otters;
- Fish biomass available: there is no significant decline in the biomass of fish stocks available for otters; and
- Barriers to connectivity: there is no significant increase in the number of barriers to otter commuting routes.

5.5.3.3 None of the offshore infrastructure, O&M Base or onshore infrastructure overlap with SAC and the river catchment located within the onshore (i.e., the Shanganagh River and tributaries) is not located within the SAC. Therefore, distribution and potential reduction of fish biomass availability are considered the conservation objectives at risk due to the project and all other Conservation Objectives have been discounted at this stage.

The link between the Wicklow Mountains SAC and the project:

5.5.3.4 Three river catchments are considered relevant:

- The Dargle originates in the SAC and discharges at Bray;
- The Dodder originates in the SAC and discharges in Dublin harbour; and
- The Barnacullia (Ballyogan)/Carrickmines Stream, Kill-O-The-Grange Stream and the Shanganagh River and tributaries (hereafter referred to as the Shanganagh River and tributaries), which the OES crosses, before it discharges at Loughlinstown.

5.5.3.5 Otters have large home ranges and can travel significant distances. Whilst this is usually confined to within a catchment, otters may move overland up to 2.5 km between catchments and juveniles can often use nearby catchments for dispersal (Pagacz, 2016). Therefore, it is assessed that the population within the project area is likely to be a supporting population to the SAC. Rather than making up a part of the SAC population.

Disturbance and displacement (construction, O&M and decommissioning)

5.5.3.6 The Wicklow Mountains SAC lies onshore, located 18.4 km from the array area, 11.8 km from the O&M Base, 8.1 km from the Offshore ECC, and 5.54 km from the OES (at the closest point). Therefore, there is no direct risk of potential for disturbance (noise and visual) or displacement to otters within the SAC. Only otters within the Shanganagh River catchment (i.e., a potential supporting population) are at risk of disturbance and displacement from the project and this is only a risk to the SAC if this inhibits this population from reaching the SAC and supplementing that population.

5.5.3.7 It should be noted that adverse effects on species or habitats outside the protected areas, where such adverse effects may be detrimental to the CO of the protected areas should be included in the NIS process (Brian Holohan and Others v An Bord Pleanála, 2018). There is only considered to be a risk to the CO for otter dispersal in the SAC if the population within the Shanganagh River and tributaries provides an important immigration supply of otters to the relevant catchments located in the SAC. This is unknown and therefore it is assumed that it is an important supporting population to the SAC.

5.5.3.8 There is a risk of impacts through disturbance or displacement of this population, which may indirectly affect the SAC population. This is most likely to occur during construction or decommissioning works of the OES and when otters are most active (e.g. dawn or dusk; Findlay *et al*., 2017). Primarily, the largest risk is at special crossings of rivers for the OES cable route (detailed below) during the construction phase and the construction and decommissioning phases at the landfall and O&M Base.

5.5.3.9 All of the proposed river crossings associated with the OES are located in the Shanganagh River and tributaries. These streams do not originate in the SAC and discharge at Loughlinstown but they do sit between the Dargle and the Dodder. The special crossings are located at the following locations:

- Shanganagh River crossing, Shanganagh;
- Deansgrange Stream crossing, Loughlinstown;
- N11 crossing, Cherrywood; and
- M50 crossing, Ballyogan.

5.5.3.10 The cables for the OES at special crossings (detailed above) will be installed by trenchless means, not involving any surface excavation work, with work sites being established on either side of the obstruction. Trenchless techniques will be the preferred solution for these special crossings. Disturbance could result in permanent displacement from the area, especially if the disturbance is sustained or occurs near a sensitive location for otters, such as a holt or couch (NRA, 2005).

5.5.3.11 An otter holt (Holt 1) was identified at the fence line for the Shanganagh-Bray WWTP (ITM 725712, 723223) (Triturus, 2023). Holt 1 was located approximately 120 m from the planned ECC location at Clifton Park. Holt 1 was located >150 m from the proposed HDD activities. It is unknown whether Holt 1 comprises an active breeding holt. Guidelines for the treatment of otters prior to the construction of national road schemes (NRA, 2005) state that any works within 150 m of any holts at which breeding females or cubs are present will require a derogation licence. The Applicant will undertake pre-construction verification surveys for the purpose of determining the purpose and status of the holt and whether it is an active breeding holt. Depending on the outcome of this survey, it may be necessary for the Applicant to apply for a derogation licence.

5.5.3.12 Planned maintenance of the OES requires one visit to each cable joint pit per year by a team of two personnel. Unplanned maintenance may involve the repair of onshore export cable faults. This is extremely rare (indicatively 1-2 events per lifetime). Typically, this involves excavating the two adjacent joint bays, pulling the cable back through the ducting and pulling a new cable through. Alternatively, the area of the fault may be excavated (i.e., up to 40m in both directions) and two new joints installed within this area. Methods for excavation and reburial will be similar to the original installation.

5.5.3.13 Planned maintenance on the two proposed OCC is anticipated to be localized with a minimal likelihood of disturbance expected to the adjacent habitats and species. Approximately six to eight visits per month are anticipated, typically involving two personnel for each OCC. Quarterly inspection site and maintenance visits as required. For unplanned major maintenance, vehicles similar to those used for construction may also be required (e.g., rigid lorries delivering materials, low loaders delivering plants, and individual vehicles for personnel). Therefore, the planned maintenance across the onshore OCC will be highly localised and unlikely to cause disturbance or displacement to otters.

5.5.3.14 Trenchless techniques will be used to cross watercourses within the OES and so disturbance will be limited in temporal and physical extent. Moreover, trenchless techniques will be implemented to avoid removal, damage, or disturbance to adjacent riparian habitats. No sensitive otter couches or holts were recorded by dedicated aquatic ecology surveys within 150 m of any of the planned river crossings. Therefore, only foraging otters comprising a potential supporting population to the SAC are likely to be disturbed by these works. Given the highly urban nature of much of the OES, background levels of disturbance are high, and otters are already likely to have a degree of habituation to disturbance. Therefore, due to the limited extent of disturbance predicted from the Dublin Array project, no permanent displacement of foraging otters is predicted.

5.5.3.15 A second otter holt (Holt 2) was located on boulder revetment along 'The Green', between Commissioners of Irish Lights and the Royal Irish Yacht Club) (ITM 724132, 728965) (Triturus, 2023). Holt 2 was located approximately 330 m west of the proposed O&M Base.

5.5.3.16 Guidelines for the treatment of otters prior to the construction of national road schemes (NRA, 2005) state that only works within 150 m of any holts at which breeding females or cubs are present require a derogation licence for disturbance. Holt 2 is located well beyond this recommended 150 m distance and will, therefore, not be impacted by noise and vibrations caused by the proposed works at the O&M Base during any phase.

5.5.3.17 The O&M Base already experiences high levels of disturbance due to its urban location and existing high levels of human activity. The operation and maintenance phase is not expected to increase this to a significantly adverse level. The operation and maintenance phase is not expected to cause any significant increased risk of disturbance and displacement for otters. Any disturbance to foraging otter will be adverse, but minor and will not cause any permanent or long-term disruption to the distribution of otters to the SAC. Therefore, this effect, when considered alone, will not undermine the conservation objectives for the QI otters for the Wicklow Mountains SAC.

Accidental pollution (construction, O&M and decommissioning)

5.5.3.18 All proposed river crossings by the onshore electricity cables are on Shanganagh River and tributaries. These rivers are not hydrologically connected to the Wicklow Mountains SAC and there is no possibility of pollution arising from the project and flowing downstream into the SAC. Therefore, no direct effects are possible on the otter population within the Wicklow Mountains SAC.

5.5.3.19 The only risk of effects to the SAC population is through indirect effects on a supporting population of otters within the Shanganagh Rivers and tributaries also range into the SAC (e.g., a reduction of population to a supporting population that may reduce dispersal of otters to the SAC).

5.5.3.20 A pollution event occurring during the operation phase is unlikely. There will be a limited number of vehicles required onsite for routine maintenance and operational activities. The PEMP will include measures such as storage of fuels/oils onsite will be limited and will be bunded to (110% bund capacity) to prevent fluid escaping.

5.5.3.21 There is potential for accidental pollution to occur during construction and decommissioning works, which could negatively affect both otters directly and indirectly via fish kills and depletion of prey, such as salmonids. This impact is considered to be a rare occurrence and small in scale, and any impact (when considered alone) will be imperceptible as the pollution is quickly dispersed in the transient aquatic habitat.

5.5.3.22 With the implementation of the project PEMPs, the construction, O&M and decommissioning of the offshore infrastructure and O&M Base will not adversely affect otter populations of the Shanganagh River and tributaries and therefore will have no knock-on effects on the otter population of the Wicklow Mountains SAC.

5.5.3.23 This impact when considered alone will not undermine the CO for otter and will therefore not adversely affect the integrity of the qualifying interests of Wicklow Mountains SAC.

Habitat loss or disturbance (construction and decommissioning)

5.5.3.24 No habitat loss or disturbance relating to the Wicklow Mountains SAC will occur. Otters comprising the QI for the SAC will be unaffected by the project. There is a risk of habitat disturbance and loss that may impact a potential supporting otter population within the Shanganagh River and tributaries, which may reduce their potential to breed and supplement the SAC population.

5.5.3.25 No habitat loss relating to otter is expected across the onshore elements of the project. Trenchless techniques will be used to cross watercourses along the OES so there will be no direct loss of foraging habitat within the river itself or creation of any barriers to passage.

5.5.3.26 There could be temporary physical loss of limited areas of bankside vegetation where cable entry / exit holes from trenchless techniques are located or where accommodation works are required. This will be reinstated upon completion of works. Such habitat losses will be limited in size and scale and there will be no loss of any couches or holts and this impact would be imperceptible.

5.5.3.27 There is the potential for disturbance to otter foraging, resting, or breeding habitats across the OES due to trenchless crossing activities. Trenchless crossings will be limited to the four river crossing areas and its impacts will be highly localised and temporary in nature (i.e., 16 weeks per location). It is not expected to affect otter breeding success or populations to otter as the closest holt was located >150 m from planned trenchless works at Shanganagh-Bray WWTP and no breeding activity was recorded. 150 m also represents the minimum protective buffer zone as advised under the Guidelines for the treatment of otters prior to the construction of national road schemes (NRA, 2008).

5.5.3.28 No loss of habitats for otters will occur at the O&M Base in Dún Laoghaire Harbour, which will continue to be used as a harbour following the construction and decommissioning phases. Disturbance arising from the construction and decommissioning phases of the project may affect foraging otters that may comprise a supporting population to the SAC within 150m of the O&M Base. There are already high levels of human disturbance at the O&M Base due to its urban and developed nature. The works related to the construction and decommissioning phases will create additional disturbance to foraging otter. However, it is likely to pose only a minor additional disturbance to otters that have likely largely habituated to human activities in the area. This disturbance will be limited to the duration of the construction and decommissioning phases (i.e., 24 months).

5.5.3.29 This impact will not undermine the conservation objectives for otter and will therefore not adversely affect the integrity of the qualifying interests of Wicklow Mountains SAC.

Underwater noise (construction and decommissioning)

5.5.3.30 Underwater noise arising from trenchless crossing activities at special crossings and excavation works during the construction phase along the OES will not impact the SAC population of otters. There is a risk that this impact will affect a potentially supporting population of otters to the SAC. However, it is not anticipated to disrupt their ability to disperse into the SAC.

5.5.3.31 Planned drilling from trenchless techniques could disturb foraging otters (e.g. Stepien *et al*., 2024) or their prey species (e.g., Kunc *et al*., 2016; Masud *et al*., 2020 - detailed further below). Stepien *et al*. (2024) found noise levels between 105 – 145 dB (at frequencies between 1 and 14 kHz) caused adverse behavioural responses in otters. Trenchless activities are assessed to cause 'significant' noise levels of 64 – 76 dB along the OES according to the Noise and Vibrations Chapter (Volume 5, Chapter 5). Similar noise levels are anticipated for the drilling activities at the landfall and the installation of the TJB. The duration of the drilling would be temporary, and the effects would be highly localised.

5.5.3.32 Trenchless noise will be localised, occurring only at the four crossing locations detailed as follows:

- Shanganagh River crossing, Shanganagh;
- Deansgrange Stream crossing, Loughlinstown;
- N11 crossing, Cherrywood; and
- M50 crossing, Ballyogan.

5.5.3.33 Otters are sensitive to noise impacts, with sudden loud noises causing disturbance to otters; however, they can be tolerant to continuous noises, even when considered loud (Jefferies, 1987). Construction of the OCC is predicted to require 18 weeks for ground works and a further 34 weeks for civil works and will cause noise levels of 46 – 57 dB (SLR, 2024). Decommissioning is expected to generate similar noise levels but will likely require a shorter timeframe. The initial noise created during the construction and decommissioning phases will create disturbance to otters within the nearest water courses, located approximately 50m from the OCC. However, this noise will be largely continuous during daylight hours for the duration of the construction and operational phases and is, therefore, not predicted to cause significant levels of disturbance to otter as they habituate to the noise.

5.5.3.34 The underwater noise effect may result in minor and temporary disturbance of an individual otter within the Shanganagh River and tributaries population. However, this effect will be minor and short-lived for trenchless crossing activities, and continuous for construction operations to the point that otter will habituate to the initial disturbance. Therefore, it could not on its own affect the survival of the individual otter or affect its ability to reproduce.; and it could not affect the ability of this population to support the otter population within the SAC through the exchange of individuals.

5.5.3.35 This impact will not undermine the conservation objectives for otters and will therefore not adversely affect the integrity of the qualifying interests of Wicklow Mountains SAC.

Effects on prey (construction, O&M and decommissioning)

5.5.3.36 No 'significant' effects in EIA terms on potential prey species (fish or shellfish) or on the habitats that support them were identified in the onshore Ecology Chapter and the Fish and Shellfish Ecology Chapter.

5.5.3.37 Underwater noise may adversely impact prey species for otters in the Shanganagh River and tributaries (e.g., Kunc *et al*., 2016; and Masud *et al*., 2020). Offshore construction and decommissioning works as well as noise caused during the operational phase may impact migrating salmonids, which would affect fish biomass for a potentially supporting population of otter for the SAC. Accidental pollution events may also adversely affect prey in the Shanganagh River and tributaries. Both of these effects would affect a potential supporting population of otters, and not the SAC population directly.

5.5.3.38 Any impacts on prey (i.e., a reduction of prey) will cause a knock-on effect to the supporting population of otters. This will only affect the SAC if this population is important to maintaining the population and distribution of the SAC population. This is unknown and must be assumed to be important to the SAC.

5.6 Ornithology

5.6.1.1 European sites designated for ornithological features with potential connectivity to Dublin Array have been screened in according to their areas defined in the SISAA. Given the mobile nature of the species considered, the area considered to have potential connectivity with the offshore infrastructure of Dublin Array has been classified taking into account the scale of movement and population structure for each species. During the breeding season, connectivity is defined as the area within the mean maximum foraging range plus one standard deviation (MMFR plus 1SD) (taken from Woodward *et al.*, 2019), while during the non-breeding season birds range wider than this and therefore sites within the wider region are considered. For migratory birds, the overlap of migratory flight paths with Dublin Array is considered. Full details on the screening process are presented in the SISAA.

5.6.1.2 All sites identified with potential connectivity and the potential for LSE are detailed in Table 18.

5.6.1.3 To inform the assessment, determination of which option (MDO or Alternative Design Option) presents the greatest potential for AEoI on designated sites has been presented within Volume 2 of this HDA.

Table 18 SPAs screened in for ornithology

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
North-west Irish Sea SPA [IE004236] (3.36km from array, 10.48km from Offshore ECC)	Common scoter Great northern diver Red-throated diver	▪ Disturbance and displacement	▪ Disturbance and displacement
	Arctic tern Black-headed gull Common gull Common scoter Common tern Cormorant Fulmar Great black-backed gull Great northern diver Guillemot Herring gull Kittiwake Lesser black-backed gull Little tern	▪ Indirect effects on prey	▪ Indirect effects on prey

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
	Little gull Manx shearwater Puffin Red-throated diver Roseate tern Razorbill Shag		
South Dublin Bay and River Tolka Estuary SPA [IE004024] (5.88km from Offshore ECC, 12.06km from array)	Common tern Roseate tern	▪ Indirect effects on prey	▪ Collision risk ▪ Indirect effects on prey
	Arctic tern Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey
	Dunlin Grey plover Knot Light-bellied brent goose Oystercatcher Redshank Ringed plover	-	▪ Migratory collision risk
North Bull Island SPA [IE004006] (10.22km from array, 11.07km from Offshore ECC)	Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey
	Curlew Dunlin Grey plover Knot Light-bellied brent goose Oystercatcher Pintail Redshank Shelduck Shoveler Teal Turnstone	-	▪ Migratory collision risk
Dalkey Island SPA [IE004172] (2.16km from Offshore ECC,	Arctic tern	▪ Indirect effects on prey	▪ Indirect effects on prey

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
8.57km from array)	Common tern Roseate tern	▪ Indirect effects on prey	▪ Collision risk ▪ Indirect effects on prey
Howth Head Coast SPA [IE004113] (8.51km from array, 12.32km from Offshore ECC)	Kittiwake	▪ Indirect effects on prey ▪ Disturbance and Displacement	▪ Indirect effects on prey ▪ Disturbance and displacement ▪ Collision risk
Ireland's Eye SPA [IE004117] (12.00km from array, 16.33km from Offshore ECC)	Kittiwake	▪ Disturbance and Displacement	▪ Displacement and displacement ▪ Collision risk
	Guillemot Razorbill	▪ Disturbance and displacement	▪ Disturbance and displacement
	Herring gull	-	▪ Collision risk
	Cormorant	▪ Disturbance and displacement	-
	Cormorant Guillemot Herring gull Kittiwake Razorbill	▪ Indirect effects on prey	▪ Indirect effects on prey
Wicklow Mountains SPA [IE002122] (8.96km from Offshore ECC, 18.39km from array)	Merlin	▪ -	▪ Migratory collision risk
Baldoyle Bay SPA [IE004016] (14.05km from array, 16.03km from Offshore ECC)	Grey plover Light-bellied brent goose Ringed plover Shelduck	-	▪ Migratory collision risk

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
The Murrough SPA [IE004186] (2.39km from array and 8.11km from Offshore ECC)	Red-throated diver	▪ Disturbance and displacement	▪ Disturbance and displacement
	Black-headed gull Herring gull Little tern Red-throated diver	Indirect effects on prey	▪ Indirect effects on prey
	Light-bellied brent goose Teal Wigeon	-	▪ Migratory collision risk
Lambay Island SPA [IE004069] (19.27km from array, 25.83km from Offshore ECC)	Kittiwake	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk
	Guillemot Razorbill Shag	▪ Disturbance and displacement	▪ Disturbance and displacement
	Herring gull Lesser black-backed gull	-	▪ Collision risk
	Cormorant	▪ Disturbance and displacement	▪ -
Wicklow Head SPA [IE004127] (19.84km from array, 25.59km from Offshore ECC)	Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
Skerries Islands SPA [IE004122] (30.16km from array, 35.45km	Herring gull	-	▪ Collision risk

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
from Offshore ECC)	Cormorant	▪ Disturbance and displacement	-
Aberdaron Coast and Bardsey Island / Glannau Aberdaron ac Ynys Enlli [UK9013121] (74.9 km from array, 81.1km from Offshore ECC)	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
Saltee Islands SPA [IE004002] (119.69km from array, 123.61km from Offshore ECC)	Kittiwake Gannet	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk
	Guillemot Razorbill	▪ Disturbance and displacement	▪ Disturbance and displacement
	Lesser black-backed gull	-	▪ Collision risk
Copeland Islands SPA [UK9020291] (153 km from array, 153 km from Offshore ECC)	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051] (156.54km from array, 163.25km from Offshore ECC)	Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
	Guillemot Razorbill Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
	Lesser black-backed gull	-	▪ Collision risk
Grassholm SPA [UK9014041] (157.90km from array, 164.47km	Gannet	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
from Offshore ECC)			
Dungarvan Harbour SPA [IE004032] (160.64km from Offshore ECC, 161.02km from array)	Black-tailed godwit Curlew Dunlin Great crested grebe Grey plover Knot Lapwing Light-bellied brent goose Oystercatcher Red-breasted merganser Redshank Shelduck Turnstone	-	▪ Migratory collision risk
Helvick Head and Ballyquin SPA [IE00665] (162.64km from array, 162.72km from Offshore ECC)	Kittiwake	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk
Old Head of Kinsale SPA [IE004021] (244.59km from Offshore ECC, 246.10km from array)	Kittiwake	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk
Blackwater Estuary SPA [IE004028] (180.27km from Offshore ECC, 181.21km from array)	Black-tailed godwit Curlew Dunlin Lapwing Redshank Wigeon	-	▪ Migratory collision risk
Ribble and Alt Estuaries SPA [UK9005103] (184.5km from Offshore ECC,	Lesser black-backed gull	-	▪ Collision risk

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
188.3km from array)			
Ballymacoda Bay SPA [IE004023] (189.03km from Offshore ECC, 189.49km from array)	Black-tailed godwit Curlew Dunlin Grey plover Lapwing Ringed plover Redshank Teal Turnstone Wigeon	-	▪ Migratory collision risk
Morecambe Bay and Duddon Estuary SPA [UK9020326] (195.8km from Offshore ECC, 189.2km from array)	Herring gull Lesser black-backed gull	-	▪ Collision risk
Ballycotton Bay SPA [IE004022] (200.57km from the array)	Black-tailed godwit Curlew Grey plover Lapwing Ringed plover Teal Turnstone	-	▪ Migratory Collision risk
Rathlin Island SPA [UK9020011] (223.2km from Offshore ECC, 216.98km from array)	Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
	Guillemot Razorbill		▪ Disturbance and displacement
Ailsa Craig SPA [UK9003091] (219.23km from array, 228.29km from Offshore ECC)	Gannet	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk
	Lesser black-backed gull	-	▪ Collision risk

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
	Kittiwake	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk
North Colonsay and Western Cliffs SPA [UK9003171] (314.7 from ECC, 308.3km from array)	Guillemot	-	▪ Disturbance and displacement
	Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
Isles of Scilly SPA [UK9020288]	Lesser black-backed gull Great black-backed gull	-	▪ Collision risk
Mingulay and Berneray SPA [UK9001121] (401.9km from Offshore ECC, 397.9km from array)	Guillemot Razorbill	-	▪ Disturbance and displacement
Rum SPA [UK9001341] (406.4km from Offshore ECC, 400.1km from array)	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement
Shiant Isles SPA [UK9001041] (513.7km from Offshore ECC, 507.4km from array)	Razorbill	-	▪ Disturbance and displacement
St Kilda SPA [UK9001031] (522.8km from Offshore ECC, 519.3km from array)	Gannet	-	▪ Disturbance and displacement ▪ Collision risk
	Guillemot	-	▪ Disturbance and displacement
Flannan Isle SPA [UK9001021] (564.3km from Offshore ECC,	Guillemot	-	▪ Disturbance and displacement

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M
559.3km from array)			
Handa SPA [UK9001241] (570.8km from Offshore ECC, 563.3km from array)	Guillemot Razorbill	-	▪ Disturbance and displacement
Cape Wrath SPA [UK9001231] (595.2km from Offshore ECC, 587.5km from array)	Guillemot Razorbill	-	▪ Disturbance and displacement
	Kittiwake	-	▪ Disturbance and displacement ▪ Collision risk
Sule Skerry and Sule Stack SPA [UK9002181] (648.1km from Offshore ECC, 640km from array)	Gannet	-	▪ Disturbance and displacement ▪ Collision risk
	Guillemot	-	▪ Disturbance and displacement
North Rona and Sula Sgeir SPA [UK9001011] (648km from Offshore ECC, 641.5km from array)	Gannet	-	▪ Disturbance and displacement ▪ Collision risk

5.6.1.4 From the screening process, three key impacts are screened in to the assessment for which a quantitative assessment has been undertaken (disturbance and displacement, collision risk, and migratory collision risk). A quantitative assessment where available has been undertaken for screened in species for each of these impacts, and impacts are then apportioned to designated sites using methodology outlined in the Appendix C of this HDA: Apportioning. A fourth impact (indirect impacts on prey) was also screened in, for which a qualitative assessment has been undertaken. Impacts in each phase are considered in more detail below, alongside key thresholds used within the assessment.

5.6.2 Construction and Decommissioning

5.6.2.1 During construction and decommissioning the following effects have been screened in for potential impact to designated ornithological features:

- Direct disturbance and displacement; and
- Indirect impacts on prey.

5.6.2.2 Table 19 identifies the designated sites and relevant features where the screening process concluded there was potential for these effects during the construction and decommissioning phases where LSE cannot be ruled out.

Disturbance and Displacement

5.6.2.3 During the Construction and Decommissioning phases, namely the installation of foundations, towers, blades, export cables and other infrastructure and associated movement of vessels and helicopters, seabirds could be disturbed. This disturbance may result in displacement of birds from the immediate area, driving a temporary habitat loss and reduce the area available to birds for foraging, loafing, and moulting.

5.6.2.4 The effect 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, temporary occupation area, Offshore ECC and intertidal zone), with the extent of effects depending on the activities taking place. The effects are also reversable in nature, with birds returning to the area following the end of construction and/or decommissioning.

5.6.2.5 There is no descriptive guidance detailing an approach for assessing displacement effects on birds in an Irish context. Therefore, joint guidance produced by SNCBs in the UK has been used as the basis for this assessment. This approach has been applied to assess displacement effects on seabirds for several recent offshore wind farm projects. Consideration is also given to recent NatureScot guidance (NatureScot, 2023).

5.6.2.6 The initial SNCB displacement guidance was published in 2017 (SNCBs, 2017) and was revised, primarily for the assessment of red-throated divers in 2022 (SNCBs, 2022). In this assessment, displacement and barrier effects have been considered together following the recommended SNCBs approach (SNCBs, 2017). As defined in the guidance, both flying birds and birds on the water are considered in this displacement assessment.

5.6.2.7 The SNCB guidance recommends assessing the impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of survey) in the development footprint and an appropriate buffer (SNCBs, 2022). For this assessment, where possible, numbers of birds in the array area and a buffer area were estimated for each month, and then divided by the number of surveys undertaken for that month over the two survey periods (2016-2017 and 2019-2021) to give the mean estimated number of birds per month. The mean peak number per season was then used for the displacement assessment (Volume 4: Appendix 4.3.6-6).

5.6.2.8 Sensitivity to displacement differs considerably between seabird species. The SNCB guidance contains a table of species ranked according to their sensitivity to disturbance and also the degree of habitat specialization, which has been compiled from previous reviews such as Furness *et al*. (2013) and Bradbury *et al*. (2014). These two metrics together give an indication of which species are expected to be most susceptible to displacement impacts. The guidance recommends that as a general guide, any species scoring three or more under either category (sensitivity to displacement and degree of habitat specialization), and which is present in the offshore wind farm site, a relevant buffer should be considered within the displacement assessment unless there is strong empirical evidence to the contrary. 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), the species identified were guillemot, razorbill, shag, cormorant, common scoter, great northern diver, red-throated diver and gannet.

5.6.2.9 Although scores for gannet are less than three for both categories, and would therefore not be included within the displacement assessment based on the metrics described above, SNCB guidance states that gannet should be included in the assessment, as there are empirical studies demonstrating they are sensitive to displacement (e.g. Krijgsveld *et al*., 2011, Vanermen *et al*., 2013). Additionally, and kittiwake and Manx shearwater were assessed based on ABPmer feedback. It is noted that kittiwake are not recommended for assessment of displacement effects in English and Welsh projects owing to its low sensitivity to displacement impacts. However, recent NatureScot (2023b) guidance has recommended its inclusion for this impact, alongside the feedback from ABPmer.

5.6.2.10 The screening process has identified the ornithological features and sites for which LSE cannot be ruled out for potential for disturbance and displacement during the construction and decommissioning phases. These sites are presented in Table 19 below.

Table 19 Sites and associated designated features where LSE cannot be ruled out from disturbance / displacement within the C&D phase.

Site	Feature
North-west Irish Sea SPA [IE004236]	▪ Red-throated diver ▪ Great northern diver ▪ Common scoter
Ireland's Eye SPA [IE004117]	▪ Razorbill ▪ Guillemot ▪ Cormorant ▪ Kittiwake
The Murrough SPA [IE004186]	▪ Red-throated diver
Howth Head Coast SPA [IE004113]	▪ Kittiwake
Lambay Island SPA [IE004069]	▪ Guillemot ▪ Razorbill ▪ Shag ▪ Cormorant ▪ Kittiwake
Wicklow Head SPA [IE004127]	▪ Kittiwake

Site	Feature
Aberdaron Coast and Bardsey Island SPA / Glannau Aberdaron ac Ynys Enlli [UK9013121]	▪ Manx Shearwater
Saltee Islands SPA [IE004002]	▪ Razorbill ▪ Guillemot ▪ Gannet ▪ Kittiwake
Copeland Island SPA [UK9020291]	▪ Manx Shearwater
Skomer, Skokholm, the seas off Pembrokeshire / Sgomer Sgogwm a Moroedd Penfro SPA [UK9014051]	▪ Kittiwake ▪ Manx Shearwater
Grassholm SPA [UK9014041]	▪ Gannet
Helvick Head and Ballyquin SPA [IE004192]	▪ Kittiwake
Ailsa Craig SPA [UK9003091]	▪ Gannet ▪ Kittiwake
Old Head of Kinsale SPA [IE004021]	▪ Kittiwake
Rum SPA [UK9001341]	▪ Manx shearwater
Skerries Island SPA [IE004122]	▪ Cormorant
Cape Wrath SPA [UK9001231]	▪ Razorbill ▪ Guillemot ▪ Kittiwake
Flannan Isle SPA [UK9001021]	▪ Guillemot
Handa SPA [UK9001241]	▪ Razorbill ▪ Guillemot
Mingulay and Berneray SPA [UK9001121]	▪ Guillemot ▪ Razorbill
North Colonsay and Western Cliffs SPA [UK9003171]	▪ Guillemot ▪ Kittiwake
Rathlin Island SPA [UK9020011]	▪ Kittiwake ▪ Guillemot ▪ Razorbill
St Kilda SPA [UK9001031]	▪ Gannet ▪ Guillemot
Sule Skerry and Sule Stack SPA [UK9002181]	▪ Gannet ▪ Guillemot
North Rona and Sula Sgeir SPA [UK9001011]	▪ Gannet

5.6.2.11 For the majority of seabird species, it is considered that a 2 km buffer around the array area is appropriate, however for more sensitive species such as great northern diver and common scoter, a 4 km buffer is recommended, while for very sensitive species such as red-throated diver, a 10 km buffer is recommended (SNCBs, 2022).

Overview of rates

5.6.2.12 As outlined in SNCB guidance (SNCBs, 2022), displacement rates for the construction and decommissioning phases are halved relative to the O&M phase based on the spatially and temporally limited nature of impacts in the C&D phase. However, mortality rates remain the same. Discussion around selected displacement and mortality rates is therefore presented in Section 5.6.3.

5.6.2.13 Cormorant is the only species assessed for disturbance and displacement for construction and decommissioning but not for operation and maintenance. Cormorant was screened in based on vessel disturbance, rather than to disturbance of the array itself as this species is attracted to offshore wind farms, with cormorants often being observed sitting on the base of turbines (Dierschke *et al*., 2016). Activities resulting in the disturbance from increased vessel and construction activity will occur intermittently throughout the construction period. The impact is predicted to be of local spatial extent, intermittent, and temporary to short-term duration. It is considered that only a small proportion of the total array area will be affected by construction activities at any one time, and that individual construction activities will typically be completed within a few months. Consequently, only birds in the vicinity of these individual activities will be affected directly at that time. Any impacts resulting from disturbance from the activities associated with the construction works will be short-term, temporary and reversible in nature, lasting only for the duration of activities. Birds are expected to return to the area once these activities have ceased. The significance of vessel disturbance will be negligible. Therefore, cormorant have not been assessed further for vessel disturbance within this NIS.

5.6.2.14 An overview of the displacement and mortality rates during the C&D phases is presented in Table 20 below.

Table 20 Displacement and mortality rates used for the assessment in C&D phases, with displacement rates representing half those in the O&M phase

Species	Displacement Rate (%)	Mortality Rate (%)
Guillemot	▪ 25% (plus range of 15% to 35%); ▪ 30% (NatureScot)	▪ 1% (plus 1% to 2%); ▪ 3 to 5% breeding, 1 to 3% non-breeding (NatureScot)
Razorbill	▪ 25% (plus range of 15% to 35%); ▪ 30% (NatureScot)	▪ 1% (plus 1% to 2%); ▪ 3 to 5% breeding, 1 to 3% non-breeding (NatureScot)
Gannet	▪ 35% (plus range of 30% to 40%)	▪ 1% ▪ 1% to 3% (NatureScot)
Shag	▪ 30% (plus range of 20% to 40%)	▪ 1%
Kittiwake	▪ 15%	▪ 1% to 3%
Red-throated diver	▪ Array and 4km buffer = 50% ▪ 4 to 10km buffer = 26%	▪ 1% to 2%
Common scoter	▪ 50%	▪ 1% to 2%
Great-northern diver	▪ 50%	▪ 1% to 2%

Indirect impacts on prey

5.6.2.15 Indirect effects on foraging seabirds caused by disturbance or displacement to prey species may occur during construction and decommissioning. Indirect effects may arise from the generation of suspended sediments (e.g. during cable-laying). Such activities may change the behaviour or distribution of prey species for foraging seabirds in the vicinity, resulting in lower prey availability for these individuals. An increase in suspended sediment concentration (SSC) may cause fish and mobile invertebrates to avoid the construction area and smother and hide immobile benthic prey. Suspended sediments may also make it harder for foraging seabirds to see their prey. These outcomes may lead to a reduction in prey being available within the construction area for foraging seabirds. Such potential effects on benthic invertebrates and fish have been assessed in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter (Volume 3: Chapter 4 of the EIAR). The conclusions of the Benthic Ecology and Fish and Shellfish assessments inform this assessment of indirect effects on foraging seabirds in the array area and the Offshore ECC.

5.6.2.16 The screening process has identified the features and sites to have potential impacts from indirect impacts to prey during the construction and decommissioning phases (LSE cannot be ruled out) as those presented in Table 21 below.

Table 21 Sites and associated designated features identified where LSE cannot be ruled out from indirect impacts from prey within the C&D phase

Site	Feature
North-west Irish Sea SPA [IE004236]	▪ Red-throated diver ▪ Great northern diver ▪ Common Scoter ▪ Guillemot ▪ Razorbill ▪ Puffin ▪ Fulmar ▪ Manx shearwater ▪ Cormorant ▪ Shag ▪ Black-headed gull ▪ Common gull ▪ Lesser black-backed gull ▪ Herring gull ▪ Great black-backed gull ▪ Kittiwake ▪ Roseate tern ▪ Common tern ▪ Arctic tern ▪ Little tern ▪ Little gull
South Dublin Bay and River Tolka Estuary SPA [IE004024]	▪ Roseate tern ▪ Common tern ▪ Arctic tern ▪ Black-headed gull
North Bull Island SPA [IE004006]	▪ Black-headed gull
Dalkey Island [IE004172]]	▪ Arctic tern ▪ Common tern

Site	Feature
Howth Head Coast [IE004113]	▪ Kittiwake
The Murrough SPA [IE004186]	▪ Herring gull ▪ Black-headed gull ▪ Little tern ▪ Red-throated diver
Ireland's Eye SPA [IE004117]	▪ Razorbill ▪ Guillemot ▪ Herring gull ▪ Kittiwake ▪ Cormorant

5.6.2.17 Construction activities may change the behaviour or availability of prey species for seabirds, resulting in the availability of such prey species being temporarily reduced. However, the majority of seabird species have a variety of target prey species and have large foraging ranges, meaning that they can forage for alternative prey species or move to other foraging areas if prey becomes temporarily unavailable due to construction activities. The sensitivity of seabirds to indirect effects as a result of habitat loss or displacement of prey species due to increased noise and disturbance during construction is therefore considered to be low.

5.6.2.18 Within the array area, the area of seabed predicted to be disturbed during construction is predicted to be small in comparison with the total array area. Construction of Dublin Array will last up to a maximum of 30 months, excluding preparation works. Therefore, both habitat disturbance to prey species and increases in suspended sediment will be temporary, short-term and small in extent. It is considered that these impacts together with the limited habitat lost as a result of cable protection within the array area will not cause a significant reduction in the extent, distribution or quality of habitats that support the prey of foraging seabirds.

5.6.2.19 As no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them were identified in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter, there is no potential for any indirect effects of an adverse significance to occur on foraging seabirds in the vicinity (Table 22). The impacts on prey species have therefore not been considered in further detail within the NIS.

5.6.2.20 There is, therefore, no potential for an AEoI to the population conservation objectives of screened-in SPAs of species relation to indirect impacts on prey from Dublin Array. Therefore, subject to natural change, the features will be maintained in the long term with respect to the potential for indirect impacts on prey.

Table 22 Construction and decommissioning conclusions of effects on benthic invertebrates and fish and relevant EIAR Chapter references.

Receptor	Impact	Conclusion	EIAR Chapter Reference
Fish and Shellfish	Increases in SSC and deposition occurring as a result of	The magnitude of the impact on fish and shellfish receptors from increases in SSC and deposition occurring as a result of construction activities has been assessed as Low, with the maximum sensitivity of these receptors being	Volume 3: Chapter 4

Receptor	Impact	Conclusion	EIAR Chapter Reference
	construction activities	Medium. Therefore, the significance of effect of temporary increases in SSC and deposition on fish and shellfish receptors is Slight Adverse, which is not significant in EIA terms.	
Fish and Shellfish	Underwater noise from piling and unexploded ordnance (UXO) clearance	The maximum magnitude of the impact of underwater noise from piling and unexploded ordnance (UXO) clearance on fish and shellfish species has been assessed as Low, with the maximum sensitivity of these receptors being Low. Therefore, the significance of effect of additional underwater noise and vibration on fish and shellfish receptors is a Slight Adverse effect, which is not significant.	Volume 3: Chapter 4
Benthic Ecology	Increases in SSC and deposition occurring as a result of construction activities	The magnitude of the impact to biotopes identified within the region has been assessed as Low, with the maximum sensitivity of the receptors (including Annex I habitats) being High (range: low to high). Therefore, the maximum significance of effect from SSC and deposition occurring as a result of construction activities in the array area is Moderate Adverse (but lower for a number of the biotopes recorded – range: slight to moderate adverse), which is not significant.	Volume 3: Chapter 3

5.6.3 Operation and Maintenance

5.6.3.1 During operation and maintenance, the following effects have been screened in for potential impact to designated ornithological features:

- Collision risk;
- Direct disturbance and displacement; and
- Indirect impacts on prey.

5.6.3.2 Table 23 identifies the designated sites and relevant features where the screening process concluded there was potential for these effects during the operation and maintenance phases where LSE cannot be ruled out.

Collision Risk

5.6.3.3 There is potential risk to birds from offshore wind farms arising from incidental collision with operating turbines resulting in potential injury or fatality. This may occur when birds fly through an offshore wind farm whilst foraging for food, commuting between breeding colonies and foraging areas, or during migration. The approach to assessment of collision risk is informed by the use of collision risk modelling (as detailed in the CRM). The approach to CRM is outlined below, of note CRM has been run with multiple design options specific to this project to aid in preventing and avoiding impacts, particularly the requirement for minimum blade clearance heights above MHWM to ensure the lowest risk possible for all species assessed. This approach allows for careful consideration of alternatives, design detail and bespoke mitigation measures and has therefore been integral to informing project design decisions.

5.6.3.4 The screening process has identified the features and sites to have potential collision risk during the operation and maintenance phase (LSE cannot be ruled out) as those presented in Table 23 and Table 24 below.

Table 23 Sites and associated designated features identified where LSE cannot be ruled out from collision risk within the O&M phase.

Site	Feature
Dalkey Island SPA [IE004172]	▪ Common tern ▪ Roseate tern
Howth Head Coast [IE004113]	▪ Kittiwake
Ireland's Eye SPA [IE004117]	▪ Herring gull ▪ Kittiwake
Lambay Island SPA [IE004069]	▪ Herring gull ▪ Kittiwake ▪ Lesser black-backed gull
Wicklow Head SPA [IE004127]	▪ Kittiwake
Skerries Islands SPA [IE004122]	▪ Herring gull
Saltee Islands SPA [IE004002]	▪ Lesser black-backed gull ▪ Kittiwake ▪ Gannet
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051]	▪ Kittiwake ▪ Lesser black-backed gull
Grassholm SPA [UK9014041]	▪ Gannet
Helvick Head and Ballyquin SPA [IE00665]	▪ Kittiwake
Old Head of Kinsale SPA [IE004021]	▪ Kittiwake
Ailsa Craig SPA [UK9003091]	▪ Lesser black-backed gull ▪ Kittiwake ▪ Gannet
South Dublin Bay and River Tolka Estuary SPA [IE004024]	▪ Roseate tern ▪ Common tern
Ribble and Alt Estuaries SPA [UK9005103]	▪ Lesser black-backed gull

Site	Feature
Morecambe Bay and Duddon Estuary SPA [UK9020326]	▪ Herring gull ▪ Lesser black-backed gull
Rathlin Island SPA [UK9020011]	▪ Kittiwake
North Colonsay and Western Cliffs SPA [UK9003171]	▪ Kittiwake
Isles of Scilly SPA [UK9020288]	▪ Lesser black-backed gull ▪ Great black-backed gull
St Kilda SPA [UK9001031]	▪ Gannet
Cape Wrath SPA [UK9001231]	▪ Kittiwake
Sule Skerry and Sule Stack SPA [UK9002181]	▪ Gannet
North Rona and Sula Sgeir SPA [UK9001011]	▪ Gannet

Table 24 Sites and associated designated features identified where LSE cannot be ruled out from migratory collision risk within the O&M phase.

Site	Feature
Baldoyle Bay SPA [IE004016]	▪ Grey plover ▪ Light-bellied brent goose ▪ Ringed plover ▪ Shelduck
Ballycotton Bay SPA [IE004022]	▪ Black-tailed godwit ▪ Curlew ▪ Grey plover ▪ Lapwing ▪ Ringed plover ▪ Teal ▪ Turnstone
Ballymacoda Bay SPA [IE004023]	▪ Black-tailed godwit ▪ Curlew ▪ Dunlin ▪ Grey plover ▪ Lapwing ▪ Redshank ▪ Ringed plover ▪ Teal ▪ Turnstone ▪ Wigeon
Blackwater Estuary SPA [IE004028]	▪ Black-tailed godwit ▪ Curlew ▪ Dunlin ▪ Lapwing ▪ Redshank ▪ Wigeon
Dungarvan Harbour SPA [IE004032]	▪ Black-tailed godwit ▪ Curlew ▪ Dunlin ▪ Great crested grebe ▪ Grey plover ▪ Knot ▪ Lapwing ▪ Light-bellied brent goose

Site	Feature
	▪ Oystercatcher ▪ Red-breasted merganser ▪ Redshank ▪ Shelduck ▪ Turnstone
North Bull Island SPA [IE004006]	▪ Curlew ▪ Dunlin ▪ Grey plover ▪ Knot ▪ Light-bellied brent goose ▪ Oystercatcher ▪ Pintail ▪ Redshank ▪ Shelduck ▪ Shoveler ▪ Teal ▪ Turnstone
South Dublin Bay and River Tolka Estuary SPA [IE004024]	▪ Dunlin ▪ Grey plover ▪ Knot ▪ Light-bellied brent goose ▪ Oystercatcher ▪ Redshank ▪ Ringed plover
The Murrough SPA [IE004186]	▪ Light-bellied brent goose ▪ Teal ▪ Wigeon
Wicklow Mountains SPA [IE002122]	▪ Merlin

5.6.3.5 Collision Risk Modelling (CRM) has been undertaken, with detailed methods and results presented in the CRM. CRM was conducted using the stochastic implementation of the Band (2012) model provided as scripts in the R programming environment (package: stochLAB v.1.1.2; Caneco *et al*. 2022).

5.6.3.6 CRM follows an evidence led approach taking into account site-specific ornithological data collected from within the array area along with the up-to-date literature on seabirds and their behaviour in relation to OWFs (see the CRM) . Due to the large number of existing OWF developments in the UK and Europe, the robust evidence from these projects has been used to provide data on the impacts of OWFs to seabird species that are found in Irish waters. There is currently no Irish specific guidance on the use of site-specific or generic data for flight height estimates to be used in the CRM within Ireland. UK guidance on minimum data requirements for using site-specific data recommends that species with more than 100 flight height estimates should be assessed using band option 1 and less frequently observed birds, band option 2.

5.6.3.7 The number of flight height observations for each species and corresponding proportion of birds at rotor height are presented in Volume 4: Appendix 4.3.6-1. The site-specific data shows that for common and roseate tern, zero individuals were recorded at rotor height, this was based on 360 observations for common tern and 119 for roseate tern. Nevertheless, Band Option 2 has been modelled on a precautionary basis. Several other different species-specific behavioural aspects of assessed birds, including their ability to avoid moving or static structures and how active they are diurnally and nocturnally, are accounted for by the CRM. Details of these considerations are also provided in the CRM.

5.6.3.8 The MDO, outlined in Table 25 describes the turbine scenarios considered within this assessment, noting that multiple design options were reviewed to aid in preventing and avoiding impacts. In all cases, turbine model option A resulted in the MDO, based on CRM outputs. Further details are presented in the CRM.

Table 25 Turbine scenarios considered within the CRM assessment for Dublin Array.

Turbine model option	Average RPM	Rotor radius (m)	Hub height (m. above MSL)	Predicted operation time (%)	Max. blade width (m)	Average blade pitch (°)	No. of turbines	Latitude (°)
A	5	118	147.5	99	8.5	2.4	50	53.23
B	4.7	125	154.5	99	9.0	2.4	45	53.23
C	4.2	139	168.5	99	10.0	2.3	39	53.23

Precautionary Nature of CRM

5.6.3.9 CRM was undertaken for this assessment using the species parameters as outlined in the CRM Report and as agreed across other east coast Phase 1 projects. NatureScot (2023a) and Natural England (2022) avoidance rates have been used throughout the CRM assessment. However, these values are precautionary, and are based on species group avoidance rates rather than species specific avoidance rates. For instance, using the species-specific avoidance rate of 0.9991 for the great black-backed gull from Ozsanlav-Harris *et al.* (2023), rather than the 'large gull' avoidance rate of 0.994 recommended by Natural England, leads to an 85% reduction in collisions. Also, the Offshore Renewables Joint Industry Programme[28] (ORJIP) conducted a study around Thanet OWF that found only six birds (all gull species) out of 12,000 recorded bird movements collided with WTGs during the two-year period from 2014 to 2016 (Skov *et al.*, 2018).

[28] ORJIP is a UK-wide programme aimed to address environmental and consenting risks and issues within the offshore wind and marine energy industry. ORJIP fosters collaboration between industry professionals, regulators, SNCBs, and academics.

5.6.3.10 APEM Ltd (2014) carried out four aerial surveys of the Greater Gabbard offshore windfarm between 30 October 2014 and 23 November 2014, with a total image coverage of 1,459 km^2. The study found that most gannets (328 out of 336 gannets avoided flying into areas with operational WTGs, during the migration period with the estimated macro-avoidance being 95%. Furthermore, no gannets were observed within 359m of a WTG, therefore, the density of birds at the distance at which micro-avoidance could occur was 0 birds per km^2. This suggests, 100% micro-avoidance is occurring and in turn a potential 100% total avoidance rate for gannet. Overall the APEM Ltd (2014) study suggested an avoidance rate of 99.5% during the autumn migration would be suitably precautionary. However, an avoidance rate of 99.2% has been suggested in the NatureScot (2023a) guidance. This lower suggested avoidance rate therefore overemphasizes collision risk for this species.

5.6.3.11 In addition, a report from Aberdeen Offshore Windfarm Limited (AOWFL, 2023) at the European Offshore Wind Development Centre (EOWDC) recorded zero collisions or narrow escapes in 10,000 videos of bird flight in relation to OWFs. This indicates that bird collision rates are lower in reality than the predicted rates and highlights the precautionary nature of the current methodology.

5.6.3.12 Furthermore, flight speeds from the current methodology have also been shown to be precautionary. Royal Haskoning DHV (2020b) undertook a review of the published literature on kittiwake flight speeds for Norfolk Boreas Offshore windfarm. This study found that a flight speed of 10.8m/s is a more realistic estimation of flight speed for kittiwake compared to the current recommended flight speed for kittiwake (13.1m/s). Other studies have even suggested flight speeds of 8.7m/s for kittiwake and lower flight speeds for gannet and large gulls compared to the current advice (Skov *et al*., 2018). The flight speed parameter used within the CRM assessment directly impacts the predicted potential mortality for seabirds due to collision risk. Therefore, the predicted potential mortalities could be lowered using more appropriate precautionary rates compared to the current advice.

5.6.3.13 Overall, a review of the current studies surrounding CRM parameters for seabirds suggest that the parameters used in this assessment incorporate a high degree of precaution. Therefore, the CRM results will be a precautionary indication of collision risk.

Disturbance and Displacement

5.6.3.14 Displacement has been defined as 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm' (Furness *et al*., 2013). Displacement of birds within an offshore wind farm and the immediate surrounding area during the operation and maintenance phase may occur as a result of the presence of the operational turbines. Displacement effects have the potential to affect individuals of sensitive bird species directly. In effect, this represents indirect habitat loss, which would potentially reduce the area available to forage, rest and/or moult for sensitive seabirds that currently occur within and around the array area. Displacement may contribute to the overall fitness of individual birds, which could also reduce individual breeding success or at an extreme level, cause mortality of individuals.

5.6.3.15 There is no descriptive guidance detailing an approach for assessing displacement effects on birds in an Irish context. Therefore, joint guidance produced by SNCBs in the UK has been used as the basis for this assessment. This approach has been applied to assess displacement effects on seabirds for several recent offshore wind farm projects.

5.6.3.16 The initial SNCB displacement guidance was published in 2017 (SNCBs, 2017) and was revised, primarily for the assessment of red-throated divers in 2022 (SNCBs, 2022). In this assessment, displacement and barrier effects have been considered together following the recommended SNCBs approach (SNCBs, 2017). As defined in the guidance, both flying birds and birds on the water are considered in this displacement assessment. Including flying birds in the displacement assessment provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker et al., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects).

5.6.3.17 The SNCB guidance recommends assessing the impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of survey) in the development footprint and an appropriate buffer (SNCBs, 2022). For this assessment, where possible, numbers of birds in the array area and a buffer area were estimated for each month, and then divided by the number of surveys undertaken for that month over the two survey periods (2016-2017 and 2019-2021) to give the mean estimated number of birds per month. The mean peak number per season was then used for the displacement report.

5.6.3.18 Sensitivity to displacement differs considerably between seabird species. The SNCB guidance contains a table of species ranked according to their sensitivity to disturbance and also the degree of habitat specialization, from previous reviews e.g. Furness *et al*. (2013) and Bradbury *et al*. (2014). These two metrics together give an indication of which species are expected to be most susceptible to displacement impacts. The guidance recommends that as a general guide, any species scoring three or more under either category (sensitivity to displacement and degree of habitat specialization), and which is present in the offshore wind farm site or buffer should be progressed for full assessment unless there is strong empirical evidence to the contrary. A review of count data gathered during site-specific surveys and associated expert ornithological judgement (e.g., Bradbury *et al*., 2014; Dierschke *et al*., 2016) was used to identify species that are likely to be sensitive to displacement. The species identified were guillemot, razorbill, gannet, shag, common scoter, great northern diver and red-throated diver. Although scores for gannet are less than three for both categories and would therefore not be included within the displacement assessment based on the metrics described above, SNCB guidance states that gannet should be included in the assessment, as there are empirical studies demonstrating they are sensitive to displacement (e.g. Krijgsveld *et al*., 2011, Vanermen *et al*., 2013). Additionally, and kittiwake and Manx shearwater were assessed based on ABPmer feedback. It is noted that kittiwake are not recommended for assessment of displacement effects in English and Welsh projects owing to its low sensitivity to displacement impacts. However, recent NatureScot (2023b) guidance has recommended its inclusion for this impact, alongside the feedback from ABPmer.

5.6.3.19 The screening process has identified the features and sites which have potential for disturbance and displacement during the operation and maintenance phase (LSE cannot be ruled out) as those presented in Table 26Table below.

Table 26 Sites and associated designated features identified where LSE cannot be ruled out from disturbance / displacement within the O&M phase

Site	Feature
North-west Irish Sea SPA [IE004236]	▪ Red-throated diver ▪ Great Northern diver ▪ Common Scoter
Ireland's Eye SPA [IE004117]	▪ Razorbill ▪ Guillemot ▪ Kittiwake
The Murrough SPA [IE004186]	▪ Red-throated diver
Lambay Island SPA [IE004069]	▪ Guillemot ▪ Razorbill ▪ Shag ▪ Kittiwake
Saltee Islands SPA [IE004002]	▪ Razorbill ▪ Guillemot ▪ Gannet ▪ Kittiwake
Grassholm SPA [UK9014041]	▪ Gannet
Ailsa Craig SPA [UK9003091]	▪ Gannet ▪ Kittiwake
Howth Head Coast SPA [IE004113]	▪ Kittiwake
Wicklow Head SPA [IE004127]	▪ Kittiwake
Aberdaron Coast and Bardsey Island SPA / Glannau Aberdaron ac Ynys Enlli [UK9013121]	▪ Manx Shearwater
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer Sgogwm a Moroedd Penfro SPA [UK9014051]	▪ Kittiwake ▪ Guillemot ▪ Razorbill ▪ Manx shearwater
Copeland Island SPA [UK9020291]	▪ Manx Shearwater
Helvick Head and Ballyquin SPA [IE00665]	▪ Kittiwake
Old Head of Kinsale SPA [IE004021]	▪ Kittiwake
Rathlin Island SPA [UK9020011]	▪ Kittiwake ▪ Guillemot ▪ Razorbill
North Colonsay and Western Cliffs SPA [UK9003171]	▪ Guillemot ▪ Kittiwake
Mingulay and Berneray SPA [UK9001121]	▪ Guillemot ▪ Razorbill
Shiant Isles SPA [UK9001041]	▪ Razorbill
St Kilda SPA [UK9001031]	▪ Gannet ▪ Guillemot
Flannan Isle SPA [UK9001021]	▪ Guillemot
Handa SPA [UK9001241]	▪ Razorbill

Site	Feature
	▪ Guillemot
Cape Wrath SPA [UK9001231]	▪ Razorbill ▪ Guillemot ▪ Kittiwake
Sule Skerry and Sule Stack SPA [UK9002181]	▪ Gannet ▪ Guillemot
North Rona and Sula Sgeir SPA [UK9001011]	▪ Gannet
Rum SPA [UK9001341]	▪ Manx shearwater

5.6.3.20 For the majority of seabird species, SNCB guidance considers that a 2 km buffer around the array area is appropriate, however for more sensitive species such as great northern diver and common scoter, a 4 km buffer is recommended, while for very sensitive species such as red-throated diver, a 10 km buffer is recommended (SNCBs, 2022).

Auk species

5.6.3.21 For auk species, SNCB guidance (SNCBs 2022) recommends the use of 30% to 70% displacement and 1 to 10% mortality, with NatureScot (NaureScot, 2023) recommending the use of 60% displacement, and 3 to 5% mortality in the breeding season, with 1 to 3% mortality in the non-breeding season.

5.6.3.22 A review undertaken by APEM (2022) provides an in-depth evaluation of empirical data from 21 OWF). The findings highlighted significant variation in study results across sites: one OWF showed positive displacement effects, eight showed no significant or minimal displacement effects, three had inferred (but not statistically tested) displacement effects, and eight showed negative displacement effects (APEM, 2022). It is worth noting that some predicted effects were influenced by zero-inflation bias. Based on these findings, the review recommended using a displacement rate of up to 50% for the OWF site and a 2km buffer as a cautious yet evidence-based approach for assessing distributional responses.

5.6.3.23 The upper mortality rate of 10% is considered highly over-precautionary based on available evidence and from decisions on UK projects. For example, APEM (2022) carried out a review of recent available evidence and study data from 21 OWFs, on behalf of the Hornsea Four OWF. According to APEM (2022) and the results of simulation models by Searle *et al*. (2014) and van Kooten *et al*. (2019) the use of 10% mortality rates for auks is overly precautionary, and a 1% mortality rate is both appropriate and representing while remaining precautionary. Expert judgement from several UK offshore wind farm projects has suggested that a mortality rate of 1% or 2% is more appropriate for auks (Norfolk Boreas Limited, 2019; SPR, 2019; Ørsted, 2018). Post-construction monitoring for Beatrice offshore windfarm has revealed little displacement response among auks, suggesting that a mortality rate as little as 1% is still precautionary (Trinder *et al*., 2024). On recent projects (notably Outer Dowsing, Five Estuaries, Hornsea Four, Norfolk Vanguard, Norfolk Boreas, and the Dudgeon and Sheringham Shoal Extension projects), SNCBs have agreed a worst-case scenario of 70% displacement and 2% mortality for auks. While SNCBs suggested the use of a 5% mortality for Hornsea Four, the secretary of state stated that a mortality rate of 2% (for both the breeding and non-breeding season) was acceptable for auks. The evidence from these recent projects, therefore, suggest that a mortality rate of 10% is over-precautionary, as the regulator has not endorsed a mortality rate over 2% even when higher mortality rates have been suggested by SNCBs.

5.6.3.24 The assessment will therefore be based on 50% displacement and 1% mortality based on the review undertaken by APEM (2022), with a range of impacts also presented in line with SNCB guidance (30% to 70% displacement, and 1% to 2% mortality), and in line with NatureScot guidance (60% displacement and 3% to 5% / 1% to 3% mortality).

Gannet

5.6.3.25 For gannet, SNCB guidance (SNCBs 2022) recommends the use of 60% to 80% displacement and 1% mortality, with NatureScot (NatureScot, 2023) recommending the use of 70% displacement, and 1 to 3% mortality.

5.6.3.26 The assessment will be based on 70% displacement and 1% mortality with a range of impacts also presented in line with SNCB guidance (60% to 80% displacement, and 1% to 2% mortality), and in line with NatureScot guidance (70% displacement and 1% to 3% mortality).

Kittiwake

5.6.3.27 Kittiwake is generally not recommended for assessment of displacement effects in English and Welsh projects owing to its low sensitivity to displacement impacts. However, recent NatureScot (2023b) guidance has recommended its inclusion for this impact, alongside feedback from ABPmer. Therefore, kittiwake is assessed using rates suggested by NatureScot (30% displacement and 1 to 3% mortality).

5.6.3.28 It is noted that SNCB guidance suggests that the 'Habitat Specialisation' score from Bradbury *et al*. (2014) can be useful, when combined with expert opinion, as to the likely range of possible mortality impacts resulting from particular levels of displacement. The habitat specialisation score for kittiwake was 2 per Bradbury *et al*. (2014), lower than both guillemot and razorbill (which both have a score of 3). As kittiwake has a lower habitat specialisation score, 3% morality is over-precautionary based on the recommended mortality rates for auks in APEM (2022).

Shag

5.6.3.29 There is currently no set guidance for displacement and mortality rates for assessing OWF disturbance to shag. Nevertheless, the SNCBs guidance (2022) states that 'Disturbance Susceptibility' scores can be used to determine the appropriate displacement rates on a species-by-species basis. Shag has a 'Disturbance Susceptibility' score of 3, similar to guillemot and razorbill (based on Bradbury *et al*., 2014). As stated above, SNCB guidance advises a displacement rate of 30-70% for guillemot and razorbill. Whereas recent guidance for OWF projects in Scottish waters recommended a displacement level of 60% (NatureScot, 2023). Additionally, the JNCC have recommended a displacement level of 40-60% for shags (Busch *et al*., 2015). Based on a review of these approaches, a range of 40-60% displacement effects has been applied for shags. This is considered to be precautionary, given the existing but limited evidence of potential attraction to offshore wind farms for this species.

5.6.3.30 In regards to mortality rates, SNCB guidance suggests that the 'Habitat Specialisation' score from Bradbury *et al*. (2014) can be useful, when combined with expert opinion, as to the likely range of possible mortality impacts resulting from particular levels of displacement. The habitat specialisation score for shag was 3 per Bradbury *et al*. (2014), similar to guillemot and razorbill. As these three species have the same habitat specialisation score, the same mortality rate of 1% recommended by APEM (2022) for guillemot and razorbill has been applied for shag in this assessment.

Divers and seaducks

5.6.3.31 For divers and seaducks, SNCB guidance (SNCBs 2022) recommends the use of 90% to 100% displacement and 1% to 10% mortality. However, as highlighted within the SNCB guidance, displacement will not be 100% across the distance over which the effect occurs but there will likely be a gradation, with decreasing effects at increased distance from an OWF (SNCBs, 2022).

5.6.3.32 Evidence from studies at operational OWFs also indicates that displacement effects are likely to decrease with distance from the array area. Studies in the German North Sea have shown that red-throated diver abundance declined within a wind farm and surrounding 1 km buffer by 94%, and within 10 km of the wind farm by 52% (Garthe *et al*., 2023). In the UK North Sea, Webb *et al*. (2017) estimated a decrease in density of 83% within the Lincs, Lynn and Inner Dowsing OWF based on visual and digital aerial surveys, with the displacement effect decreasing to 55% at 4 km and 34% at 8 km from the OWF. Post-construction monitoring at Kentish Flats in the UK southern North Sea using boat-based surveys indicated a 95% displacement rate within the OWF site, decreasing to 63% at 3 km from the OWF site (Percival *et al*., 2010).

5.6.3.33 Based on the above evidence, the displacement rates used within this assessment are:

- 100% displacement within the array area and 4km buffer; and
- 52% displacement from the 4km to 10km buffer.

5.6.3.34 Behaviour-based computer simulation models of waders, geese and sea ducks have demonstrated that displacement can, through changes to the energy budgets of individuals, lead to changes to mortality levels (SNCBs, 2022). However, no such effects were predicted when similar models were applied to wintering divers (Topping and Petersen 2011). This modelling predicted that even in a scenario where there were many OWFs in an area, the increase in population level mortality would be less than 2%. Additionally, a study in the German Bight found that though red-throated diver display strong avoidance behaviour, this disturbance does not translate to declines at the population level (Vilela *et al.*, 2021). The addition of 20 OWFs in the German North Sea (within a study area of 28,625km^2), while contributing to diver disturbance behaviour, did not affect divers at the population level, and no declines were seen as the population fluctuated around 16,600 individuals with an annual 95% CI between 13,400 and 21,360 individuals. Therefore the realistic worst-case scenario for mortality is considered to be 2%, with 1% mortality considered more realistic.

5.6.3.35 An overview of the displacement and mortality rates during the O&M phase is presented in Table 27 below.

Table 27 Displacement and mortality rates used for the assessment in O&M phases

Species	Displacement Rate (%)	Mortality Rate (%)
Guillemot	▪ 50 (plus range of 30% to 70%); ▪ 60% (NatureScot)	▪ 1% (plus 1% to 2%); ▪ 3 to 5% breeding, 1 to 3% non-breeding (NatureScot)
Razorbill	▪ 50 (plus range of 30% to 70%); ▪ 60% (NatureScot)	▪ 1% (plus 1% to 2%); ▪ 3 to 5% breeding, 1 to 3% non-breeding (NatureScot)
Gannet	▪ 70% (plus range of 60% to 80%)	▪ 1% ▪ 1 to 3% (NaureScot)
Shag	▪ 60% (plus range of 40% to 80%)	▪ 1%
Red-throated diver	▪ Array and 4km buffer = 100% ▪ 4 to 10km buffer = 52%	▪ 1% to 2%
Common scoter	▪ 100%	▪ 1% to 2%
Great northern diver	▪ 100%	▪ 1% to 2%
Kittiwake	▪ 30%	▪ 1% to 3%

Combined Displacement and Collision Impacts

5.6.3.36 During operation and maintenance, gannet and kittiwake have been assessed at a number of SPAs for impacts by both displacement and collision risk (see Table 28Table). Throughout the assessment for gannet, macro-avoidance rates have been used to avoid overestimation of combined impacts of collision and displacement. To avoid this overestimation, the macro-avoidance rate of 70% was applied which reduced the density of gannet in flight going into the CRM by 70%, as per the Natural England interim advice on updated CRM parameters (Natural England, July, 2022). The avoidance rates used have been detailed in the CRM. It is noted that macro-avoidance has not been taken into account for kittiwake displacement within the CRM, therefore the combined results are therefore over-precautionary.

5.6.3.37 The subsequent potential collision mortalities were then summed with the potential displacement mortalities for each relevant SPA. The screening process has identified the features and sites to have potential for disturbance and displacement during the operation and maintenance phase (LSE cannot be ruled out) as those presented in Table 28Table below.

Table 28 Sites and associated designated features identified where LSE cannot be ruled out from combined impacts from collision risk and disturbance / displacement within the O&M phase.

Site	Feature
Saltee Islands SPA [IE004002]	Kittiwake Gannet
Grassholm SPA [UK901401]	Gannet
Ailsa Craig SPA [UK9003091]	Gannet Kittiwake
Howth Head Coast SPA [IE004113]	Kittiwake
Ireland’s Eye SPA [IE004117]	Kittiwake
Lambay Island SPA [IE004069]	Kittiwake
Wicklow Head SPA [IE004127]	Kittiwake
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfo SPA [UK9014051]	Kittiwake
Helvick Head and Ballyquin SPA [IE00665]	Kittiwake
Old Head of Kinsale SPA [IE004021]	Kittiwake
Rathlin Island SPA [UK9020011]	Kittiwake
North Colonsay and Western Cliffs SPA [UK9003171]	Kittiwake
St Kilda SPA [UK9001031]	Gannet
Cape Wrath SPA [UK9001231]	Kittiwake
Sule Skerry and Sule Stack SPA [UK9002181]	Gannet
North Rona and Sula Sgeir SPA [UK9001011]	Gannet

Indirect impacts on prey

5.6.3.38 Long term subtidal habitat loss impacts will occur during the construction phase and will be continuous throughout the anticipated 30-year operation and maintenance phase. Long term habitat loss will occur directly under all turbine and OSP foundation structures, and at any associated scour protection and cable protection (including at cable crossings) where this is required. The seabed habitats removed by the installation of infrastructure will reduce the amount of suitable habitat and available food resource for fish and shellfish species and benthic communities associated with the baseline substrates/sediments, which could in turn, reduce the availability of these prey species for foraging seabirds in the vicinity.

5.6.3.39 The screening process has identified the features and sites to have potential impacts from indirect impacts to prey during the operation and maintenance phase (LSE cannot be ruled out) as those presented in Table 29.

Table 29 Sites and associated designated features identified where LSE cannot be ruled out from indirect impacts from prey within the O&M phase

Site	Feature
North-west Irish Sea SPA [IE004236]	▪ Red-throated diver ▪ Great northern diver ▪ Common scoter ▪ Guillemot ▪ Razorbill ▪ Puffin ▪ Fulmar ▪ Manx shearwater ▪ Cormorant ▪ Shag ▪ Black-headed gull ▪ Common gull ▪ Lesser black-backed gull ▪ Herring gull ▪ Great black-backed gull ▪ Kittiwake ▪ Roseate tern ▪ Common tern ▪ Arctic tern ▪ Little tern ▪ Little gull
South Dublin Bay and River Tolka Estuary SPA [IE004024]	▪ Roseate tern ▪ Common tern ▪ Arctic tern ▪ Black-headed gull
North Bull Island SPA [IE004006]	▪ Black-headed gull
Howth Head Coast [IE004113]	▪ Kittiwake
The Murrough SPA [IE004186]	▪ Herring gull ▪ Black-headed gull ▪ Little tern ▪ Red-throated diver
Dalkey Islands SPA [IE004172]	▪ Arctic tern ▪ Common tern ▪ Roseate tern

Site	Feature
Ireland's Eye SPA [IE004117]	▪ Razorbill ▪ Guillemot ▪ Herring gull ▪ Kittiwake ▪ Cormorant

5.6.3.40 However, the majority of fish species would be able to avoid habitat loss effects due to their greater mobility and would recover following completion of construction in the areas affected where temporary disturbance has taken place. Sandeels (and other less mobile prey species) would be affected by long term subtidal habitat loss due to the addition of permanent infrastructure, although recovery of this species is expected to occur quickly as the sediments recover following installation of infrastructure and adults recolonise and also via larval recolonisation of any sandy sediments in the vicinity.

5.6.3.41 As no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them have been identified, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter (Table 30), then there is no potential for any indirect effects of an adverse significance to occur on foraging seabirds in the vicinity. The impacts on prey species have therefore not been considered in further detail within the NIS and have been screened out from any further assessment.

Table 30 Operation and maintenance conclusions of effects on benthic invertebrates and fish and relevant Chapter references.

Receptor	Impact	Conclusion	Chapter Reference
Fish and Shellfish	Habitat loss	The magnitude of the impact on fish receptors has been assessed as Negligible, with the maximum sensitivity of the receptors being Low. Therefore, the significance of effect of long-term loss of habitat on fish receptors is a Neutral Effect, which is not significant.	Volume 3: Chapter 4
Benthic Ecology	Habitat loss	The magnitude for impacts in the subtidal and intertidal is assessed as Low Adverse, with the maximum sensitivity of the receptors in the subtidal and intertidal is High. Therefore, the significance of effect from habitat loss as a result of Dublin offshore infrastructure is Moderate Adverse within the subtidal and intertidal regions, which is not significant in EIA terms.	Volume 3: Chapter 3

5.6.4 Additional assessment information

Seasonal variation

5.6.4.1 The population of birds in the area in and around Dublin Array changes throughout the year. Therefore, the assessment is carried out on a seasonal basis for species from each screened in SPA.

5.6.4.2 During the defined breeding season, when birds are limited in the distance and number of days over which they can forage by the need to return regularly to the nest site, it can be expected that the area in and around Dublin Array will contain a high proportion of adult birds that can be attributed to those designated sites within foraging range. Therefore, predicted impacts can be apportioned to each of these sites, as well as non-designated sites, within foraging range. Currently, there is no Irish specific guidance on the methodology for apportioning impacts to designated sites, therefore the proposed methodology for Dublin Array is presented in Appendix C of this HDA. This proposed methodology is in line with other offshore wind farm projects within proximity to Dublin Array and follows the guidance set out by NatureScot (2018).

5.6.4.3 As per NatureScot (2018) guidance, the proportion of potential impacts being apportioned to each breeding colony was calculated based on the i) colony population size; ii) distance from each colony (geometric centre) to Dublin Array (geometric centre); and iii) proportion of sea within foraging range (as presented in Woodward *et al*., 2019). This weighting was then applied to the predicted breeding season mortalities to provide the proportion of mortalities for each colony. For this assessment, impacts are apportioned to breeding adults only during the breeding season, therefore immatures and sabbaticals are removed from this assessment. Table 31 presents the proportion of adults in the population during the breeding season, which was taken from Furness (2015), and the adaptations to remove sabbaticals. For further details regarding the apportioning methodology applied here see Appendix C of this HDA.

Table 31. Demographic data used for the breeding season apportioning of impacts for the NIS derived from Furness (2015).

Species	Adult proportion	Sabbatical rate	Adult proportion including sabbatical rate
Guillemot	0.57	0.07	0.53
Razorbill	0.57	0.07	0.53
Gannet	0.55	0.10	0.50
Kittiwake	0.53	0.10	0.48
Roseate tern	0.57	-	-
Common tern	0.60	-	-
Herring gull	0.48	0.35	0.31
Lesser black-backed gull	0.60	0.34	0.39
Shag	0.43	-	-
Manx shearwater	0.54	-	-

5.6.4.4 Outside the defined breeding season, the population of each species contains a mix of individuals from Irish breeding colonies and from further away, therefore, a much lower percentage of birds can be attributed to any particular breeding colony SPA population. During these non-breeding defined seasons, regional populations have been defined for the purpose of apportionment. Currently, there are no Irish specific bio-geographically defined populations during the non-breeding season for seabird species, therefore the proposed methodology for calculating these regional populations for use in the Dublin Array assessment for each species and the subsequent apportioning methodology during the non-breeding season is presented in Appendix C of this HDA.

5.6.4.5 Apportionment outside of the breeding season was undertaken by calculating the proportion that each colony contributes to the non-breeding regional population. The non-breeding season apportioning approach used the following data: i) Furness (2015) defined seasons; ii) breeding populations for UK sites (Furness, 2015), most recent SPA breeding adult populations Cummins *et al*. (2019) or the SMP; iii) non-breeding season population sizes (UK BDMPS equivalent); iiii) proportions of SPA adult population remaining in relevant regions during the non-breeding bio-seasons. The apportioning approach considers regional populations of birds present in the non-breeding season and sites that are within the relevant regional population area for each species (see Appendix C of this HDA).

Biologically Defined Seasons

5.6.4.6 Table 32 presents the biologically defined seasons used in the assessment for Dublin Array. Due to the lack of Irish specific data, these seasons have been taken from Furness (2015) which defines seabird seasons in UK waters, as these seasons are the most geographically relevant seasons to colonies in Ireland.

5.6.4.7 For this assessment, impacts have been presented for the full breeding season for all species except kittiwake, for which the migration-free breeding season (May to July) has been used (see Table 32). This is because there is evidence from Irish colonies that the breeding season is over by the end of July, with adults and fledged chicks predominantly having left the colonies by the end of July (C. Barton pers. obs.).

Assessment thresholds

5.6.4.8 For impacts where a quantitative assessment Is provided (disturbance and displacement, and collision risk), impacts are considered in the context of the percentage increase in baseline mortality relative to the designated site population size. Where the percentage increase in baseline mortality is lower than 1%, the impact is deemed to be undetectable in the context of natural variation in baseline mortality (recommended in Natural England guidance, Parker *et al*., 2022c). Impacts on designated sites which represent a greater than 0.05% increase in baseline mortality for the project alone are also considered at the in-combination level, with impacts below this threshold concluded to be so low that they would make no material contribution to any in-combination effect and therefore do not require further consideration. In addition, impacts greater than 0.05% increase in baseline mortality but the number of mortalities is <0.2 individuals per annum are not taken forward for an in-combination assessment as they are considered sufficiently small that they would make no material contribution to an in-combination impact. These thresholds has been determined using expert assessment of similar thresholds found in other OWF projects.

5.6.4.9 Where an impact exceeds a 1% increase in baseline mortality (either for the project alone, or in-combination), further consideration to the impact is given to determine if AEoI can be ruled out, such as through Population Viability Analysis (PVA). This threshold is recommended in Natural England guidance (Parker *et al*., 2022c), and has been applied throughout the industry in other OWF projects as standard.

5.6.4.10 Outputs from PVA are presented as the counterfactuals population growth rate (CGR) and counterfactual population size (CPS). The CGR represents the median of the ratio of the annual growth rate of the impacted to un-impacted population and the CPS is the median of the ratio of end-point size of the impacted to un-impacted (baseline) population. When interpreting PVA results, 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. However, impacts are also considered in the context of the annual population growth rate based on available data. Therefore, if the CGR is above 0.995, then no AEoI is concluded.

Table 32 Defined seasons used as the basis for assessment. Based on Furness (2015).

Species	Breeding Season	Pre-breeding migration	Migration-free winter / Non-breeding season	Post-breeding migration
Gannet	March-September	December-February	N/A	October-November
Kittiwake	March-August (Migration free – May to July)	January-February	N/A	September-December
Lesser black-backed gull	April-August	March	November-February	September-October
Herring gull	March-August	N/A	September-February	N/A
Guillemot	March-July	N/A	August-February	N/A
Razorbill	April-July	January-March	November-December	August-October
Common tern	May-August	April	N/A	September
Roseate tern	May-August	April	N/A	September

5.6.5 Migratory Collision Risk Assessment

Assessment Information

5.6.5.1 Throughout the migratory collision risk assessment, sites have been assessed against their ability to meet their targets and conservation objectives. The conservation objectives are further discussed in Appendix A. The conservation objectives for all sites screened in for migratory collision risk are to maintain the favourable conservation condition of the bird species listed as Special Conservation Interests for the SPA. The targets associated with each site-specific conservation objectives are described in Table 33.

Table 33 Conservation objectives for sites screened in for migratory collision risk.

<table>
<tr><th>Site</th><th>Specific targets associated with the site conservation objective</th></tr>
<tr><td>Baldoyle Bay SPA [IE0004016]</td><td rowspan="6">Favourable conservation status is achieved when:
▪ The long-term population trend is stable or increasing; and
▪ There is no significant decrease in the range, timing and intensity of use of areas by these species, other than that occurring from natural patterns of variation.</td></tr>
<tr><td>Ballycotton Bay SPA [IE004022]</td></tr>
<tr><td>Ballymacoda Bay SPA [IE004023]</td></tr>
<tr><td>Blackwater Estuary SPA [IE004028]</td></tr>
<tr><td>North Bull Island SPA [IE0004006]</td></tr>
<tr><td>South Dublin Bay and River Tolka Estuary SPA [IE0004024][1]</td></tr>
<tr><td>Dungarvan Harbour SPA [IE004032]</td><td>Favourable conservation status is achieved when:
▪ The long-term population trend is stable or increasing; and
▪ There is no significant decrease in the numbers or range of areas used by these species, other than that occurring from natural patterns of variation.</td></tr>
<tr><td>The Murrough SPA [IE0004186]</td><td>Favourable conservation status is achieved when:
▪ The long-term population trend is stable or increasing;
▪ There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population target;
▪ Disturbance occurs at levels that do not significantly impact the achievement of targets for population trend and spatial distribution;
▪ Barriers do not significantly impact the wintering population's access to the SPA or other ecologically important sites outside the SPA;
▪ There is a sufficient number of locations, area of suitable habitat and available</td></tr>
</table>

Site	Specific targets associated with the site conservation objective
	forage biomass to support the population target; ▪ There is a sufficient number of locations, area and availability of suitable roosting habitat to support the population target; and ▪ There is a sufficient area of utilisable habitat available in ecologically important sites outside the SPA.
Wicklow Mountains SPA [IE002122]	Favourable conservation status is achieved when: ▪ The breeding population is stable/increasing; ▪ The productivity rate is sufficient to meet the population size target; ▪ There is sufficient availability of suitable nesting sites throughout the SPA to maintain the population; ▪ There is sufficient availability of suitable foraging habitat across the SPA to support targets relating to population size, productivity rate and distribution; and ▪ Disturbance occurs at levels that do not significantly impact upon the breeding population.

1 Grey Plover is proposed for removal from the list of Special Conservation Interests for South Dublin Bay and River Tolka Estuary SPA. As a result, a site-specific conservation objective has not been set for this species. Nevertheless, on a precautionary basis grey plover has been assessed using the generalised conservation objectives for other waterbirds for this SPA and those assigned for grey plover designated at other SPAs.

Conclusions

5.6.5.2 The potential collision risk for relevant migratory species was estimated using migratory collision risk modelling (mCRM). Using project parameters (turbine parameters, array footprint etc.), bird specific biometrics and population estimates, and data on the number of birds predicted to pass through the array on migration the mCRM presents the predicted number of annual collisions estimated for each screened-in species. To model the movements of migratory birds for Dublin Array the Marine Scotland Avian Migration Collision Risk Model Shiny Application ("mCRM App”) was used. Further information regarding the specifics of methodology and input parameters are available in the CRM.

5.6.5.3 The apportionment of collision mortalities was calculated as the SPA citation population divided by the sum of all citation populations screened in for that species.

Table 34 Migratory species collision risk assessment outputs for screened-in SPAs

Site (SPA)	Distance to DA Array (km)	Migratory seabird species	SPA citation count	Predicted impact (no. mortalities)	Apportioned impact (no. mortalities)	Increase to baseline mortality (%)
Baldoyle Bay SPA [IE0004016]	14.05	Grey plover	200	0	0.00	0.000
		Light-bellied brent goose	726	0.008	0.00	0.002
		Ringed plover	223	0.02	0.01	0.012
		Shelduck	147	0.03	0.00	0.014
Ballycotton Bay SPA [IE004022]	200.57	Black-tailed godwit	136	0.028	0.00	0.017
		Curlew	853	0.016	0.00	0.003
		Grey plover	124	0.000	0.00	0.000
		Lapwing	2782	0.020	0.00	0.001
		Ringed plover	167	0.02	0.00	0.012
		Teal	903	0.45	0.12	0.028
		Turnstone	179	0.022	0.01	0.024
Ballymacoda Bay SPA [IE004023]	189.49	Black-tailed godwit	765	0.028	0.01	0.017
		Curlew	1145	0.016	0.00	0.003
		Dunlin	3192	0.136	0.03	0.003
		Grey plover	535	0.000	0.00	0.000
		Lapwing	4063	0.020	0.01	0.001
		Redshank	357	0.028	0.00	0.003
		Ringed plover	153	0.02	0.00	0.012
		Teal	887	0.45	0.12	0.028
		Turnstone	137	0.022	0.00	0.024
		Wigeon	907	0.524	0.15	0.036

Site (SPA)	Distance to DA Array (km)	Migratory seabird species	SPA citation count	Predicted impact (no. mortalities)	Apportioned impact (no. mortalities)	Increase to baseline mortality (%)
Blackwater Estuary SPA [IE004028]	181.21	Black-tailed godwit	620	0.028	0.01	0.017
		Curlew	1007	0.016	0.00	0.003
		Dunlin	1807	0.136	0.02	0.003
		Lapwing	3054	0.020	0.00	0.001
		Redshank	520	0.028	0.00	0.003
		Wigeon	953	0.524	0.16	0.036
Dungarvan Harbour SPA [IE004032]	161.02	Black-tailed godwit	779	0.028	0.01	0.017
		Curlew	766	0.016	0.00	0.003
		Dunlin	4984	0.136	0.04	0.003
		Great crested grebe	53	0.009	0.01	0.063
		Grey plover	444	0.000	0.00	0.000
		Knot	698	0.024	0.00	0.004
		Lapwing	3233	0.020	0.00	0.001
		Light-bellied brent goose	723	0.008	0.00	0.002
		Oystercatcher	767	0.034	0.01	0.008
		Red-breasted merganser	52	0.024	0.02	0.243
		Redshank	731	0.028	0.01	0.003
		Shelduck	538	0.03	0.01	0.014
		Turnstone	177	0.022	0.01	0.024
North Bull Island SPA [IE0004006]	10.22	Black-tailed godwit	367	0.028	0.00	0.017
		Curlew	937	0.016	0.00	0.003
		Dunlin	4146	0.136	0.04	0.003

Site (SPA)	Distance to DA Array (km)	Migratory seabird species	SPA citation count	Predicted impact (no. mortalities)	Apportioned impact (no. mortalities)	Increase to baseline mortality (%)
		Grey plover	517	0.000	0.00	0.000
		Knot	2837	0.024	0.02	0.004
		Light-bellied brent goose	1548	0.008	0.00	0.002
		Oystercatcher	1784	0.034	0.02	0.008
		Pintail	233	0.020	0.02	0.025
		Redshank	1431	0.028	0.01	0.003
		Shelduck	1259	0.03	0.02	0.014
		Shoveler	141	0.015	0.02	0.025
		Teal	953	0.45	0.13	0.028
		Turnstone	157	0.022	0.01	0.024
South Dublin Bay and River Tolka Estuary SPA [IE0004024]	12.06	Dunlin	1923	0.136	0.02	0.003
		Grey plover	45	0.000	0.00	0.000
		Knot	548	0.024	0.00	0.004
		Light-bellied brent goose	368	0.008	0.00	0.002
		Oystercatcher	1145	0.034	0.01	0.008
		Redshank	260	0.028	0.00	0.003
		Ringed plover	161	0.02	0.00	0.012
The Murrough SPA [IE0004186]	2.39	Light-bellied brent goose	859	0.008	0.00	0.002
		Teal	644	0.45	0.09	0.028
		Wigeon	1209	0.524	0.21	0.036
Wicklow Mountains SPA [IE002122]	18.16	Merlin	18	0.012	0.01	0.556

5.6.5.4 For migratory species, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the populations for all screened-in SPAs (Table 34). There is, therefore, no potential for an AEoI to the population conservation objectives of screened-in SPAs of migratory species in relation to collision risk effects from Dublin Array alone. Therefore, subject to natural change, migratory species features will be maintained in the long term with respect to the potential for collision risk.

5.6.6 Dalkey Island SPA

Features and Effects for Assessment

5.6.6.1 Potential for LSE alone has been identified for the following feature of Dalkey Island SPA:

- Common tern
  - Collision risk (O&M only)
- Roseate tern
  - Collision risk (O&M only)

Assessment Information

5.6.6.2 The conservation objective (as described in Appendix A) for Dalkey Island SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.6.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved is when:

- The long-term SPA population trend is stable or increasing;
- There is sufficient availability of suitable roosting resources within the SPA to maintain a stable or increasing population;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- Disturbance occurs at levels that do not significantly impact on birds at the roost sites;
- Disturbance occurs at levels that do not significantly impact on the post-breeding and passage population; and
- Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.

Common Tern

Collision Risk (Operation and Maintenance)

5.6.6.4 Dalkey Islands SPA is 8.57 km (around land) from Dublin Array, within the MMFR ± 1SD of common tern (18.0±8.9 km; Woodward *et al*., 2019). Common tern have been screened into the assessment for collision risk as they are susceptible to collision due to their distribution (Bradbury *et al*., 2014).

5.6.6.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Common tern have been assessed during the breeding season of May to August, the post-breeding season of early September, and the pre-breeding season of April in relation to Dalkey Islands SPA. Table 35 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Dalkey Islands SPA during each defined season and the overall annual impact.

5.6.6.6 Impacts are assessed relative to the citation population of 124 individuals (with a background mortality of 14.5 individuals per annum), and the most recent count (2017) of 30 individuals (with a background mortality of 3.5 individuals per annum).

Table 35 Common tern predicted collision mortalities during the operation and maintenance phase attributed to Dalkey Island SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined Season	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Dalkey Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Citation population	Most recent population
Breeding (May – Aug)	2.26	0.08	0.563	2.328
Post-breeding (Early sep)	0.71	<0.01 (0.003)	0.023	0.095
Pre-breeding (Apr)	0.02	<0.01 (0.0001)	0.001	0.003
Annual total	**2.99**	**0.09**	**0.587**	**2.426**

Breeding season

5.6.6.7 The predicted common tern collision mortality during the breeding season is 2.26 individuals (see CRM Appendix 4.3.6-4 of the EIAR). Assuming that 60% of the population are adults (Table 31; Furness, 2015), the total predicted number of breeding adult collisions is 1.36 per annum during the breeding season.

5.6.6.8 It is estimated that 6.0% of predicted mortalities during the breeding season derive from Dalkey Islands SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Dalkey Islands SPA during the breeding season is less than one (0.08) breeding adults per annum (Table 35).

5.6.6.9 The population of common tern at Dalkey Islands SPA has reduced since the citation colony count in 2003 of 124 individuals, having decreased to 30 individuals (2017). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.6.10 Using the citation colony count of 124 breeding adults and an annual background mortality of 14.5 individuals, the addition of 0.08 predicted breeding adult mortalities would result in a 0.563% increase in baseline mortality during the breeding season. When considering the most up to date counts of 30 and an annual background mortality of 3.5 adults, this results in an increase of 2.328% in baseline mortality during the breeding season (Table 35).

Non-breeding season

5.6.6.11 The predicted common tern collision mortality during the post-breeding season is 0.71 individuals and 0.02 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.5% of predicted mortalities during the post-breeding season are estimated to derive from Dalkey Islands SPA and 0.5% during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult common tern during the post-breeding season is predicted at less than one (0.003) and less than one (0.0001) during the pre-breeding season per annum.

5.6.6.12 Based on the 2003 citation colony count of 124 breeding adults and using an annual background mortality of 14.5 individuals, the addition of 0.003 and 0.0001 predicted breeding adult mortalities would result in a 0.023% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 30 and an annual background mortality of 3.5 adults, this results in an increase of 0.095% and 0.003% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 35).

5.6.6.13 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.003) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.024% and 0.098%, respectively (Table 35).

Annual total

5.6.6.14 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Dalkey Islands SPA, is less than one (0.09) common tern per annum. The addition of 0.09 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.587% and. 2.426% respectively (Table 35).

5.6.6.15 For the citation count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. For the most recent count, the increase in baseline mortality was predicted to be greater than 1%. However, impacts from the Dublin Array are less than 0.1 birds per annum and the small predicted impact is considered to be an overestimate of realistic impacts on common tern based on a combination of the precautionary nature of CRM and recorded site-specific flight heights, as during the boat-based surveys, zero common tern were observed flying at rotor height (29.5m) across 360 observations. Considering the impact is <0.1 birds per annum, there is, no potential for an AEoI to the population conservation objective of the common tern feature of Dalkey Islands SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the common tern feature will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table 36.

Table 36. Collision risk assessment conclusions for common tern at Dalkey Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	Though the predicted impact exceeds a 1% increase in baseline mortality based on the most recent, the impact is <1% based on the citation population. The impacts from the Dublin Array are less than 0.1 birds per annum and the small predicted impact is considered to be an overestimate of realistic impacts on common tern based on a combination of the precautionary nature of CRM and recorded site-specific flight heights. A such there is, no potential for an AEoI to the population conservation objective of the common tern feature of Dalkey Islands SPA in relation to potential collision risk from Dublin Array alone.
There is sufficient availability of suitable roosting resources within the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable roosting resources. There is, therefore, no potential for an AEoI to the COs of the common tern at Dalkey Island SPA in relation to availability of roosting resources from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the common tern at Dalkey Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the roost sites;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the roost site. There is, therefore, no potential for an AEoI to the COs of the common tern at Dalkey Island SPA in relation to roost site disturbance from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on the post-breeding and passage population; and	Common tern is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) common tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an AEoI to the conservation objectives of the common tern feature of Dalkey Island SPA in relation to potential displacement effects from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	For most collision risk species 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'. There is, therefore, no potential for an AEoI to the COs of the common tern at

Conservation Objective	Conclusion
	Dalkey Island SPA in relation to barrier effects from Dublin Array alone.

Roseate tern

Collision Risk (Operation and Maintenance)

5.6.6.16 Roseate tern is designated as a passage feature at Dalkey Island SPA as the area is an important staging/passage site for a Roseate tern in the autumn (mostly late July to September). Roseate tern no longer breed at this site, therefore the feature has only been assessed during the non-breeding season. Roseate tern have been screened into the assessment for collision risk as they are susceptible to collision due to their distribution (Bradbury *et al*., 2014).

5.6.6.17 Table 37 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to South Dublin Bay and River Tolka SPA for staging/passage. It is noted that there are no Roseate tern breeding colonies within MMFR + 1SD of Dublin Array, therefore all potential predicted mortalities have been assessed during passage as they are known to come to this site earlier than the defined migration season (mostly late July to September).

5.6.6.18 The post-breeding impacts are assessed relative to the citation passage population of 2,000 individuals (with a background mortality of 290.0 individuals per annum), and an adaption of the BDMPS estimate of 5,797 individuals (with a background mortality of 921.9 individuals per annum). The most recent regional population estimate (original BDMPS estimate of 6,358 individuals) was derived from the most recently available counts for the two Irish breeding colonies, which were estimated at 1,704 pairs at Rockabill in 2021 (BWI, 2021), and 273 pairs at Lady's Island Lake in 2020 (Irish Times, 2020). However, the majority of individuals passing through will have come from Rockabill, therefore only the population (adults and juveniles) from Rockabill were included in this assessment (the adapted BDMPS value) on a precautionary basis.

Table 37 Roseate tern predicted collision mortalities during the operation and maintenance phase attributed to Dalkey Island SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined Season	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Dalkey Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Citation population	Most recent population
Post-breeding (June – Sep) (adapted to	0.27	0.27	0.093	0.032

Defined Season	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Dalkey Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Citation population	Most recent population
include all collisions)				
Pre-breeding (Apr)	0.00	0.00	-	-
Total	**0.27**	**-**	**-**	**-**

Non-breeding season

5.6.6.19 The predicted Roseate tern collision mortality during the post-breeding season is 0.27 individuals, with 0 during the pre-breeding season. Based on the 1999 citation passage count of 2,000 individuals and using an annual background mortality of 290.0 individuals, the addition of 0.27 predicted breeding adult mortalities would result in a 0.093% increase in baseline mortality during the post-breeding season. When considering the most up to date counts of 5,797 and an annual background mortality of 840.6 individuals, this results in an increase of 0.032% in baseline mortality during the post-breeding (Table 37).

5.6.6.20 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Roseate tern feature of Dalkey Island SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the Roseate tern feature will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table 38.

Table 38. Collision risk assessment conclusions for Roseate tern at Dalkey Island SPA.

Conservation Objective	Conclusion
The long-term SPA post-breeding and passage population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. A such there is, no potential for an AEoI to the population conservation objective of the Roseate tern feature of Dalkey Islands SPA in relation to potential collision risk from Dublin Array alone.
There is sufficient availability of suitable roosting resources within the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable roosting resources. There is, therefore, no potential for an AEoI to the COs of the Roseate tern at Dalkey Island SPA in relation to availability of roosting resources from Dublin Array alone.

Conservation Objective	Conclusion
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the Roseate tern at Dalkey Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the roost sites;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the roost site. There is, therefore, no potential for an AEoI to the COs of the Roseate tern at Dalkey Island SPA in relation to roost site disturbance from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on the post-breeding and passage population; and	Roseate tern is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) common tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an AEoI to the conservation objectives of the common tern feature of Dalkey Island SPA in relation to potential displacement effects from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	For most collision risk species 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'. There is, therefore, no potential for an AEoI to the COs of the Roseate tern at Dalkey Island SPA in relation to barrier effects from Dublin Array alone.

5.6.7 The Murrough SPA

Features and Effects for Assessment

5.6.7.1 Potential for LSE alone has been identified for the following designated wintering feature of The Murrough SPA:

- Red-throated diver
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)

Assessment Information

5.6.7.2 The conservation objective (as described in Appendix A) for The Murrough SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.7.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- The long-term SPA non-breeding population trend is stable or increasing;
- There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population target;
- Disturbance occurs at levels that do not significantly impact the achievement of targets for population trend and spatial distribution;
- Barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target; and
- There is a sufficient number of locations, area and availability of suitable roosting habitat to support the population target.

Red-throated diver

5.6.7.4 The Murrough SPA is located 2.40km from the array area (based on the recent seaward extension). Based on these distances, it is considered that there is the potential for disturbance or displacement effects on red-throated diver as this species has a very high sensitivity to disturbance and displacement (Bradbury *et al.*, 2013) and UK SNCB advice specifies that potential displacement effects can apply to red-throated diver out to 10km from the array area (SNCBs, 2022a).

5.6.7.5 Red-throated divers were recorded in low numbers during the non-breeding season, with only two sightings between May and September. A total of 12 birds were recorded on 2016-2017 baseline surveys between October and May. On 2019-2020 surveys, 51 red-throated divers were recorded between September and April, with a peak of nine birds in January 2020. Overall combined average abundance (birds/km) was low, with a peak of 0.12 birds/km recorded. The baseline surveys extended out to 4km from the array area, therefore to consider potential impacts between 4 and 10km from the array area data from the SPA citation and ObSERVE dataset (Jessop *et al.,* 2018) have been analysed.

Disturbance and Displacement

Construction and Decommissioning

5.6.7.6 The potential red-throated diver displacement mortality from the construction and decommissioning of Dublin Array attributed to Murrough Head SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.7.7 The Murrough SPA is located 2.40km from the array area (based on the recent seaward extension). Based on these distances, it is considered that there is the potential for disturbance or displacement effects on red-throated diver. UK SNCB advice specifies that potential displacement effects can apply to red-throated diver out to 10 km from the array area (SNCBs, 2022a).

5.6.7.8 The recent seaward extension for the Murrough SPA covers an area of 91.8 km^2. If displacement effects on red-throated diver extend out to 10 km from the array area, then this could potentially affect an area of 40.36 km^2 within The Murrough SPA. This equates to approximately 44.0% of the overall area of sea covered by The Murrough SPA. It is noted that low numbers of red-throated diver were recorded within the array area and 4 km buffer during the surveys, with peaks of 5 and 9 individuals. Red-throated divers were scattered in low numbers predominantly across the southern half of the offshore ornithology study area, with fewer birds recorded in the northern half, during both periods of baseline surveys. Based on the low numbers of red-throated diver observed within the array area and 4 km buffer, it is assumed that any impacts within 4km would be negligible. Therefore, this assessment focuses on the potential impacts outwith the 4km buffer. The buffer overlap between the 4 – 10km buffer covers an area of 38.04km^2, 33.8% of the SPA.

5.6.7.9 For red-throated diver, the estimated number of birds within the Murrough SPA in winter was 32 birds based on the SPA citation (NPWS, 2015) and 131 based on the updated SPA boundary (NPWS, 2024). If it is assumed that red-throated divers are evenly distributed across the SPA then, as the 4 – 10 km buffer overlaps with 33.8% of the SPA area then it could be assumed that 33.8% of the total estimated SPA population would be within the 10 km buffer overlap. This would equate to approximately 11 and 44 red-throated divers based on the citation count and most recent population estimate respectively. Assuming a displacement rate within the 4 - 10 km buffer overlap area of 52% (based on Garthe *et al.,* 2023), then an estimated 6 (5.7) and 23 (23.02) birds would potentially be displaced from the 4 - 10 km buffer overlap area based on the citation count and most recent population estimate respectively. Therefore, based on 52% displacement and 1% mortality, the displacement consequent mortality is predicted as 0.06 and 0.23 mortalities, or 0.11 and 0.46 when considering 52% displacement and 2% mortality based on the citation count and most recent population estimate respectively.

5.6.7.10 The average mortality rate across all age classes for red-throated diver is 0.224. If the SPA population is assumed to be 32 birds for the citation count, then applying this mortality rate, the estimated baseline mortality for the SPA for red-throated diver is 7 (7.17) birds per non-breeding season (all ages) (population of wintering birds multiplied by the baseline morality rate). The additional predicted mortality of less than one red-throated divers in the non-breeding season would increase the baseline mortality rate by 0.837% (based on 52% displacement and 1% mortality) and 1.534% (based on 52% displacement and 2% mortality).

5.6.7.11 For the most recent count of 131 birds, the estimated baseline mortality for the SPA for red-throated diver is 29 (29.34) birds per non-breeding season (all ages) (population of wintering birds multiplied by the baseline morality rate). The additional predicted mortality of less than one red-throated divers in the non-breeding season would increase the baseline mortality rate by 0.784% (based on 52% displacement and 1% mortality) and 1.568% (based on 52% displacement and 2% mortality).

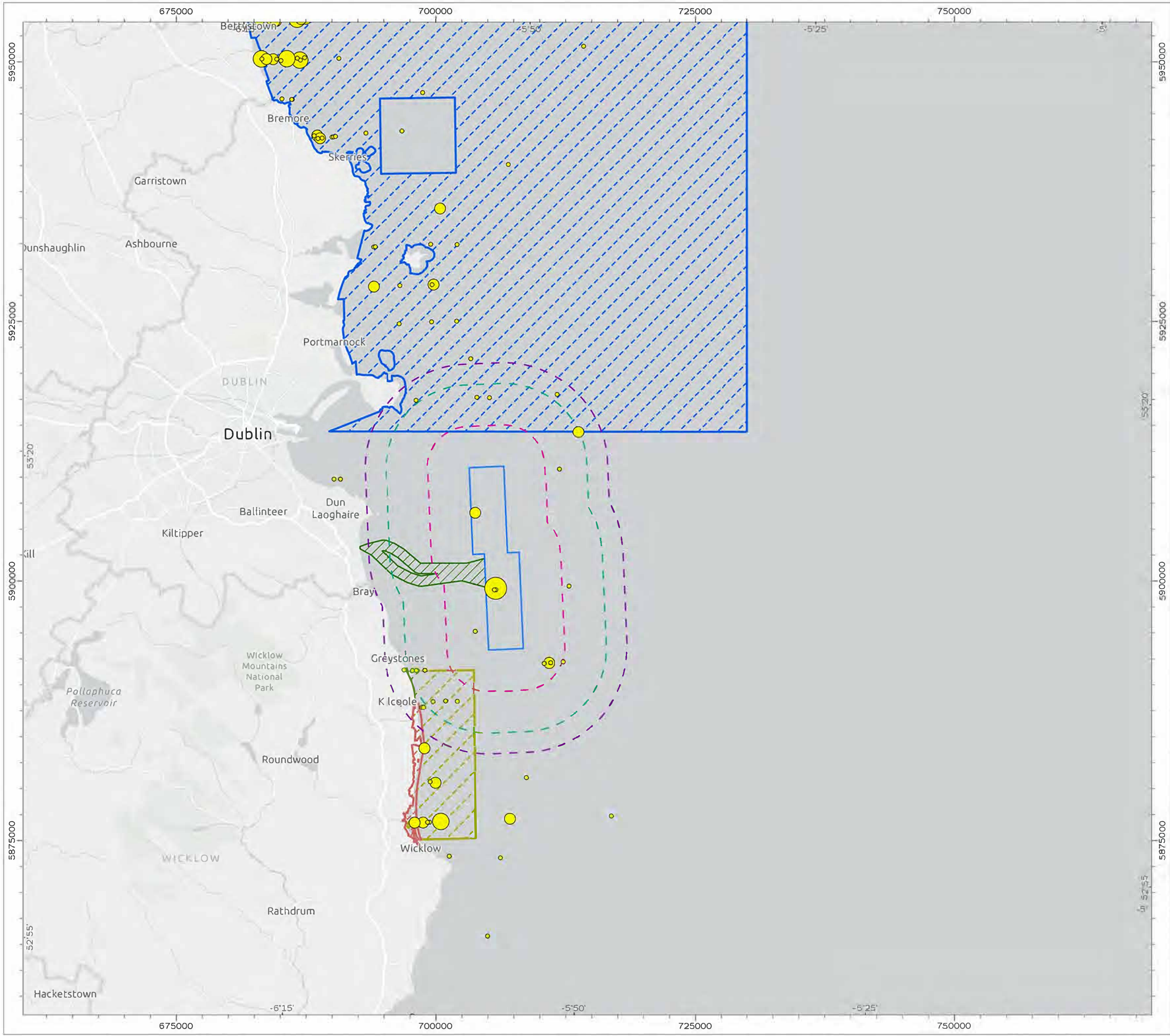
5.6.7.12 However, distribution data for red-throated divers from the 2016 ObSERVE surveys (Jessopp *et al*., 2018) shows that the majority of diver sightings within the revised boundary for The Murrough SPA were beyond the Dublin Array offshore infrastructure 10km buffer (Figure 9). This indicates that even though areas of the Dublin Array offshore infrastructure 10km buffer overlap with the SPA, the waters within the Dublin Array offshore infrastructure 10km buffer do not support the peak concentrations of red-throated divers within The Murrough SPA and the potential mortalities would be less than 0.23 or 0.46 when considering 52% displacement and 1%/2% mortality respectively. Moreover, based on the distribution data, the natural range of the species will not be negatively impacted by Dublin Array.

5.6.7.13 Based on the assessment above, the potential mortalities of red-throated diver from the Murrough SPA would be negligible, particularly when considering the distribution of red-throated diver within the SPA (Figure 9). There is, therefore, no potential for an AEoI of the Murrough SPA to occur, having regard to the population conservation objective of the red-throated diver wintering feature in relation to potential displacement effects from Dublin Array alone during the O&M phase. Therefore, subject to natural change, the red-throated diver feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of red-throated diver at the Murrough SPA. Conclusions against all conservation objectives are provided in Table 39.

Table 39. Displacement assessment conclusions for red-throated diver at The Murrough SPA.

Conservation Objective	Conclusion
The long-term SPA non-breeding population trend is stable or increasing	Though the predicted impact exceeds a 1% increase in baseline mortality based on the citation population when using the higher range of mortality, the distribution data presented in Jessop *et al*., (2018) indicated the natural range of the species will not be negatively impacted by Dublin Array (see Figure 9). Furthermore, based on the assessment above, the potential mortalities of red-throated diver from the Murrough SPA would be negligible. There is, therefore, no potential for an AEoI of the Murrough SPA to occur, having regard to the population conservation objective of the red-throated diver wintering feature in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population target	
Disturbance occurs at levels that do not significantly impact the achievement of targets for population trend and spatial distribution	
There is a sufficient number of locations, area and availability of suitable roosting habitat to support the population target	
Barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the red-throated diver at The Murrough SPA in relation to barrier effects from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the red-throated diver at The

Conservation Objective	Conclusion
	Murrough SPA in relation to prey biomass availability from Dublin Array alone.



Array Area
Export Cable Corridor
Array Area - 4km Buffer
Array Area - 8km Buffer
Array Area - 10km Buffer
The Murrough SPA (old boundary)
The Murrough SPA (new boundary)
North-West Irish Sea SPA

Divers Sightings - Jessop *et al.*, 2018
- 1
- 2 - 4
- 5 - 8
- 9 - 15

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Diver Sightings - Jessop *et al.*, 2018

DRAWING NUMBER: 9 | PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-14	For Issue	GB	BB	SS

0 3 6 9 12 km
0 2 3 5 6 nm

SCALE 1:375,000 | PLOT SIZE A3
DATUM WGS 1984 | VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe

Dublin Array — Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

5.6.8 North-west Irish Sea SPA

Features and Effects for Assessment

5.6.8.1 Potential for LSE alone has been identified for the following non-breeding features of North-west Irish Sea SPA:

- Red-throated diver
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
- Great northern diver
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
- Common scoter
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)

Assessment Information

5.6.8.2 The conservation objective (Appendix A) for the North-west Irish Sea SPA is to maintain or restore the favourable conservation condition of the species in North-west Irish Sea SPA.

5.6.8.3 Based on the above conservation objective, the specific targets for those screened in features of the SPA, in order for favourable conservation status to be achieved, is when:

- No significant decline in individuals of non-breeding population size;
- There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- 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;
- The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.

Red-Throated Diver

5.6.8.4 Red-throated diver have been screened in for the C&D and O&M phases to assess the potential of an AEoI from displacement in relation to potential disturbance. The potential for AEoI was assessed in relation to the following conservation objectives for this species, as a qualifying feature of the North-west Irish Sea SPA:

5.6.8.5 To maintain the favourable conservation condition of this species in North-west Irish Sea SPA, which is defined by the following list of attributes and targets:

- No significant decline in individuals of non-breeding population size.
- Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population.
- Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target.
- 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.
- The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.

5.6.8.6 Red-throated divers were recorded in low numbers during site-specific surveys only in the non-breeding season, with only two sightings between May and September. A total of 12 birds were recorded on 2016-2017 baseline surveys between October and May. On 2019-2020 surveys, 51 red-throated divers were recorded between September and April, with a peak of nine birds in January 2020. Overall combined average abundance (birds/km) was low, with a peak of 0.12 birds/km recorded. Nevertheless, this species has been screened in for assessment due to its very high sensitivity to disturbance and displacement (Bradbury *et al*., 2013).

Disturbance and Displacement

Construction and Decommissioning

5.6.8.7 The potential red-throated diver displacement mortality from the construction and decommissioning of Dublin Array attributed to North-west Irish Sea SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.8.8 The North-west Irish Sea SPA is located 3.36 km from the array area, therefore there is the potential for disturbance or displacement of red-throated diver from the array area. It is noted that low numbers of red-throated diver were recorded within the array area and 4km buffer during the surveys, with peaks of 5 and 9 individuals. Red-throated divers were scattered in low numbers predominantly across the southern half of the offshore ornithology study area, with fewer birds recorded in the northern half, during both periods of baseline surveys. Based on the low numbers of red-throated diver observed within the array area and 4km buffer, it is assumed that any impacts within 4km would be negligible. Therefore, this assessment focuses on the potential impacts outwith the 4km buffer.

5.6.8.9 The North-west Irish Sea SPA covers an area of 2,333 km^2. If displacement effects on red-throated diver extend out from 4km to 10km from the array area, then this could potentially affect an area of 106.03 km^2 within the North-west Irish Sea SPA. This equates to approximately 4.5% of the overall SPA area. However, as above, displacement will not be 100% across the distance over which the effect occurs, but there will likely be a gradation, with decreasing effects at increased distance from an OWF (SNCBs, 2022).

5.6.8.10 For red-throated diver, the estimated number of birds within the North West Irish Sea SPA in winter 2016-17 was 538 birds (NPWS, 2023). If it is assumed that red-throated divers are evenly distributed across the SPA then, as the 4 - 10km buffer overlaps with 4.5% of the SPA area then it could be assumed that 4.5% of the total estimated SPA population would be within the 10km buffer overlap. This would equate to approximately 24 red-throated divers. Assuming a displacement rate within the 4 - 10 km buffer overlap area of 52% (based on Garthe *et al.,* 2023), then an estimated 13 birds would be displaced from the 10 km buffer overlap area.

5.6.8.11 However, based on site-specific data, the abundances of red-throated diver in the North West Irish Sea SPA are low in the area that overlaps with the 4 - 10 km buffer from the array area (Figure 9). The number of potential mortalities is therefore likely to be lower than 13. Moreover, based on the distribution data, the natural range of the species will not be negatively impacted by Dublin Array.

5.6.8.12 Therefore, based on 52% displacement and 1% mortality, the displacement consequent mortality is predicted as 0.13 mortalities, or 0.25 when considering 52% displacement and 2% mortality.

5.6.8.13 The average mortality rate across all age classes for red-throated diver is 0.224. If the SPA population is assumed to be 538 birds, then applying this mortality rate, the estimated baseline mortality for the SPA for red-throated diver is 121 (120.5) birds per non-breeding season (all ages) (538 x 0.224). The additional predicted mortality of less than one red-throated divers in the non-breeding season would increase the baseline mortality rate by 0.108% (based on 100% displacement and 1% mortality) and 0.209% (based on 100% displacement and 2% mortality).

5.6.8.14 As red-throated diver presence in the array area was restricted to the non-breeding season, with no birds recorded between May and August, any disturbance from the array area will therefore be limited to the non-breeding season. Any potential disturbance and displacement effects on the red-throated diver population would contribute to a less than 1% increase in baseline mortality (0.108%), which is indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the red-throated feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone during the O&M phase. Therefore, subject to natural change, the red-throated diver feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of red-throated diver at NWIS SPA. Conclusions against all conservation objectives are provided in Table 40.

Table 40. Displacement assessment conclusions for red-throated diver at North-west Irish Sea SPA.

Conservation Objective	Conclusion
No significant decline in individuals of non-breeding population size;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. Additionally, potential displacement may occur within only 4.5% of the total area of the SPA. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the red-throated diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population;	
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;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the red-throated diver at North-west Irish Sea SPA in relation to prey biomass availability from Dublin Array alone.
The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the red-throated diver at North-west Irish Sea SPA in relation to barrier effects from Dublin Array alone.

Great northern diver

5.6.8.15 Great northern diver have been screened in for the C&D and O&M phases to assess the potential of an AEoI from disturbance / displacement. The potential for AEoI will be assessed in relation to the following conservation objectives for this species, as a qualifying feature of the North-west Irish Sea SPA (Appendix A):

5.6.8.16 To maintain the favourable conservation condition of this species in North-west Irish Sea SPA, which is defined by the following list of attributes and targets:

- No significant decline in individuals of non-breeding population size.
- Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population.
- Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target.
- 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.
- The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.

5.6.8.17 A single great northern diver was recorded on 2016-2017 baseline surveys, in March 2017. On the 2019-2021 surveys, 20 great northern diver were recorded between November and May, with a peak of three birds in both December 2019 and December 2020. Combined average abundance (birds/km) over the two survey periods was highest in December, with 0.03 birds/km recorded. Though the overall combined average abundance for great northern diver was low, this species has been screened in for assessment due to its high sensitivity to disturbance and displacement (Bradbury *et al.*, 2013).

Disturbance and Displacement

Construction and Decommissioning

5.6.8.18 The potential great northern diver displacement mortality from the construction and decommissioning of Dublin Array attributed to North-west Irish Sea SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.8.19 North-west Irish Sea SPA is located 3.36 km from the array area. Based on these distances, it is considered that there is the potential for disturbance or displacement effects on great northern diver. UK SNCB advice specifies that potential displacement effects can apply to great northern diver out to 4km from the array area (SNCBs, 2017).

5.6.8.20 The North-west Irish Sea SPA covers an area of 2,333 km^2. If displacement effects on great northern diver extend out to 4km from the array area, then this could potentially affect an area of 3.48 km^2 within the North-west Irish Sea SPA. This equates to approximately 0.15% of the overall SPA area. On this basis, it is considered that any displacement effect on great northern diver within this SPA would be negligible. Moreover, no great northern diver were recorded in the baseline surveys in the area which the 4 km buffer overlapped with the NWIS SPA (Ornithology Baseline), or within the buffer from the ObSERVE dataset (Figure 9). Based on this distribution data, the natural range of the species will not be negatively impacted by Dublin Array.

5.6.8.21 As great northern diver presence in the array plus 4 km buffer was low, any disturbance of birds from the NWIS will therefore be limited. There is, therefore, no potential for an AEoI to the population conservation objective of the great northern diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone during the O&M phase. Therefore, subject to natural change, the great northern diver feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of great northern diver at North-west Irish Sea SPA. Conclusions against all conservation objectives are provided in Table 41.

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Table 41. Displacement assessment conclusions for great northern diver at North-west Irish Sea SPA.

Conservation Objective	Conclusion
No significant decline in individuals of non-breeding population size;	The potential displacement of great northern diver may occur within only 0.15% of the total area of the SPA. Moreover, no great northern diver were recorded in the baseline surveys in the area which the 4 km buffer overlapped with the NWIS SPA (see Ornithology Baseline), or within the buffer from the ObSERVE dataset. There is, therefore, no potential for an AEoI to the population conservation objectives of the great northern diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population;	The potential displacement of great northern diver may occur within only 0.15% of the total area of the SPA. Moreover, no great northern diver were recorded in the baseline surveys in the area which the 4 km buffer overlapped with the NWIS SPA (see Ornithology Baseline), or within the buffer from the ObSERVE dataset. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the great northern diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the great northern diver at North-west Irish Sea SPA in relation to prey biomass availability from Dublin Array alone.
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;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. Additionally, potential displacement may occur within only 0.15% of the total area of the SPA. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the great northern diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.

Conservation Objective	Conclusion
The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the great northern diver at North-west Irish Sea SPA in relation to barrier effects from Dublin Array alone.

Common Scoter

5.6.8.22 Common scoter have been screened in for the construction and decommissioning and O&M phases to assess the potential of an AEoI from disturbance / displacement. The potential for AEoI will be assessed in relation to the following conservation objectives for this species, as a qualifying feature of the North-west Irish Sea SPA (Appendix A):

5.6.8.23 To maintain the favourable conservation condition of this species in North-west Irish Sea SPA, which is defined by the following list of attributes and targets:

- No significant decline in individuals of non-breeding population size.
- Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population.
- Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target.
- 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.
- The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.

5.6.8.24 Baseline surveys recorded highest numbers of common scoter in autumn. A total of nine common scoter were recorded on 2016-2017 baseline surveys, with eight birds in October 2016 and one bird in February 2017. On 2019-2021 surveys, 124 common scoter were recorded, with a peak count of 55 birds in late April 2021. Average abundance over the two survey periods was highest in April, with 0.27 birds/km recorded, and October, with 0.18 birds/km recorded. Though the overall combined average abundance for common scoter was low, this species has been screened in for assessment due to its high sensitivity to disturbance and displacement (Bradbury *et al*., 2013)

Disturbance and Displacement

Construction and Decommissioning

5.6.8.25 The potential common scoter displacement mortality from the construction and decommissioning of Dublin Array attributed to North-west Irish Sea SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.8.26 North-west Irish Sea SPA is located 3.36 km from the array area. Based on these distances, it is considered that there is the potential for disturbance or displacement effects on common scoter (based on a 4 km buffer).

5.6.8.27 The North-west Irish Sea SPA covers an area of 2,333 km^2. If displacement effects on common scoter extend out to 4 km from the array area, then this could potentially affect an area of 3.48 km^2 within the North-west Irish Sea SPA. This equates to approximately 0.15% of the overall SPA area. On this basis, it is considered that any displacement effect on common scoter within this SPA would be negligible and the natural range of the species will not be negatively impacted by Dublin Array.

5.6.8.28 As common scoter presence in the array area was low, any disturbance from the array area will therefore be limited. On this basis, it is considered that any disturbance to common scoter will be temporary, and that the magnitude of any effect will be low. Therefore, any disturbance and displacement effects on common scoter would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the common scoter feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone during the O&M phase. Therefore, subject to natural change, the common scoter feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of common scoter at North-west Irish Sea SPA. Conclusions against all conservation objectives are provided in Table 42.

Table 42. Displacement assessment conclusions for common scoter at North-west Irish Sea SPA.

Conservation Objective	Conclusion
No significant decline in individuals of non-breeding population size;	The potential displacement of common scoter may occur within only 0.15% of the total area of the SPA. Additionally, common scoter presence in the array area was low, any disturbance from the array area will therefore be limited. There is, therefore, no potential for an AEoI to the population conservation objectives of the common scoter feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population;	The potential displacement of common scoter may occur within only 0.15% of the total area of the SPA. Additionally, common scoter presence in the array area was low, any disturbance from the array area will therefore be limited. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the common scoter feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the common scoter at North-west Irish Sea SPA in relation to prey biomass availability from Dublin Array alone.
The intensity, frequency, timing and duration of disturbance occurs at levels that do not	For both citation and most recent count, the predicted increase in baseline mortality would

Conservation Objective	Conclusion
significantly impact the achievement of targets for population size and spatial distribution;	be indistinguishable from natural fluctuations in the population. Additionally, potential displacement may occur within only 0.15% of the total area of the SPA. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the common scoter feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array alone.
The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the common scoter at North-west Irish Sea SPA in relation to barrier effects from Dublin Array alone.

5.6.9 South Dublin Bay and River Tolka Estuary SPA

Features and Effects for Assessment

5.6.9.1 Potential for LSE alone has been identified for the following feature of South Dublin Bay and River Tolka Estuary SPA:

- Common tern
  - Collision risk (O&M only)
- Roseate tern
  - Collision risk (O&M only)

Assessment Information

5.6.9.2 The conservation objective (as described in Appendix A) for South Dublin Bay and River Tolka Estuary SPA is to maintain the favourable conservation condition of the bird species in South Dublin Bay and River Tolka Estuary SPA.

5.6.9.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- No significant decline in individuals of passage population or no significant decline in the number of apparently occupied nests;
- No significant decline in the mean number of fledged young per breeding pair;
- No significant decline in the number of passage individuals;
- No significant decline in number, location or area of roosting areas or breeding colonies;
- No significant decline in the prey biomass available; and
- No significant increase in barriers to connectivity.

5.6.9.4 Disturbance at roosting site - Human activities should occur at levels that do not adversely affect the numbers of roseate or common tern among the breeding or post-breeding aggregation of terns.

Common Tern

Collision Risk (Operation and Maintenance)

5.6.9.5 South Dublin Bay and River Tolka Estuary SPA is 12.06 km (around land) from Dublin Array, within the MMFR ± 1SD of common tern (18.0±8.9 km; Woodward *et al*., 2019). Common tern have been screened into the assessment for collision risk as they are susceptible to collision due to their distribution (Bradbury *et al*., 2014).

5.6.9.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Common tern have been assessed during the breeding season of May to August, the post-breeding season of early September, and the pre-breeding season of April in relation to South Dublin Bay and River Tolka Estuary SPA. Table 43 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to South Dublin Bay and River Tolka SPA during each defined season and the overall annual impact.

5.6.9.7 Impacts are assessed relative to the citation population of 800 individuals (with a background mortality of 96.6 individuals per annum), and the most recent count (2016) of 988 individuals (with a background mortality of 115.6 individuals per annum).

Table 43 Common tern predicted collision mortalities during the operation and maintenance phase attributed to South Dublin Bay and River Tolka Estuary SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined Season	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to South Dublin Bay and River Tolka Estuary SPA (individuals per annum)	Increase in baseline mortality (%)	
			Citation population	Most recent population
Breeding (May – Aug)	2.26	1.27	1.353	1.096
Post-breeding (Early Sep)	0.71	0.01	0.010	0.008
Pre-breeding (Apr)	0.02	<0.01 (0.0003)	<0.001 (0.0003)	<0.001 (0.0002)
Total	**2.99**	**1.28**	**1.363**	**1.104**

Breeding season

5.6.9.8 The predicted common tern collision mortality during the breeding season is 2.26 individuals (see CRM). Assuming that 60% of the population are adults (Table 31; Furness, 2015), the total predicted number of breeding adult collisions is 1.36 per annum during the breeding season.

5.6.9.9 It is estimated that 93.0% of predicted mortalities during the breeding season derive from South Dublin Bay and River Tolka SPA (see Apportioning: Appendix C of the HDA). Therefore, the predicted breeding adult mortalities attributed to South Dublin Bay and River Tolka SPA during the breeding season is one (1.27) breeding adult per annum (Table 43).

5.6.9.10 The population of common tern at South Dublin Bay and River Tolka SPA has increased since the citation colony count in 2007 of 800 individuals, having increased to 988 individuals (2016). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.9.11 Using the citation colony count of 800 breeding adults and an annual background mortality of 93.6 individuals, the addition of 1.27 predicted breeding adult mortalities would result in a 1.353% increase in baseline mortality during the breeding season. When considering the most up to date counts of 988 and an annual background mortality of 115.6 adults, this results in an increase of 1.096% in baseline mortality during the breeding season (Table 43).

Non-breeding season

5.6.9.12 The predicted common tern collision mortality during the post-breeding season is 0.71 individuals and 0.02 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 1.3% of predicted mortalities during the post-breeding season are estimated to derive from South Dublin Bay and River Tolka Estuary SPA and 1.3% during the pre-breeding season (see Apportioning: Appendix C of the HDA). The consequent predicted collision mortality of adult common tern during the post-breeding season is predicted at less than one (0.01) and less than one (0.0003) during the pre-breeding season per annum.

5.6.9.13 Based on the 2007 citation colony count of 800 breeding adults and using an annual background mortality of 93.6 individuals, the addition of 0.01 and 0.0003 predicted breeding adult mortalities would result in a 0.010% and a 0.0003% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 988 and an annual background mortality of 115.6 adults, this results in an increase of 0.008% and 0.0002% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 43).

5.6.9.14 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.010% and 0.008%, respectively (Table 43).

Annual total

5.6.9.15 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to South Dublin Bay and River Tolka Estuary SPA, is one (1.28) common tern per annum. The addition of 1.28 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 1.363% and 1.104% respectively (Table 43). For both the citation and latest colony count, the predicted increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through PVA.

PVA Analysis

5.6.9.16 The PVA results are shown in Table 44. Assuming a predicted annual mortality of one (1.28) breeding adults, the CGR and CPS values from South Dublin Bay and River Tolka Estuary SPA are 0.999 and 0.947 respectively. This represents a 0.150% reduction in GR and a reduction in final population size of 5.280%. For further details regarding the PVA results presented here see the PVA: Appendix 4.3.6-7 of the EIAR.

5.6.9.17 The common tern colony at South Dublin Bay and River Tolka Estuary SPA has displayed a continued increase in population size since 1999. Between the Seabird 2000 and Seabirds count 2015-2021, the colony grew from 216 pairs to 494 pairs, translating to an annual colony growth of 5% (Burnell *et al*., 2023). The project alone impact is below 0.5% and as such would be indistinguishable from natural fluctuations in population and would cause no reversal in the observed growth rate. In addition, the predicted impact is considered to be an overestimate of realistic impacts on common tern. Based on site-specific flight height data, zero common terns were observed flying at rotor height (29.5m above MSL) for Dublin Array across 360 observations.

5.6.9.18 Furthermore, the reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

5.6.9.19 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA: Appendix 4.3.6-7 of the EIAR.

5.6.9.20 There is, therefore, no potential for an AEoI to the population conservation objective of the common tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the common tern population will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table 45.

Table 44 PVA outputs for breeding adult common tern at South Dublin Bay and River Tolka Estuary SPA for Dublin Array alone.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone	1.28	0.999 (0.002)	0.947 (0.075)	0.150	5.280

Table 45. Collision risk assessment conclusions for common tern at South Dublin Bay and River Tolka Estuary SPA.

Conservation Objective	Conclusion
No significant decline in individuals of passage population or no significant decline in the number of apparently occupied nests;	See results of PVA in the PVA Analysis Section above.
No significant decline in the mean number of fledged young per breeding pair;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the common tern feature of South Dublin Bay and River Tolka Estuary SPA.
No significant decline in the number of passage individuals;	Common tern is not vulnerable to displacement from the proposed development. According to Bradbury *et al.* (2014) and Dierschke *et al*. (2016) common tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an AEoI to the conservation objectives of the common tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential displacement effects from Dublin Array alone.
No significant decline in number, location or area of roosting areas or breeding colonies;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the common tern at of South Dublin Bay and River Tolka Estuary SPA in relation to breeding/roost site disturbance from Dublin Array alone.
No significant decline in the prey biomass available; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology

Conservation Objective	Conclusion
	Chapter. There is, therefore, no potential for an AEoI to the COs of the common tern at South Dublin Bay and River Tolka Estuary SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	For most collision risk species 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'. There is, therefore, no potential for an AEoI to the COs of the common tern at South Dublin Bay and River Tolka Estuary SPA in relation to barrier effects from Dublin Array alone.

Roseate tern

Collision Risk (Operation and Maintenance)

5.6.9.21 Roseate tern is designated as a passage feature at South Dublin Bay and River Tolka Estuary SPA as the area is an important staging/passage site for a Roseate tern in the autumn (mostly late July to September). Roseate tern do not breed at this site, therefore the feature has only been assessed during the non-breeding season. Roseate tern have been screened into the assessment for collision risk as they are susceptible to collision due to their distribution (Bradbury *et al*., 2014).

5.6.9.22 Table 46 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to South Dublin Bay and River Tolka SPA for staging/passage. It is noted that there are no Roseate tern breeding colonies within MMFR + 1SD of Dublin Array, therefore all potential predicted mortalities have been assessed during passage as they are known to come to this site earlier than the defined migration season (mostly late July to September).

5.6.9.23 The post-breeding impacts are assessed relative to the citation passage population of 2,000 individuals (with a background mortality of 290.0 individuals per annum), and an adaption of the BDMPS estimate of 5,797 individuals (with a background mortality of 921.9 individuals per annum). The most recent regional population estimate (original BDMPS estimate of 6,358 individuals) was derived from the most recently available counts for the two Irish breeding colonies, which were estimated at 1,704 pairs at Rockabill in 2021 (BWI, 2021), and 273 pairs at Lady's Island Lake in 2020 (Irish Times, 2020). However, the majority of individuals passing through will have come from Rockabill, therefore only the population (adults and juveniles) from Rockabill were included in this assessment (the adapted BDMPS value) on a precautionary basis.

Table 46 Roseate tern predicted collision mortalities during the operation and maintenance phase attributed to South Dublin Bay and River Tolka Estuary SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined Season	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to South Dublin Bay and River Tolka Estuary SPA (individuals per annum)	Increase in baseline mortality (%)	
			Citation population	Most recent population
Post-breeding (June – Sep) (adapted to include all collisions)	0.27	0.27	0.093	0.032
Pre-breeding (Apr)	0.00	0.00	-	-
Total	**0.27**	**-**	**-**	**-**

Non-breeding season

5.6.9.24 The predicted Roseate tern collision mortality during the post-breeding season is 0.27 individuals, with 0 during the pre-breeding season. Based on the 1999 citation passage count of 2,000 individuals and using an annual background mortality of 290.0 individuals, the addition of 0.27 predicted breeding adult mortalities would result in a 0.093% increase in baseline mortality during the post-breeding season. When considering the most up to date counts of 5,797 and an annual background mortality of 840.6 individuals, this results in an increase of 0.032% in baseline mortality during the post-breeding (Table 46).

5.6.9.25 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Roseate tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the Roseate tern feature will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table .

Table 47. Collision risk assessment conclusions for roseate tern at South Dublin Bay and River Tolka Estuary SPA.

Conservation Objective	Conclusion
No significant decline in individuals of passage population or no significant decline in the number of apparently occupied nests;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the roseate tern feature of South Dublin Bay and River Tolka Estuary SPA in

Conservation Objective	Conclusion
	relation to potential collision risk from Dublin Array alone.
No significant decline in the mean number of fledged young per breeding pair;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the roseate tern feature of South Dublin Bay and River Tolka Estuary SPA.
No significant decline in the number of passage individuals;	Roseate tern is not vulnerable to displacement from the proposed development. According to Bradbury *et al.* (2014) and Dierschke *et al*. (2016) roseate tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an AEoI to the conservation objectives of the roseate tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential displacement effects from Dublin Array alone.
No significant decline in number, location or area of roosting areas or breeding colonies;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the roseate tern at of South Dublin Bay and River Tolka Estuary SPA in relation to breeding/roost site disturbance from Dublin Array alone.
No significant decline in the prey biomass available; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the roseate tern at South Dublin Bay and River Tolka Estuary SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	For most collision risk species 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) roseate tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an

Conservation Objective	Conclusion
	AEoI to the COs of the roseate tern at South Dublin Bay and River Tolka Estuary SPA in relation to barrier effects from Dublin Array alone.

5.6.10 Howth Head Coast SPA

Features and Effects for Assessment

5.6.10.1 Potential for LSE alone has been identified for the following feature of Howth Head Coast SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M only)
  - Combined collision risk and direct disturbance and displacement (O&M)

Assessment Information

5.6.10.2 The conservation objective (as described in Appendix A) for Howth Head Coast SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.10.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved is when:

- The long-term SPA population trend is stable or increasing;
- The productivity rate is sufficient to maintain a stable or increasing population;
- There is sufficient availability of suitable nesting throughout the SPA to maintain a stable or increasing population;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- Disturbance occurs at levels that do not significantly impact on birds at the breeding site;
- Disturbance occurs at levels that do not significantly impact on breeding population; and

- Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.

Kittiwake

Direct Disturbance and Displacement

5.6.10.4 Howth Head Coast is 18.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback (ABPmer, 2023) despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.10.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Howth Head Coast SPA.

5.6.10.6 Impacts are assessed relative to the citation population of 4,538 individuals (with a background mortality of 662.5 individuals per annum), and the most recent count (2015-2018) of 3,546 individuals (with a background mortality of 517.7 individuals per annum).

Construction and Decommissioning

5.6.10.7 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Howth Head Coast SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.10.8 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Howth Head Coast SPA is presented in Table 48 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Howth Head Coast SPA can also be found in Table 31.

Table 48. Predicted kittiwake displacement mortalities attributed to Howth Head Coast SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	93	0.28	0.84	0.042	0.127	0.054	0.162
Post-breeding (Aug-Dec)	3	0.01	0.03	0.001	0.004	0.002	0.005
Pre-breeding (Jan-Apr)	4	0.01	0.04	0.002	0.006	0.002	0.007
Annual Total	**100**	**0.30**	**0.90**	**0.045**	**0.136**	**0.058**	**0.175**

Table 49 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Howth Head Coast SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.10	0.20	0.30	1	1	2	3	4	5	6	7	8	9	10
	20	0.20	0.40	1	1	2	4	6	8	10	12	14	16	18	20
	30	0.30	1	1	2	3	6	9	12	15	18	21	24	27	30
	40	0.40	1	1	2	4	8	12	16	20	24	28	32	36	40
	50	1	1	2	3	5	10	15	20	25	30	35	40	45	50
	60	1	1	2	3	6	12	18	24	30	36	42	48	54	60
	70	1	1	2	4	7	14	21	28	35	42	49	56	63	70
	80	1	2	2	4	8	16	24	32	40	48	56	64	72	80
	90	1	2	3	5	9	18	27	36	45	54	63	72	81	90
	100	1	2	3	5	10	20	30	40	50	60	70	80	90	100

Outputs highlighted in blue represent the predicted annual mortality estimates as per the NatureScot Guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.10.9 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals. Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.10.10 It is estimated that 31.5% of kittiwake during the breeding season derive from Howth Head Coast SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Howth Head Coast SPA potentially impacted by displacement is 93 per annum during the breeding season (Table 31).

5.6.10.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Howth Head Coast SPA is estimated to be less than one (0.28) breeding adults per annum. Table 31 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.10.12 The population of kittiwake at Howth Head Coast SPA has reduced since the citation colony count of 4,538 individuals to 3,546 individuals (2015-2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 31).

5.6.10.13 Using the citation colony count of 4,538 breeding adults and an annual background mortality of 662.5 individuals, the addition of 0.28 predicted breeding adult mortalities would result in a 0.042% increase in baseline mortality during the breeding season. When considering the most up to date counts of 3,546 breeding adults and an annual background mortality of 517.7 adults, this results in an increase of 0.054% in baseline mortality during the breeding season (see Table 31).

Non-breeding Season

5.6.10.14 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.4% of predicted mortalities during the post-breeding season are estimated to derive from Howth Head Coast SPA and 0.5% during the pre-breeding season (see Apportioning Appendix C).

5.6.10.15 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Howth Head Coast SPA during the post-breeding season is predicted at less than one (0.01), and less than one (0.01) during the pre-breeding season per annum.

5.6.10.16 Based on the citation colony count of 4,538 breeding adults and using an annual background mortality of 662.5 individuals, the addition of 0.01 and 0.01 predicted breeding adult mortalities would result in a 0.001% and a 0.002% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 3,546 and an annual background mortality of 517.7 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 31).

5.6.10.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.02) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.003% and 0.004%, respectively

Annual Total

5.6.10.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Howth Head Coast SPA during operation and maintenance, is less than one (0.30) kittiwake per annum. The addition of 0.30 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.045% and 0.058% respectively (see Table 31).

5.6.10.19 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Howth Head Coast SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Howth Head Coast SPA.

Collision Risk (Operation and Maintenance)

5.6.10.20 Howth Head Coast SPA is 18.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al.*, 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.*, 2014).

5.6.10.21 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Howth Head Coast SPA. Table 50 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Howth Head Coast SPA during each defined season and the overall annual impact.

Table 50 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Howth Head Coast SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Howth Head Coast SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	2.92	0.441	0.564
Post-breeding (Aug-Dec)	14.92	0.06	0.009	0.011
Pre-breeding (Jan-Apr)	7.69	0.04	0.006	0.007
Annual	**42.07**	**3.02**	**0.455**	**0.583**

5.6.10.22 Impacts are assessed relative to the citation population of 4,538 individuals (with a background mortality of 662.5 individuals per annum), and the most recent count (2018) of 3,456 individuals (with a background mortality of 517.7 individuals per annum).

Breeding season

5.6.10.23 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.10.24 It is estimated that 31.5% of predicted mortalities during the breeding season derive from Howth Head Coast SPA (see Apportioning: Appendix C). Therefore, the predicted breeding adult mortalities attributed to Howth Head Coast SPA during the migration-free breeding season is three (2.92) breeding adults per annum (Table 50).

5.6.10.25 The population of kittiwake at Howth Head Coast SPA has reduced since the citation colony count in 1999 of 4,538 individuals, having decreased to 3,546 individuals (2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.10.26 Using the citation colony count of 4,538 breeding adults and an annual background mortality of 665.2 individuals, the addition of 2.92 predicted breeding adult mortalities would result in a 0.441% increase in baseline mortality during the breeding season. When considering the most up to date counts of 3,546 and an annual background mortality of 517.7 adults, this results in an increase of 0.564% in baseline mortality during the breeding season (Table 50).

Non-breeding season

5.6.10.27 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.4% of predicted mortalities during the post-breeding season are estimated to derive from Howth Head Coast SPA and 0.5% during the pre-breeding season (see Apportioning Appendix C), the consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.06) and less than one (0.04) during the pre-breeding season per annum.

5.6.10.28 Based on the 1999 citation colony count of 4,538 breeding adults and using an annual background mortality of 665.2 individuals, the addition of 0.06 and 0.04 predicted breeding adult mortalities would result in a 0.009% and a 0.006% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 3,546 and an annual background mortality of 517.7 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 50).

5.6.10.29 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.09) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.014% and 0.018%, respectively (Table 50).

Annual Total

5.6.10.30 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Howth Head Coast SPA, is three (3.02) kittiwake per annum. The addition of 3.02 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.455% and. 0.583% respectively (Table 50).

5.6.10.31 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Howth Head Coast SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Howth Head SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.10.32 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Howth Head Coast SPA.

5.6.10.33 Based on the separate assessments of kittiwake from Howth Head Coast SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is a total of three (3.32) breeding adult mortalities (Table 51). This represents an increase in baseline mortality of 0.501% when considering the citation colony count and an increase in baseline mortality of 0.641% 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 kittiwake feature of Howth Head Coast SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Howth Head Coast SPA. Conclusions against all conservation objectives are provided in Table .

Table 51 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Howth Head Coast SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	3.32	0.501	0.641

Table 52. Assessment conclusions for kittiwake at Howth Head SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Howth Head SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Howth Head SPA.
There is sufficient availability of suitable nesting throughout the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to availability of nesting sites from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective

Conservation Objective	Conclusion
	relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to breeding/roost site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to barrier effects from Dublin Array alone.

5.6.11 Ireland's Eye SPA

Features and Effects for Assessment

5.6.11.1 Potential for LSE alone has been identified for the following features of Ireland's Eye SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Razorbill
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Guillemot
  - Direct disturbance and displacement (C&D)

  - Direct disturbance and displacement (O&M)
- Herring gull
  - Collision risk (O&M)
- Cormorant
  - Direct disturbance and displacement (C&D)

5.6.11.2 As discussed in Paragraph 5.6.2.13, any impacts resulting from disturbance from the activities associated with the construction works will be short-term, temporary and reversible in nature, lasting only for the duration of activities. Birds are expected to return to the area once these activities have ceased. The significance of vessel disturbance will be negligible. There is, therefore, no potential for an AEoI to the population conservation objectives of Ireland's Eye SPA to potential disturbance to cormorant from Dublin Array. Therefore, subject to natural change, the feature will be maintained in the long term with respect to the potential for disturbance.

Assessment Information

5.6.11.3 The conservation objective (as described in Appendix A) for Ireland's Eye SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.11.4 Based on the above conservation objective, the specific target for those screened in features of the SPA, in order for favourable conservation status to be achieved is when:

- The long-term SPA population trend is stable or increasing (herring gull, kittiwake);
- The long term SPA population trend is stable or increasing: Individual (IND) (guillemot and razorbill);
- The productivity rate is sufficient to maintain a stable or increasing population;
- There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- Disturbance occurs at levels that do not significantly impact on birds at the breeding site;
- Disturbance occurs at levels that do not significantly impact on breeding population; and
- Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.

Kittiwake

Direct Disturbance and Displacement

5.6.11.5 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback (ABPmer, 2023) despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.11.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Ireland's Eye SPA.

5.6.11.7 Impacts are assessed relative to the citation population of 2,048 individuals (with a background mortality of 299.0 individuals per annum), and the most recent count (2016) of 802 individuals (with a background mortality of 117.1 individuals per annum).

Construction and Decommissioning

5.6.11.8 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Ireland's Eye SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.11.9 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Ireland's Eye SPA is presented in Table 53 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Ireland's Eye SPA can also be found in Table 54.

Table 53 Predicted kittiwake displacement mortalities attributed to Ireland's Eye SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	15	0.04	0.13	0.015	0.044	0.038	0.113
Post-breeding (Aug-Dec)	1	<0.01 (0.002)	0.01	0.001	0.002	0.002	0.005
Pre-breeding (Jan-Apr)	1	<0.01 (0.003)	0.01	0.001	0.003	0.002	0.007
Annual Total	**17**	**0.05**	**0.15**	**0.016**	**0.049**	**0.042**	**0.125**

Table 54 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Ireland's Eye SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.02	0.03	0.05	0.09	0.17	0.34	1	1	1	1	1	1	2	2
	20	0.03	0.07	0.10	0.17	0.34	1	1	1	2	2	2	3	3	3
	30	0.05	0.10	0.15	0.26	1	1	2	2	3	3	4	4	5	5
	40	0.07	0.14	0.20	0.34	1	1	2	3	3	4	5	5	6	7
	50	0.09	0.17	0.26	0.43	1	2	3	3	4	5	6	7	8	9
	60	0.10	0.20	0.31	1	1	2	3	4	5	6	7	8	9	10
	70	0.12	0.24	0.36	1	1	2	4	5	6	7	8	10	11	12
	80	0.14	0.27	0.41	1	1	3	4	5	7	8	10	11	12	14
	90	0.15	0.31	0.46	1	2	3	5	6	8	9	11	12	14	15
	100	0.17	0.34	1	1	2	3	5	7	9	10	12	14	15	17

Outputs highlighted in blue represent the predicted annual mortality estimates as per the NatureScot Guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.11.10 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals. Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.11.11 It is estimated that 5.0% of kittiwake during the breeding season derive from Ireland's Eye SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Ireland's Eye SPA potentially impacted by displacement is 15 per annum during the breeding season (Table 53).

5.6.11.12 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Ireland's Eye SPA is estimated to be less than one (0.04) breeding adults per annum. Table 53 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.11.13 The population of kittiwake at Ireland's Eye SPA has reduced since the citation colony count in 2001 of 2,048 individuals to 802 individuals (2016). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 53).

5.6.11.14 Using the citation colony count of 2,048 breeding adults and an annual background mortality of 299.0 individuals, the addition of 0.04 predicted breeding adult mortalities would result in a 0.015% increase in baseline mortality during the breeding season. When considering the most up to date counts of 802 breeding adults and an annual background mortality of 117.1 adults, this results in an increase of 0.038% in baseline mortality during the breeding season (see Table 53).

Non-breeding Season

5.6.11.15 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Ireland's Eye SPA and 0.1% during the pre-breeding season (see Apportioning Appendix C).

5.6.11.16 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Ireland's Eye SPA during the post-breeding season is predicted at less than one (0.002), and less than one (0.003) during the pre-breeding season per annum.

5.6.11.17 Based on the 2001 citation colony count of 2,048 breeding adults and using an annual background mortality of 299 individuals, the addition of 0.002 and 0.003 predicted breeding adult mortalities would result in a 0.001% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 802 and an annual background mortality of 117.1 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 53).

5.6.11.18 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.002% and 0.004%, respectively

Annual Total

5.6.11.19 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Ireland's Eye SPA during operation and maintenance, is less than one (0.05) kittiwake per annum. The addition of 0.05 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.016% and 0.042% respectively (see Table 53).

5.6.11.20 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Ireland's Eye SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Ireland's Eye SPA.

Collision Risk (Operation and Maintenance)

5.6.11.21 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.11.22 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Ireland's Eye SPA. Table 55 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Ireland's Eye SPA during each defined season and the overall annual impact.

Table 55 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Ireland's Eye SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Ireland's Eye SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	0.46	0.154	0.393
Post-breeding (Aug-Dec)	14.92	0.01	0.004	0.011
Pre-breeding (Jan-Apr)	7.69	0.01	0.003	0.007
Annual	**42.07**	**0.48**	**0.161**	**0.412**

5.6.11.23 Impacts are assessed relative to the citation population of 2,048 individuals (with a background mortality of 299.0 individuals per annum), and the most recent count (2016) of 802 individuals (with a background mortality of 117.1 individuals per annum).

Breeding season

5.6.11.24 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.11.25 It is estimated that 5.0% of predicted mortalities during the breeding season derive from Ireland's Eye SPA (see Apportioning Appendix C) Therefore, the predicted breeding adult mortalities attributed to Ireland's Eye SPA during the migration-free breeding season is less than one (0.46) breeding adult per annum (Table 55).

5.6.11.26 The population of kittiwake at Ireland's Eye SPA has reduced since the citation colony count in 2001 of 2,048 individuals, having decreased to 802 individuals (2016). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.11.27 Using the citation colony count of 2,048 breeding adults and an annual background mortality of 299 individuals, the addition of 0.46 predicted breeding adult mortalities would result in a 0.154% increase in baseline mortality during the breeding season. When considering the most up to date counts of 802 and an annual background mortality of 117.1 adults, this results in an increase of 0.393% in baseline mortality during the breeding season (see Table 55).

Non-breeding season

5.6.11.28 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Ireland's Eye SPA and 0.1% during the pre-breeding season (see Apportioning Appendix C), the consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.01) and less than one (0.01) during the pre-breeding season per annum.

5.6.11.29 Based on the 2001 citation colony count of 2,048 breeding adults and using an annual background mortality of 299 individuals, the addition of 0.01 and 0.01 predicted breeding adult mortalities would result in a 0.004% and a 0.003% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 802 and an annual background mortality of 117.1 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 55).

5.6.11.30 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.02) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.007% and 0.018%, respectively (see Table 55).

Annual Total

5.6.11.31 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Ireland's Eye SPA, is less than one (0.48) kittiwake per annum. The addition of 0.48 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.161% and. 0.412% respectively (see Table 55).

5.6.11.32 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Ireland's Eye SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Ireland's Eye SPA.

Combined Collision and Displacement

5.6.11.33 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Ireland's Eye SPA.

5.6.11.34 Based on the separate assessments of kittiwake from Ireland's Eye SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is one (0.53) breeding adult mortality (Table 56). This represents an increase in baseline mortality of 0.178% when considering the citation colony count and an increase in baseline mortality of 0.454% when considering the latest colony count. This level of impact would be indistinguishable from natural fluctuations in the population.

5.6.11.35 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Ireland's Eye SPA in relation to potential combined collision risk and displacement effects from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table .

Table 56 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Ireland's Eye SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.53	0.178	0.454

Table 57. Assessment conclusions for kittiwake at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Ireland's Eye SPA in relation to potential displacement affects and collision risk from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Ireland's Eye SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ireland's Eye SPA in relation to breeding/roost site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of

Conservation Objective	Conclusion
	interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Ireland's Eye SPA in relation to barrier effects from Dublin Array alone.

Razorbill

Direct Disturbance and Displacement

5.6.11.36 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR +1SD of razorbill (88.7+75.9km; Woodward *et al*., 2019). Razorbill have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

5.6.11.37 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Razorbill have been assessed during the breeding season of April to July, the post-breeding season of August to October, the migration-free winter season of November to December, and the pre-breeding season of January to March, in relation to Ireland's Eye SPA.

5.6.11.38 Impacts are assessed relative to the citation population of 920 individuals (with a background mortality of 96.6 individuals per annum), and the most recent count (2015) of 1,600 individuals (with a background mortality of 168 individuals per annum).

Construction and Decommissioning

5.6.11.39 The potential razorbill displacement mortality from the construction and decommissioning of Dublin Array attributed to Ireland's Eye SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.11.40 The potential razorbill displacement mortality from the operation and maintenance of Dublin Array attributed to Ireland's Eye SPA is presented in Table 58 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual razorbill displacement mortalities during operation and maintenance attributed to Ireland's Eye SPA can also be found in Table 59.

Table 58 Predicted razorbill displacement mortalities attributed to Ireland's Eye SPA during the operation and maintenance phase of Dublin Array.

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Apr-Jul)	139	0.69	0.42 – 1.94	2.49 - 4.16	0.717	0.435-2.008	2.582 – 4.303	0.412	0.247-1.155	1.485 – 2.474
Post-breeding(Aug-Oct)	5	0.03	0.02 – 0.07	0.03 - 0.09	0.027	0.021 – 0.076	0.033 – 0.098	0.016	0.009-0.044	0.019 – 0.056
Pre-breeding (Jan-Mar)	1	0.01	<0.01 (0.003) – 0.02	0.01 - 0.02	0.006	0.005 – 0.018	0.008 – 0.023	0.004	0.002-0.012	0.004 – 0.013
Winter (Nov-Dec)	1	0.01	<0.01 (0.003) – 0.02	0.01 - 0.02	0.006	0.005 – 0.018	0.008 – 0.023	0.004	0.002-0.012	0.004 – 0.013

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Annual Total	146	0.73	0.40-2.05	2.54 – 4.29	0.757	0.454 – 2.119	2.630 – 4.446	0.435	0.261-1.219	1.512–2.557

Table 59 The full displacement matrix of potential annual razorbill displacement mortalities during operation and maintenance attributed to Ireland's Eye SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.15	0.29	0.44	1	1	3	4	6	7	9	10	12	13	15
	20	0.29	1	1	1	3	6	9	12	15	18	20	23	26	29
	30	0.44	1	1	2	4	9	13	18	22	26	31	35	39	44
	40	1	1	2	3	6	12	18	23	29	35	41	47	53	58
	50	1	1	2	4	7	15	22	29	37	44	51	58	66	73
	60	1	2	3	4	9	18	26	35	44	53	61	70	79	88
	70	1	2	3	5	10	20	31	41	51	61	72	82	92	102
	80	1	2	4	6	12	23	35	47	58	70	82	93	105	117
	90	1	3	4	7	13	26	39	53	66	79	92	105	118	131
	100	1	3	4	7	15	29	44	58	73	88	102	117	131	146

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.11.41 The estimated razorbill mean peak abundance during the breeding season is 1,068 individuals (Table 58). Assuming that 57% of the razorbill population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 566 per annum during the breeding season.

5.6.11.42 It is estimated that 24% of razorbill during the breeding season derive from Ireland's Eye SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Ireland's Eye SPA potentially impacted by displacement is 139 per annum during the breeding season (Table 58).

5.6.11.43 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult razorbill from Ireland's Eye SPA is estimated to be one (0.69) breeding adults per annum. Table 59 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.11.44 The population of razorbill at Ireland's Eye SPA has increased since the citation colony count in 2001 of 920 individuals to 1,600 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 58).

5.6.11.45 Using the citation colony count of 920 breeding adults and an annual background mortality of 96.6 individuals, the addition of 0.69 predicted breeding adult mortalities would result in a 0.717% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,600 breeding adults and an annual background mortality of 168.0 adults, this results in an increase of 0.412% in baseline mortality during the breeding season (see Table 58).

Non-breeding Season

5.6.11.46 The estimated razorbill mean peak abundance during the post-breeding season is 2,070 individuals, 478 during the pre-breeding season, and 281 during the migration-free winter season. Based on the non-breeding seasonal regional population size, 0.25% of predicted mortalities during the post-breeding season are estimated to derive from Ireland's Eye SPA, 0.25% during the pre-breeding season, and 0.4% during the migration-free winter season (see Apportioning Appendix C).

5.6.11.47 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult razorbill from Ireland's Eye SPA during the post-breeding season is predicted at less than one (0.03), less than one (0.01) during the pre-breeding season, and less than one (0.01) during the migration-free winter season per annum.

5.6.11.48 Based on the 2001 citation colony count of 920 breeding adults and using an annual background mortality of 96.6 individuals, the addition of 0.03, 0.01, and 0.01 predicted breeding adult mortalities would result in a 0.027%, 0.006%, and 0.006% increase in baseline mortality during the post-breeding, pre-breeding, and migration-free winter season, respectively. When considering the most up to date counts of 1,600 breeding adults and an annual background mortality of 168.0 adults, this results in an increase of 0.016%, 0.004%, and 0.004% in baseline mortality during the post-breeding, pre-breeding season, and migration-free winter season respectively (Table 58).

5.6.11.49 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.04) breeding adult per annum. When assessed against the citation population count and the most recent colony count, the baseline mortality rate increases by 0.040% and 0.023%, respectively (Table 58).

Annual Total

5.6.11.50 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Ireland's Eye SPA, is one (0.73) razorbill per annum. The addition of 0.73 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.757% and 0.435% respectively (Table 58).

5.6.11.51 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill feature of Ireland's Eye SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of razorbill at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 60.

Table 60. Displacement assessment conclusions for razorbill at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the razorbill feature of Ireland's Eye SPA in relation to potential displacement effects from Dublin Array alone.
The productivity rate is sufficient to maintain a stable or increasing population;	
Disturbance occurs at levels that do not significantly impact on breeding population;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to breeding/roost site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to barrier effects from Dublin Array alone.

Guillemot

Direct Disturbance and Displacement

5.6.11.52 Ireland's Eye SPA is 22.5km (around land) from Dublin Array, within the MMFR +1SD of guillemot (73.2±80.5 km; Woodward *et al*., 2019). Guillemot have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

5.6.11.53 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Guillemot have been assessed during the breeding season (March to July) and the non-breeding season (August to February) in relation to Ireland's Eye SPA.

5.6.11.54 Impacts are assessed relative to the citation population of 77,998 individuals (with a background mortality of 4,757.9 individuals per annum), and the most recent count (2015) of 59,983 individuals (with a background mortality of 3,659.0 individuals per annum)

Construction and Decommissioning

5.6.11.55 The potential guillemot displacement mortality from the construction and decommissioning of Dublin Array attributed to Ireland's Eye SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.11.56 The potential guillemot displacement mortality from the operation of Dublin Array attributed to Ireland's Eye SPA is presented in Table 61 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual guillemot displacement mortalities during operation and maintenance attributed to Ireland's Eye SPA is also found in Table 62.

Table 61 Predicted guillemot displacement mortalities attributed to Ireland's Eye SPA during the operation and maintenance phase of Dublin Array.

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Mar – Jul)	1,053	5.26	3.16 - 14.74	18.95 – 31.58	2.185	1.311 – 6.117	7.864 - 13.107	1.957	1.174-5.479	7.044 – 11.740
Non-Breeding (Aug – Feb)	7	0.03	0.02 - 0.10	0.04 – 0.13	0.014	0.009 – 0.041	2.621 – 7.864	0.013	0.008-0.036	2.348 – 7.044
Annual Total	**1,060**	**5.30**	**3.18 - 14.83**	**18.99 – 31.72**	**2.199**	**1.319 – 6.156**	**7.881 – 13.158**	**1.969**	**1.182-5.514**	**7.059 – 11.786**

Table 62 The full displacement matrix of potential annual guillemot displacement mortalities during operations and maintenance attributed to Ireland's Eye SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	1	2	3	5	11	21	32	42	53	64	74	85	95	106
	20	2	4	6	11	21	42	64	85	106	127	148	170	191	212
	30	3	6	10	16	32	64	95	127	159	191	223	254	286	318
	40	4	8	13	21	42	85	127	170	212	254	297	339	382	424
	50	5	11	16	27	53	106	159	212	265	318	371	424	477	530
	60	6	13	19	32	64	127	191	254	318	382	445	509	572	636
	70	7	15	22	37	74	148	223	297	371	445	519	594	668	742
	80	8	17	25	42	85	170	254	339	424	509	594	678	763	848
	90	10	19	29	48	95	191	286	382	477	572	668	763	859	954
	100	11	21	32	53	106	212	318	424	530	636	742	848	954	1,060

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.11.57 The estimated guillemot mean peak abundance during the breeding season is 18,687 individuals. Assuming that 57% of the guillemot population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 9,906 per annum during the breeding season.

5.6.11.58 It is estimated that 10.6% of guillemot during the breeding season derive from Ireland's Eye SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Ireland's Eye SPA potentially impacted by displacement is 1,053 per annum during the breeding season (Table 61).

5.6.11.59 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult guillemot from Ireland's Eye SPA is estimated to be five (5.26) breeding adults per annum. Table 61 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.11.60 The population of guillemot at Ireland's Eye SPA has increased since the citation colony count in 2001 of 3,950 individuals to 4,410 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 61).

5.6.11.61 Using the citation colony count of 3,950 breeding adults and an annual background mortality of 241 individuals, the addition of 5.26 predicted breeding adult mortalities would result in a 2.185% increase in baseline mortality during the breeding season. When considering the most up to date counts of 4,410 breeding adults and an annual background mortality of 269 adults, this results in an increase of 1.957% in baseline mortality during the breeding season (see Table 61).

Non-breeding Season

5.6.11.62 The estimated guillemot mean peak abundance during the non-breeding season is 2,063 individuals. Based on the non-breeding seasonal regional population size, 0.33% of predicted mortalities during the non-breeding season are estimated to derive from Ireland's Eye SPA (see Apportioning Appendix C).

5.6.11.63 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult guillemot from Ireland's Eye SPA during the non-breeding season is predicted at less than one (0.03) during the non-breeding season per annum.

5.6.11.64 Based on the 2001 citation colony count of 3,950 breeding adults and using an annual background mortality of 241 individuals, the addition of 0.03 predicted breeding adult mortalities would result in a 0.014% increase in baseline mortality during the non-breeding season. When considering the most up to date counts of 4,410 breeding adults and an annual background mortality of 269 adults, this results in a 0.013% increase in baseline mortality during the non-breeding season (see Table 61).

Annual Total

5.6.11.65 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Ireland's Eye SPA, is five (5.30) guillemot per annum. The addition of 5.30 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 2.199% and 1.969% respectively (Table 61).

5.6.11.66 For the citation and the most recent count, the increase in baseline mortality is greater than 1% and therefore has been further investigated to determine the potential impact on population level through PVA.

PVA Analysis

5.6.11.67 The PVA results are shown in Table 63. Assuming a predicted annual mortality of 5.3 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Ireland's Eye SPA are 0.999 and 0.953 respectively. This represents a 0.130% reduction in GR and a reduction in final population size of 4.690%. For further details regarding the PVA results presented here see the PVA: Appendix 4.3.6-7 of the EIAR.

5.6.11.68 The guillemot colony at Ireland's Eye SPA has displayed a continued increase in population size since 1999. Latest estimates (SMP, 2015) indicate a colony count of 4,410 individuals. This translates to an annual colony GR of 4.47% (JNCC, 2023). A conservative estimate of the impact shows a decrease in GR of <0.5% based on 50% displacement and 1% mortality (Table 63) and therefore, the predicted in-combination impacts will be indistinguishable from natural fluctuations and will not cause any material change to this ongoing colony growth.

5.6.11.69 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease in population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size. It is noted that under all PVA scenarios for NatureScot and Natural England displacement and Mortality rates, the conclusions stay the same.

5.6.11.70 There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot feature of Ireland's Eye SPA in relation to potential disturbance and displacement from Dublin Array alone. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of guillemot at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 64.

Table 63 PVA outputs for breeding adult guillemot at Ireland's Eye SPA for Dublin Array alone.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years) Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
Project alone (50%, 1%)	5.26	0.999 (0.001)	0.953 (0.027)	0.130	4.690
Project alone (70%, 2%)	14.74	0.996 (0.001)	0.873 (0.025)	0.380	12.680
Project alone (60% displacement, 3 and 1% mortality)	18.90	0.995 (0.001)	0.841 (0.024)	0.480	15.880
Project alone (60% displacement, 5% and 3% mortality)	31.60	0.992 (0.001)	0.748 (0.022)	0.800	25.160

Table 64. Displacement assessment conclusions for guillemot at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
The productivity rate is sufficient to maintain a stable or increasing population;	
Disturbance occurs at levels that do not significantly impact on breeding population;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the guillemot at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the guillemot at Ireland's Eye SPA in relation to breeding/roost site disturbance from Dublin Array alone.

Conservation Objective	Conclusion
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	See results of PVA in the PVA Analysis Section above.

Herring Gull

Collision Risk (Operation and Maintenance)

5.6.11.71 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR ± 1SD of herring gull (58.8±26.8km; Woodward *et al*., 2019). Herring gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014)

5.6.11.72 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Herring gull have been assessed during the breeding season of March to August and the non-breeding season of September to February in relation to Ireland's Eye SPA. Table 65 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Ireland's Eye SPA during each defined season and the overall annual impact.

5.6.11.73 Impacts are assessed relative to the citation population of 492 individuals (with a background mortality of 81.7 individuals per annum), and the most recent count (2016) of 796 individuals (with a background mortality of 132.1 individuals per annum)

Table 65 Herring gull predicted collision mortalities during the operation and maintenance phase attributed to Ireland's Eye SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Ireland's Eye SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Mar – Aug)	16.14	0.96	1.173	0.725
Non-breeding (Sep – Feb)	19.87	0.08	0.104	0.064
Annual total	**36.01**	**1.04**	**1.277**	**0.789**

Breeding season

5.6.11.74 The predicted herring gull collision mortality during the breeding season is 16.14 individuals (see CRM). Assuming that 48% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 31.2%. Therefore, the total predicted number of breeding adult collisions is 5.04 per annum during the breeding season.

5.6.11.75 It is estimated that 19.0% of predicted mortalities during the breeding season derive from Ireland's Eye SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Ireland's Eye SPA during the breeding season is one (0.96) breeding adult per annum (see Table 65).

5.6.11.76 The population of herring gull at Ireland's Eye SPA has increased since the citation colony count in 1999 of 492 individuals, having increased to 796 individuals (2016). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.11.77 Using the citation colony count of 492 breeding adults and an annual background morality of 81.7 individuals, the addition of 0.96 predicted breeding adult mortalities would result in a 1.173% increase in baseline mortality during the breeding season. When considering the most up to date counts of 796 and an annual background mortality of 132.1 adults, this results in an increase of 0.725% in baseline mortality during the breeding season (see Table 65).

Non-breeding season

5.6.11.78 The predicted herring gull collision mortality during the non-breeding season is 19.87 individuals. Based on the non-breeding seasonal regional population size, 0.4% of predicted mortalities during the non-breeding season are estimated to derive from Ireland's Eye SPA (see Apportioning Appendix C), the consequent predicted collision mortality of adult herring gull during the non-breeding season is predicted at less than one (0.08) per annum.

5.6.11.79 Based on the 1999 citation colony count of 492 breeding adults and using an annual background morality of 81.7 individuals, the addition of 0.08 predicted breeding adult mortalities would result in a 0.104% increase in baseline mortality during the non-breeding. When considering the most up to date count of 796 and an annual background mortality of 132.1 adults, this results in an increase of 0.064% non-breeding season (see Table 65).

Annual Total

5.6.11.80 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Ireland's Eye SPA, is one (1.04) herring gull per annum. The addition of 1.04 predicted mortality per annum would increase baseline mortality against the citation and most recent counts by 1.277% and. 0.789% respectively (see Table 65).

5.6.11.81 Based on the 1999 citation reference, the increase in baseline mortality is greater than 1%. However, when using the most recent count the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. As the most recent count provides the most relevant understanding of the herring gull feature at Ireland's Eye SPA, conclusions for need of further assessment are based on the most recent count alone. There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull feature of Ireland's Eye SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 66.

Table 66. Collision risk assessment conclusions for herring gull at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	Though the predicted impact exceeds a 1% increase in baseline mortality based on the citation population, the impact is <1% based on the more recent count, with this impact considered more realistic due to the population increase that has occurred at this site. Based on this, the impact to the current population is considered to be indistinguishable from natural fluctuations in the population.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the herring gull feature of Ireland's Eye SPA.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to availability of nesting sites from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's

Conservation Objective	Conclusion
	Eye SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to breeding site disturbance from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population; and	Herring gull are not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the conservation objectives of the herring gull feature of Ireland's Eye SPA in relation to potential displacement effects from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	For most collision risk species 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) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to barrier effects from Dublin Array alone.

5.6.12 Lambay Island SPA

Features and Effects for Assessment

5.6.12.1 Potential for LSE alone has been identified for the following features of Lambay Island SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)

- Guillemot
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Razorbill
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Shag
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Herring gull
  - Collision risk (O&M)
- Lesser black backed gull
  - Collision risk (O&M)
- Cormorant
  - Direct disturbance and displacement (C&D)

5.6.12.2 As discussed in Paragraph 5.6.2.13, any impacts resulting from disturbance from the activities associated with the construction works will be short-term, temporary and reversible in nature, lasting only for the duration of activities. Birds are expected to return to the area once these activities have ceased. The significance of vessel disturbance will be negligible. There is, therefore, no potential for an AEoI to the population conservation objectives of Lambay Island SPA to potential disturbance to cormorant from Dublin Array. Therefore, subject to natural change, the feature will be maintained in the long term with respect to the potential for disturbance.

Assessment Information

5.6.12.3 The conservation objective (as described in Appendix A) for Lambay Island SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.12.4 Based on the above conservation objective, the specific target for those screened in features of the SPA, in order for favourable conservation status to be achieved is when:

- The long-term SPA population trend is stable or increasing;
- The productivity rate is sufficient to maintain a stable or increasing population;

- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- Disturbance occurs at levels that do not significantly impact on birds at the breeding site;
- Disturbance occurs at levels that do not significantly impact on breeding population;
- Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and
- There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.

Kittiwake

Direct Disturbance and Displacement

5.6.12.5 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback (ABPmer, 2023) despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.12.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Lambay Island SPA.

5.6.12.7 Impacts are assessed relative to the citation population of 7,894 individuals (with a background mortality of 1,152.5 individuals per annum), and the most recent count (2004) of 6,640 individuals (with a background mortality of 969.4 individuals per annum).

Construction and Decommissioning

5.6.12.8 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Lambay Island SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.12.9 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Lambay Island SPA is presented in Table 67 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Lambay Island SPA can also be found in Table 68.

Table 67 Predicted kittiwake displacement mortalities attributed to Lambay Island SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	63	0.19	0.57	0.016	0.049	0.019	0.058
Post-breeding (Aug-Dec)	5	0.02	0.05	0.001	0.004	0.002	0.005
Pre-breeding (Jan-Apr)	8	0.02	0.07	0.002	0.006	0.002	0.007
Annual Total	**76**	**0.23**	**0.69**	**0.020**	**0.060**	**0.024**	**0.071**

Table 68 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Lambay Island SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.08	0.15	0.23	0.38	1	2	2	3	4	5	5	6	7	8
	20	0.15	0.30	0.46	1	2	3	5	6	8	9	11	12	14	15
	30	0.23	0.46	1	1	2	5	7	9	11	14	16	18	21	23
	40	0.30	1	1	2	3	6	9	12	15	18	21	24	27	30
	50	0.38	1	1	2	4	8	11	15	19	23	27	30	34	38
	60	0.46	1	1	2	5	9	14	18	23	27	32	36	41	46
	70	1	1	2	3	5	11	16	21	27	32	37	43	48	53
	80	1	1	2	3	6	12	18	24	30	36	43	49	55	61
	90	1	1	2	3	7	14	21	27	34	41	48	55	62	68
	100	1	2	2	4	8	15	23	30	38	46	53	61	68	76

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.12.10 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals. Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.12.11 It is estimated that 21.2% of kittiwake during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Lambay Island SPA potentially impacted by displacement is 63 per annum during the breeding season (Table 67).

5.6.12.12 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Lambay Island SPA is estimated to be less than one (0.19) breeding adults per annum. Table 67 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.12.13 The population of kittiwake at Lambay Island SPA has reduced since the citation colony count in 2004 of 7,894 individuals to 6,640 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 67).

5.6.12.14 Using the citation colony count of 7,894 breeding adults and an annual background mortality of 1,152.5 individuals, the addition of 0.19 predicted breeding adult mortalities would result in a 0.016% increase in baseline mortality during the breeding season. When considering the most up to date counts of 6,640 breeding adults and an annual background mortality of 969.4 adults, this results in an increase of 0.019% in baseline mortality during the breeding season (see Table 67).

Non-breeding Season

5.6.12.15 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.7% of predicted mortalities during the post-breeding season are estimated to derive from Lambay Island SPA and 0.9% during the pre-breeding season (see Apportioning Appendix C).

5.6.12.16 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Lambay Island SPA during the post-breeding season is predicted at less than one (0.02), and less than one (0.02) during the pre-breeding season per annum.

5.6.12.17 Based on the 2004 citation colony count of 7,894 breeding adults and using an annual background mortality of 1,152.5 individuals, the addition of 0.02 and 0.02 predicted breeding adult mortalities would result in a 0.001% and a 0.002% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 6,640 and an annual background mortality of 969.4 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 67).

5.6.12.18 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.04) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.003% and 0.004%, respectively

Annual Total

5.6.12.19 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Lambay Island SPA during operation and maintenance, is less than one (0.23) kittiwake per annum. The addition of 0.23 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.020% and 0.024% respectively (see Table 67).

5.6.12.20 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Lambay Island SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Lambay Island SPA.

Collision Risk (Operation and Maintenance)

5.6.12.21 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.,* 2014).

5.6.12.22 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Lambay Island SPA. Table 69 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Lambay Island SPA during each defined season and the overall annual impact.

Table 69 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Lambay Island SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Lambay Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	1.97	0.171	0.203
Post-breeding (Aug-Dec)	14.92	0.11	0.009	0.011
Pre-breeding (Jan-Apr)	7.69	0.07	0.006	0.007
Annual Total	**42.07**	**2.15**	**0.186**	**0.221**

5.6.12.23 Impacts are assessed relative to the citation population of 7,894 individuals (with a background mortality of 1,152.5 individuals per annum), and the most recent count (2015) of 6,640 individuals (with a background mortality of 969.4 individuals per annum).

Migration-free breeding season

5.6.12.24 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.12.25 It is estimated that 21.2% of predicted mortalities during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Lambay Island SPA during the migration-free breeding season is two (1.97) breeding adults per annum (Table 69).

5.6.12.26 The population of kittiwake at Lambay Island SPA has reduced since the citation colony count in 2004 of 7,894 individuals, having decreased to 6,640 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.12.27 Using the citation colony count of 7,894 breeding adults and an annual background mortality of 1,152.5 individuals, the addition of 1.97 predicted breeding adult mortalities would result in a 0.171% increase in baseline mortality during the breeding season. When considering the most up to date counts of 6,640 and an annual background mortality of 969.4 adults, this results in an increase of 0.203% in baseline mortality during the breeding season (Table 69).

Non-breeding season

5.6.12.28 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.7% of predicted mortalities during the post-breeding season are estimated to derive from Lambay Island SPA and 0.9% during the pre-breeding season (see Apportioning Appendix C), the consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.11) and less than one (0.07) during the pre-breeding season per annum.

5.6.12.29 Based on the 2004 citation colony count of 7,894 breeding adults and using an annual background mortality of 1,152.5 individuals, the addition of 0.11 and 0.07 predicted breeding adult mortalities would result in a 0.009% and a 0.006% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 6,640 and an annual background mortality of 969.4 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 69).

5.6.12.30 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.18) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.015% and 0.018%, respectively (Table 69).

Annual Total

5.6.12.31 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is two (2.15) kittiwake per annum. The addition of 2.15 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.186% and. 0.221% respectively (Table 69).

5.6.12.32 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Lambay Island SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Lambay Island SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.12.33 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Lambay Island SPA.

5.6.12.34 Based on the separate assessments of kittiwake from Lambay Island SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is two (2.38) breeding adult mortalities (Table 70). This represents an increase in baseline mortality of 0.206% when considering the citation colony count and an increase in baseline mortality of 0.245% 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 kittiwake feature of Lambay Island SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 71.

Table 70 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Lambay Island SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	2.38	0.206	0.245

Table 71. Assessment conclusions for kittiwake at Lambay Island.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Lambay Island SPA in relation to potential displacement affects and collision risk from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Lambay Island SPA
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects).

Conservation Objective	Conclusion
	Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to barrier effects from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Razorbill

Direct Disturbance and Displacement

5.6.12.35 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR +1SD of razorbill (88.7+75.9 km; Woodward *et al*., 2019). Razorbill have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

5.6.12.36 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Razorbill have been assessed during the breeding season of April to July, the post-breeding season of August to October, the migration-free winter season of November to December, and the pre-breeding season of January to March, in relation to Lambay Island SPA.

5.6.12.37 Impacts are assessed relative to the citation population of 7,610 individuals (with a background mortality of 799.1 individuals per annum), and the most recent count (2015) of 7,353 individuals (with a background mortality of 772.1 individuals per annum).

Construction and Decommissioning

5.6.12.38 The potential razorbill displacement mortality from the construction and decommissioning of Dublin Array attributed to Lambay Island SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.12.39 The potential razorbill displacement mortality from the operation of Dublin Array attributed to Lambay Island SPA is presented in Table 72 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual razorbill displacement mortalities during operations and maintenance attributed to Lambay Island is also found in Table 73.

Table 72 Predicted razorbill displacement mortalities attributed to Lambay Island SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2 km 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Apr-Jul)	322	1.61	0.97 - 4.51	5.80 – 9.66	0.202	0.121 – 0.564	0.726 – 1.209	0.209	0.125 – 0.584	0.751 – 1.251
Post-breeding (Aug-Oct)	24	0.12	0.07 - 0.34	0.14 – 0.43	0.015	0.009 – 0.042	0.018 – 0.054	0.016	0.009 – 0.044	0.019 – 0.056
Pre-breeding (Jan-Mar)	6	0.03	0.02 - 0.08	0.04 – 0.11	0.003	0.002 – 0.010	0.004 – 0.013	0.004	0.002 – 0.010	0.004 – 0.013
Winter (Nov-Dec)	6	0.03	0.02 - 0.08	0.04 – 0.11	0.004	0.002 – 0.010	0.004 – 0.013	0.004	0.002 – 0.010	0.004 – 0.013
Annual Total	**358**	**1.79**	**1.07 - 5.00**	**6.01 – 10.31**	**0.224**	**0.134 – 0.626**	**0.752 – 1.289**	**0.231**	**0.139 – 0.648**	0.778 – 1.334

Table 73 The full displacement matrix of potential annual razorbill displacement mortalities during operations and maintenance attributed to Lambay Island SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.36	1	1	2	4	7	11	14	18	21	25	29	32	36
	20	1	1	2	4	7	14	21	29	36	43	50	57	64	72
	30	1	2	3	5	11	21	32	43	54	64	75	86	97	107
	40	1	3	4	7	14	29	43	57	72	86	100	115	129	143
	50	2	4	5	9	18	36	54	72	90	107	125	143	161	179
	60	2	4	6	11	21	43	64	86	107	129	150	172	193	215
	70	3	5	8	13	25	50	75	100	125	150	175	200	226	251
	80	3	6	9	14	29	57	86	115	143	172	200	229	258	286
	90	3	6	10	16	32	64	97	129	161	193	226	258	290	322
	100	4	7	11	18	36	72	107	143	179	215	251	286	322	358

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.12.40 The estimated razorbill mean peak abundance during the breeding season is 1,068 individuals. Assuming that 57% of the razorbill population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 566 per annum during the breeding season.

5.6.12.41 It is estimated that 57% of razorbill during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Lambay Island SPA potentially impacted by displacement is 322 per annum during the breeding season (Table 72).

5.6.12.42 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult razorbill from Lambay Island SPA is estimated to be two (1.61) breeding adults per annum. Table 72 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.12.43 The population of razorbill at Lambay Island SPA has decreased since the citation colony count in 2001 of 7,610 individuals to 7,353 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 72).

5.6.12.44 Using the citation colony count of 7,610 breeding adults and an annual background mortality of 799.1 individuals, the addition of 1.61 predicted breeding adult mortalities would result in a 0.202% increase in baseline mortality during the breeding season. When considering the most up to date counts of 7,353 breeding adults and an annual background mortality of 772.1 adults, this results in an increase of 0.209% in baseline mortality during the breeding season (Table 72).

Non-breeding Season

5.6.12.45 The estimated razorbill mean peak abundance during the post-breeding season is 2,070 individuals, 478 during the pre-breeding season, and 281 during the migration-free winter season. Based on the non-breeding seasonal regional population size, 1.16% of predicted mortalities during the post-breeding season are estimated to derive from Lambay Island SPA, 1.16% during the pre-breeding season, and 2.00% during the migration-free winter season (see Apportioning Appendix C).

5.6.12.46 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult razorbill from Lambay Island SPA during the post-breeding season is predicted at less than one (0.12), less than one (0.03) during the pre-breeding season, and less than one (0.03) during the migration-free winter season per annum.

5.6.12.47 Based on the 2001 citation colony count of 7,610 breeding adults and using an annual background mortality of 799.1 individuals, the addition of 0.12, 0.03 and 0.03 predicted breeding adult mortalities would result in a 0.015%. 0.003%, and 0.004% increase in baseline mortality during the post-breeding, pre-breeding, and migration-free winter season, respectively. When considering the most up to date counts of 7,353 breeding adults and an annual background mortality of 772.1 adults, this results in an increase of 0.016%, 0.004%, and 0.004% in baseline mortality during the post-breeding, pre-breeding season, and migration-free winter season respectively (Table 72).

5.6.12.48 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.18) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.022% and 0.023%, respectively (Table 72).

Annual Total

5.6.12.49 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is two (1.79) razorbill per annum. The addition of 1.79 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.224% and. 0.231% respectively (Table 72).

5.6.12.50 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of razorbill at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 74.

Table 74. Displacement assessment conclusions for razorbill at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the razorbill feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology

Conservation Objective	Conclusion
	Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to barrier effects from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Guillemot

Direct Disturbance and Displacement

5.6.12.51 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR +1SD of guillemot (73.2±80.5 km; Woodward *et al.*, 2019). Guillemot have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al.*, 2014).

5.6.12.52 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Guillemot have been assessed during the breeding season (March to July) and the non-breeding season (August to February) in relation to Lambay Island SPA.

5.6.12.53 Impacts are assessed relative to the citation population of 927,998 individuals (with a background mortality of 4,757.9 individuals per annum), and the most recent count (2015) of 59,983 individuals (with a background mortality of 3,659.0 individuals per annum)

Construction and Decommissioning

5.6.12.54 The potential guillemot displacement mortality from the construction and decommissioning of Dublin Array attributed to Lambay Island SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.12.55 The potential guillemot displacement mortality from the operation of Dublin Array attributed to Lambay Island SPA is presented in Table 75 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual guillemot displacement mortalities during operations and maintenance attributed to Lambay Island SPA is also found in Table 76.

Table 75 Predicted guillemot displacement mortalities attributed to Lambay Island SPA during the operation and maintenance phase of Dublin Array.

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Mar – Jul)	7,233	36.16	21.70 - 101.26	130.19 – 216.99	0.760	0.456 – 2.128	2.736 – 4.560	0.988	0.593-2.767	3.558 – 5.930
Non-breeding (Aug – Feb)	93	0.46	0.28 – 1.30	0.56 – 1.67	0.010	0.006 – 0.027	0.912 – 2.736	0.013	0.008-0.036	1.186 – 3.558
Annual Total	**7,326**	**36.63**	**21.98 – 102.56**	**130.75 – 218.66**	**0.770**	**0.462 – 2.156**	**2.748 – 4.596**	**1.001**	**0.601-2.803**	**3.573 – 5.976**

Table 76 The full displacement matrix of potential annual guillemot displacement mortalities during operations and maintenance attributed to Lambay Island SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	7	15	22	37	73	147	220	293	366	440	513	586	659	733
	20	15	29	44	73	147	293	440	586	733	879	1,026	1,172	1,319	1,465
	30	22	44	66	110	220	440	659	879	1,099	1,319	1,538	1,758	1,978	2,198
	40	29	59	88	147	293	586	879	1,172	1,465	1,758	2,051	2,344	2,637	2,930
	50	37	73	110	183	366	733	1,099	1,465	1,832	2,198	2,564	2,930	3,297	3,663
	60	44	88	132	220	440	879	1,319	1,758	2,198	2,637	3,077	3,516	3,956	4,396
	70	51	103	154	256	513	1,026	1,538	2,051	2,564	3,077	3,590	4,103	4,615	5,128
	80	59	117	176	293	586	1,172	1,758	2,344	2,930	3,516	4,103	4,689	5,275	5,861
	90	66	132	198	330	659	1,319	1,978	2,637	3,297	3,956	4,615	5,275	5,934	6,593
	100	73	147	220	366	733	1,465	2,198	2,930	3,663	4,396	5,128	5,861	6,593	7,326

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.12.56 The estimated guillemot mean peak abundance during the breeding season is 18,687 individuals. Assuming that 57% of the guillemot population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 9,906 per annum during the breeding season.

5.6.12.57 It is estimated that 73% of guillemot during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Lambay Island SPA potentially impacted by displacement is 7,233 per annum during the breeding season (Table 75).

5.6.12.58 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult guillemot from Lambay Island SPA is estimated to be 36 (36.16) breeding adults per annum. Table 75 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.12.59 The population of guillemot at Lambay Island SPA has reduced since the citation colony count in 2004 of 77,998 individuals, decreasing to 59,983 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 75).

5.6.12.60 Using the citation colony count of 77,998 breeding adults and an annual background mortality of 4,757.9 individuals, the addition of 36.16 predicted breeding adult mortalities would result in a 0.760% increase in baseline mortality during the breeding season. When considering the most up to date counts of 59,983 breeding adults and an annual background mortality of 3,659 adults, this results in an increase of 0.988% in baseline mortality during the breeding season (Table 75).

Non-breeding Season

5.6.12.61 The estimated guillemot mean peak abundance during the non-breeding season is 2,063 individuals. Based on the non-breeding seasonal regional population size, 4.50% of predicted mortalities during the post-breeding season are estimated to derive from Lambay Island SPA (see Apportioning Appendix C).

5.6.12.62 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult guillemot from Lambay Island SPA during the post-breeding season is predicted at less than one (0.46) during the migration-free winter season per annum.

5.6.12.63 Based on the 2004 citation colony count of 77,998 breeding adults and using an annual background mortality of 4,757.9 individuals, the addition of 0.46 predicted breeding adult mortalities would result in a 0.010% increase in baseline mortality during the non-breeding season. When considering the most up to date counts of 59,983 breeding adults and an annual background mortality of 3,659.0 adults, this results in an increase 0.013% increase in baseline mortality during the non-breeding season (Table 75).

Annual Total

5.6.12.64 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is 37 (36.63) guillemot per annum. The addition of 36.63 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.770% and. 1.001% respectively (Table 75).

5.6.12.65 For the citation count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. However, when using the most recent count, the increase in baseline mortality is greater than 1% and therefore has been further investigation to determine the potential impact on population level through PVA.

PVA Analysis

5.6.12.66 The PVA results are shown in Table 77. Assuming a predicted annual mortality of 36.6 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Lambay Island SPA are 0.999 and 0.976 respectively. This represents a 0.070% reduction in GR and a reduction in final population size of 2.410%. For further details regarding the PVA results presented here see the PVA: Appendix 4.3.6-7 of the EIAR.

5.6.12.67 The guillemot colony at Lambay Island SPA has displayed a continued decrease in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 59,983 individuals. This translates to an annual colony GR of -0.08 % (JNCC, 2023). However, the impact from Dublin Array alone is below 0.5% (difference in GR = 0.040%) and as such would be indistinguishable from natural fluctuations in population. The same conclusion is also true when considering the realistic worst case scenario based on SNCB guidance (70% displacement, 2% mortality) and the worst case scenario based on NatureScot guidance (60% displacement, 3% and 5% mortality).

5.6.12.68 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

5.6.12.69 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e. the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

5.6.12.70 There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot feature of Lambay Island SPA in relation to potential disturbance and displacement from Dublin Array alone. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of guillemot at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 78.

Table 77 PVA outputs for breeding adult guillemot at Lambay Island SPA for Dublin Array alone.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		Median CGR (SD)	Median CPS (SD)		
Project alone (50%, 1%)	36.16	0.999 (0.000)	0.976 (0.008)	0.070	2.410
Project alone (70%, 2%)	101.26	0.998 (0.000)	0.934 (0.007)	0.190	6.640
Project alone (60% displacement, 3 and 1% mortality)	130.19	0.998 (0.000)	0.916 (0.007)	0.240	8.630
Project alone (60% displacement, 5% and 3% mortality)	216.98	0.996 (0.000)	0.864 (0.007)	0.410	13.620

Table 78. Displacement assessment conclusions for guillemot at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.

Conservation Objective	Conclusion
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	See results of PVA in the PVA Analysis Section above.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Shag

Direct Disturbance and Displacement

5.6.12.71 Lambay Island SPA is 31.5 km (around land) from Dublin Array, outside the MMFR +1SD of shag (13.2±10.5 km; Woodward *et al*., 2019) and therefore would typically be excluded from the apportioning. Nevertheless, tracking data from Lambay Island SPA identifies an overlap of tracks of tagged individuals from Lambay Island with the Dublin Array OWF.

5.6.12.72 Shag have been screened into the assessment for displacement risk. Seabird sensitivity rankings have been conducted by Langston (2010); Furness *et al*. (2013) and Bradbury *et al*. (2014) each of which deemed shag to be at moderate risk of displacement. The British Trust for Ornithology (BTO) conducted a review of these sensitivity rankings, on behalf of Natural England, along with additional information from Furness (2013) and Cook *et al*. (2014). The BTO deemed shag to be at low risk of displacement (Humphreys *et al*., 2015).

5.6.12.73 Additionally, several studies at operational OWFs have suggested that shags are unlikely to be at risk of displacement. According to Dierschke *et al*. (2016), shags (and cormorants) are attracted to OWFs and often rest on infrastructure like turbines, met masts and transformer platforms. This has been evidenced in the Belgian North Sea, where sightings of shags, prior to the construction of the first turbines, were rare with five individuals sighted four times throughout 20 years of seabird monitoring (Vanerman *et al*., 2013). Moreover, low numbers of shags were observed in or near to the Egmond aan Zee OWF in the Netherlands (Poot *et al*., 2011).

5.6.12.74 As per the cumulative affects model presented by Poot *et al*. (2011) shags (and cormorants) are unlikely to be at risk of negative cumulative effects and the development of more OWFs is likely to expand their habitat as a result of increased resting and foraging space. Offshore wind turbines can provide an offshore roosting platform on which seabirds can rest during foraging trips and in turn allows individuals to access foraging habitats beyond their typical foraging range. Furthermore, prey species abundance and density may increase around OWFs as these structures can act like an artificial reef therefore increasing food availability (Stenberg *et al*., 2015).

5.6.12.75 Given the available evidence from existing offshore wind farm studies, it is considered unlikely that shags will be fully displaced from the array area and could instead potentially be attracted to the OWF. As the above evidence suggests, this attraction to the array area and offshore infrastructure may provide potential benefits, for example roosting opportunities, increase in foraging availability, and increase in prey within the Array Area.

5.6.12.76 Nevertheless, a precautionary approach has been employed, and shag has been assessed for potential displacement effects.

5.6.12.77 The assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Shag have been assessed during the breeding season of February to August and the non-breeding season of September to January, in relation to Lambay Island SPA.

5.6.12.78 Impacts are assessed relative to the citation population of 3,468 individuals (with a background mortality of 133.2 individuals per annum), and the most recent count (2015) of 938 individuals (with a background mortality of 492.5 individuals per annum)

Construction and Decommissioning

5.6.12.79 The potential shag displacement mortality from the construction and decommissioning of Dublin Array attributed to Lambay Island SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.12.80 The potential shag displacement mortality from the operation and maintenance of Dublin Array attributed to Lambay Island SPA is presented in Table 79 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual shag displacement mortalities during operations and maintenance attributed to Lambay Island SPA is also found in Table 80.

Breeding season

5.6.12.81 The estimated shag mean peak abundance during the breeding season is 295 individuals (see abundance calculation methodology in Disturbance and Displacement). The proportion of breeding adults in the population is estimated at 43% (Furness, 2015). Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement at Lambay Island SPA is 127 per annum during the breeding season.

5.6.12.82 It is estimated that 33.6% of shag during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Lambay Island SPA potentially impacted by displacement is 43 per annum during the breeding season (Table 79).

5.6.12.83 When applying a displacement rate of 60% and a mortality rate of 1%, the consequent potential mortality for breeding adult shag from Lambay Island SPA is estimated to be less than one (0.26) breeding adult per annum.

5.6.12.84 The population of shag at Lambay Island SPA has decreased since the colony count in 2004 of 3,468 individuals to 938 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 79).

5.6.12.85 Using the citation colony count of 3,468 breeding adults and an annual background mortality of 492.5 individuals, the addition of 0.26 predicted breeding adult mortalities would result in a 0.052% increase in baseline mortality during the breeding season. When considering the most up to date counts of 938 breeding adults and an annual background mortality of 133.2 adults, this results in an increase of 0.193% in baseline mortality during the breeding season (Table 79).

Table 79 Predicted shag displacement mortalities attributed to Lambay Island SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		60% displacement, 1% mortality	50% - 60% displacement, 1 - 3% mortality	60% displacement, 1% mortality	50% -60% displacement, 1 - 3% mortality	60% displacement, 1% mortality	50% -60% displacement, 1-3% mortality
Breeding (Feb – Aug)	43	0.26	0.21 – 0.77	0.052	0.044 – 0.157	0.193	0.161 – 0.579
Non-Breeding (Sep – Jan)	12	0.07	0.06 – 0.21	0.014	0.012 – 0.042	0.052	0.043 – 0.204
Annual Total	**55**	**0.33**	**0.27 – 0.98**	**0.066**	**0.055 – 0.199**	**0.245**	**0.502– 0.736**

Table 80 The full displacement matrix of potential annual shag displacement mortalities during operations and maintenance attributed to Lambay Island SPA.

Displacement (%)	Mortalities (%)													
%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	1	1	2	2	3	3	4	4	5	6
20	0	0	0	1	1	2	3	4	6	7	8	9	10	11
30	0	0	0	1	2	3	5	7	8	10	12	13	15	17
40	0	0	1	1	2	4	7	9	11	13	15	18	20	22
50	0	1	1	1	3	6	8	11	14	17	19	22	25	28
60	0	1	1	2	3	7	10	13	17	20	23	26	30	33
70	0	1	1	2	4	8	12	15	19	23	27	31	35	39
80	0	1	1	2	4	9	13	18	22	26	31	35	40	44
90	0	1	1	2	5	10	15	20	25	30	35	40	45	50
100	1	1	2	3	6	11	17	22	28	33	39	44	50	55

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach (Table 27), based on a review of various approaches as detailed in Section 5.6.3 (Disturbance and Displacement).

Non-breeding season

5.6.12.86 The estimated shag mean peak abundance during the non-breeding season is 373 individuals. Based on the non-breeding regional population size, 7.2% of predicted mortalities during the non-breeding season are estimated to derive from Lambay Island SPA (see Apportioning Appendix C). Assuming that 43% of the shag population are adults (Furness, 2015), the total mean peak abundance of breeding adults at Lambay Island SPA potentially impacted by displacement is 12 per annum during the non-breeding season.

5.6.12.87 When applying a displacement rate of 60% and a mortality rate of 1%, the consequent predicted displacement mortality of adult razorbill from Lambay Island SPA during the non-breeding season is predicted at less than one (0.07).

5.6.12.88 Based on the 2004 citation colony count of 3,468 breeding adults and using an annual background mortality of 492.5 individuals, the addition of 0.07 predicted breeding adult mortalities would result in a 0.014% increase in baseline mortality during the non-breeding season. When considering the most up to date counts of 938 breeding adults and an annual background mortality of 133.2 adults, this results in an increase of 0.052% in baseline mortality during the non-breeding season (Table 79).

Annual Total

5.6.12.89 The predicted resultant mortality (when using a 60% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is less than one (0.33) shag per annum. The addition of 0.33 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.066% and 0.245% respectively (Table 79).

5.6.12.90 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the shag feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the shag feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of shag at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 81.

Table 81. Displacement assessment conclusions for shag at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing; Disturbance occurs at levels that do not significantly impact on breeding population; The productivity rate is sufficient to maintain a stable or increasing population;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the shag feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the shag at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the shag at Lambay Island SPA in relation to breeding/roost site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the shag at Lambay Island SPA in relation to barrier effects from Dublin Array alone.

Conservation Objective	Conclusion
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the shag at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Herring Gull

Collision Risk (Operation and Maintenance)

5.6.12.91 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR ± 1SD of Herring gull (58.8±26.8 km; Woodward *et al.*, 2019). Herring gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.*, 2014).

5.6.12.92 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Herring gull have been assessed during the breeding season of March to August and the non-breeding season of September to February in relation to Lambay Island SPA. Table 82 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Lambay Island SPA during each defined season and the overall annual impact.

5.6.12.93 Impacts are assessed relative to the citation population of 622 individuals (with a background mortality of 103.3 individuals per annum), and the most recent count (2015) of 1,812 individuals (with a background mortality of 300.8 individuals per annum)

Breeding season

5.6.12.94 The predicted herring gull collision mortality during the breeding season is 16.14 individuals (see CRM). Assuming that 48% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 31.2%. Therefore, the total predicted number of breeding adult collisions is 5.04 per annum during the breeding season.

5.6.12.95 It is estimated that 21.4% of predicted mortalities during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Lambay Island SPA during the breeding season is one (1.08) breeding adults per annum (Table 82).

5.6.12.96 The population of herring gull at Lambay Island SPA has increased since the citation colony count in 2004 of 622 individuals, having increased to 1,812 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.12.97 Using the citation colony count of 622 breeding adults and an annual background morality of 103.3 individuals, the addition of 1.08 predicted breeding adult mortalities would result in a 1.043% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,812 and an annual background mortality of 300.8 adults, this results in an increase of 0.358% in baseline mortality during the breeding season (Table 82).

Table 82 Herring gull predicted collision mortalities during the operation and maintenance phase attributed to Lambay Island SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Lambay Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Mar – Aug)	16.14	1.08	1.043	0.358
Non-breeding (Sep – Feb)	19.87	0.19	0.186	0.064
Annual Total	**36.01**	**1.27**	**1.230**	**0.422**

Non-breeding season

5.6.12.98 The predicted herring gull collision mortality during the non-breeding season is 19.87 individuals. Based on the non-breeding seasonal regional population size, 1.0% of predicted mortalities during the non-breeding season are estimated to derive from Lambay Island SPA (see Apportioning Appendix C), the consequent predicted collision mortality of adult herring gull during the non-breeding season is predicted at less than one (0.19) per annum.

5.6.12.99 Based on the 2004 citation colony count of 622 breeding adults and using an annual background morality of 103.3 individuals, the addition of 0.19 predicted breeding adult mortalities would result in a 0.186% increase in baseline mortality during the non-breeding. When considering the most up to date count of 1,812 and an annual background mortality of 300.8 adults, this results in an increase of 0.064% non-breeding season (Table 82).

Annual Total

5.6.12.100 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is one (1.27) herring gull per annum. The addition of 1.27 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 1.230% and. 0.422% respectively (Table 82).

5.6.12.101 Based on the 2004 citation reference, the increase in baseline mortality is greater than 1%. However, in contrast, using the most recent count the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. As the most recent count provides the most relevant understanding of the herring gull feature at Lambay Island SPA, conclusions for need of further assessment are based on the most recent count alone. Consequently, there is, no potential for an AEoI to the population conservation objective of the herring gull feature of Lambay Island SPA in relation to collision risk from Dublin Array alone. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 83.

Table 83. Collision risk assessment conclusions for herring gull at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the herring gull feature of Lambay Island SPA in relation to potential collision risk from Dublin Array alone.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are

Conservation Objective	Conclusion
	assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the herring gull feature of Lambay Island SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	Herring gull is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the conservation objectives of the herring gull feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	For most collision risk species 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) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to barrier effects from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no

Conservation Objective	Conclusion
	potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Lesser black-backed gull

Collision Risk (Operation and Maintenance)

5.6.12.102 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR ± 1SD of lesser black-backed gull (127.0±109.0km; Woodward *et al.*, 2019). Lesser black-backed gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.,* 2014).

5.6.12.103 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Lesser black-backed gull have been assessed during the breeding season of April to August, the post-breeding season of August to October, the pre-breeding season of March to April, and the migration-free winter season of November to February in relation to Lambay Island SPA. Table 84 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Lambay Island SPA during each defined season and the overall annual impact.

5.6.12.104 Impacts are assessed relative to the citation population of 266 individuals (with a background mortality of 30.6 individuals per annum), and the most recent count (2018) of 990 individuals (with a background mortality of 79.4 individuals per annum).

Breeding season

5.6.12.105 The predicted lesser black-backed gull collision mortality during the breeding season is 3.28 individuals (see CRM). Assuming that 60% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 39%. Therefore, the total predicted number of breeding adult collisions is 1.28 per annum during the breeding season.

5.6.12.106 It is estimated that 55% of predicted mortalities during the breeding season derive from Lambay Island SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Lambay Island SPA during the breeding season is one (0.70) breeding adult per annum (Table 84).

5.6.12.107 The population of lesser black-backed gull at Lambay Island SPA has increase since the citation colony count in 2004 of 266 individuals, having increased to 690 individuals (2015-2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.12.108 Using the citation colony count of 266 breeding adults and an annual background mortality of 30.6 individuals, the addition of 0.70 predicted breeding adult mortalities would result in a 2.304% increase in baseline mortality during the breeding season. When considering the most up to date counts of 690 and an annual background mortality of 79.4 adults, this results in an increase of 0.888% in baseline mortality during the breeding season (Table 84).

Table 84 Lesser black-backed gull predicted collision mortalities during the operation and maintenance phase attributed to Lambay Island SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Lambay Island SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Apr-Aug)	3.28	0.70	2.304	0.888
Post-breeding (Aug - Oct)	0.27	<0.01 (0.001)	0.004	0.001
Winter (Nov – Feb)	0.37	<0.01 (0.005)	0.016	0.006
Pre-breeding (Mar-Apr)	0.15	<0.01 (0.001)	0.002	0.001
Annual Total	**4.07**	**0.71**	**2.326**	**0.897**

Non-breeding season

5.6.12.109 The predicted lesser black-backed gull collision mortality during the post-breeding season is 0.27 individuals, 0.15 during the pre-breeding season and 0.37 during the winter season. Based on the non-breeding seasonal regional population size, 0.4% of predicted mortalities during the post-breeding season are estimated to derive from Lambay Island SPA, 0.4% during the pre-breeding season and 1.3% during the winter season (see Apportioning Appendix C), the consequent predicted collision mortality of adult lesser black-backed gull during the post-breeding season is predicted at less than one (0.001), less than one (0.001) during the pre-breeding season and less than one (0.01) during the winter season per annum.

5.6.12.110 Based on the 2004 citation colony count of 266 breeding adults and using an annual background mortality of 30.6 individuals, the addition of 0.001, 0.001 and 0.01 predicted breeding adult mortalities would result in a 0.004%, 0.002% and 0.016% increase in baseline mortality during the post-breeding, pre-breeding and winter season, respectively. When considering the most up to date count of 690 and an annual background mortality of 79.4 adults, this results in an increase of 0.001%, 0.001% and 0.006% in baseline mortality during the post-breeding, pre-breeding and winter season, respectively (Table 84).

5.6.12.111 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.021% and 0.008%, respectively (Table 84).

Annual Total

5.6.12.112 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Lambay Island SPA, is less than one (0.71) lesser black-backed gull per annum. The addition of 0.71 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 2.326% and. 0.897% respectively (Table 84).

5.6.12.113 Based on the 2004 citation reference, the increase in baseline mortality is greater than 1%. However, when using the most recent count the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. As the most recent count provides the most relevant understanding of the lesser black-backed gull feature at Lambay Island SPA, conclusions for need of further assessment are based on this citation alone. Consequently, there is, no potential for an AEoI to the population conservation objective of the lesser black-backed gull feature of Lambay Island SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the lesser black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of lesser black-backed gull at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 85.

Table 85. Collision risk assessment conclusions for lesser black-backed gull at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the lesser black-backed gull feature of Lambay Island SPA in relation to potential collision risk from Dublin Array alone.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the lesser black-backed gull feature of Lambay Island SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on breeding population;	Lesser black-backed gull is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) lesser black-backed sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the conservation objectives of the lesser black-backed gull feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other	For most collision risk species the evidence suggests that the presence of WTGs does not deter them from entering the array area

Conservation Objective	Conclusion
ecologically important sites outside the SPA; and	therefore these birds are unlikely to experience barrier effects. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to barrier effects from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

5.6.13 Wicklow Head SPA

Features and Effects for Assessment

5.6.13.1 Potential for LSE alone has been identified for the following feature of Wicklow Head SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M only)
  - Combined collision risk and direct disturbance and displacement (O&M)

Assessment Information

5.6.13.2 The conservation objective (as described in Appendix A) for Wicklow Head SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.13.3 Based on the above conservation objective, the specific target for those screened in feature of the SPA, in order for favourable conservation status to be achieved is when:

- The long-term SPA population trend is stable or increasing;
- The productivity rate is sufficient to maintain a stable or increasing population;

- There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;
- There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;
- Disturbance occurs at levels that do not significantly impact on birds at the breeding site;
- Disturbance occurs at levels that do not significantly impact on breeding population; and
- Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.

Kittiwake

Direct Disturbance and Displacement

5.6.13.4 Wicklow Head SPA is 31.9 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback (ABPmer, 2023) despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.13.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Wicklow Head SPA.

5.6.13.6 Impacts are assessed relative to the citation population of 1,912 individuals (with a background mortality of 279.2 individuals per annum), and the most recent count (2022) of 1,348 individuals (with a background mortality of 196.8 individuals per annum).

Construction and Decommissioning

5.6.13.7 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Wicklow Head SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.13.8 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Wicklow Head SPA is presented in Table 86 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Wicklow Head SPA can also be found in Table 87.

Breeding Season

5.6.13.9 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals, with an estimated 3.7% of kittiwake during the breeding season deriving from Wicklow Head SPA (Apportioning Appendix C). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season (Table 86).

5.6.13.10 It is estimated that 3.7% of kittiwake during the breeding season derive from Wicklow Head SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Wicklow Head SPA potentially impacted by displacement is 11 per annum during the breeding season (Table 86).

5.6.13.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Wicklow Head SPA is estimated to be less than one (0.03) breeding adults per annum. Table 86 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.13.12 The population of kittiwake at Wicklow Head SPA has reduced since the citation colony count in 2002 of 1,912 individuals to 1,348 individuals (2022). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 86).

Table 86 Predicted kittiwake displacement mortalities attributed to Wicklow Head SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	11	0.03	0.10	0.012	0.035	0.017	0.050
Post-breeding (Aug-Dec)	1	<0.01 (0.003)	0.01	0.001	0.003	0.002	0.005
Pre-breeding (Jan-Apr)	2	0.01	0.01	0.002	0.005	0.002	0.007
Annual Total	**14**	**0.04**	**0.12**	**0.015**	**0.044**	**0.021**	**0.062**

Table 87 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Wicklow Head SPA.

Displacement (%)	Mortalities (%)													
	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.01	0.03	0.04	0.07	0.14	0.28	0.42	1	1	1	1	1	1	1
	20	0.03	0.06	0.08	0.14	0.28	1	1	1	1	2	2	2	3	3
	30	0.04	0.08	0.13	0.21	0.42	1	1	2	2	3	3	3	4	4
	40	0.06	0.11	0.17	0.28	1	1	2	2	3	3	4	4	5	6
	50	0.07	0.14	0.21	0.35	1	1	2	3	4	4	5	6	6	7
	60	0.08	0.17	0.25	0.42	1	2	3	3	4	5	6	7	8	8
	70	0.10	0.20	0.29	0.49	1	2	3	4	5	6	7	8	9	10
	80	0.11	0.22	0.34	1	1	2	3	4	6	7	8	9	10	11
	90	0.13	0.25	0.38	1	1	3	4	5	6	8	9	10	11	13
	100	0.14	0.28	0.42	1	1	3	4	6	7	8	10	11	13	14

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

5.6.13.13 Using the citation colony count of 1,912 breeding adults and an annual background mortality of 279.2 individuals, the addition of 0.03 predicted breeding adult mortalities would result in a 0.012% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,348 breeding adults and an annual background mortality of 196.8 adults, this results in an increase of 0.017% in baseline mortality during the breeding season (see Table 86).

Non-breeding Season

5.6.13.14 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Wicklow Head SPA and 0.2% during the pre-breeding season (see Apportioning Appendix C).

5.6.13.15 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Wicklow Head SPA during the post-breeding season is predicted at less than one (0.003), and less than one (0.01) during the pre-breeding season per annum.

5.6.13.16 Based on the 2002 citation colony count of 1,912 breeding adults and using an annual background mortality of 279.2 individuals, the addition of 0.003 and 0.01 predicted breeding adult mortalities would result in a 0.001% and a 0.002% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 1,348 and an annual background mortality of 279.2 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 86).

5.6.13.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.003% and 0.004%, respectively

Annual Total

5.6.13.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Wicklow Head SPA during operation and maintenance, is less than one (0.04) kittiwake per annum. The addition of 0.04 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.015% and 0.021% respectively (see Table 86).

5.6.13.19 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Wicklow Head SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Wicklow Head SPA.

Collision Risk (Operation and Maintenance)

5.6.13.20 Wicklow Head SPA is 31.9 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.13.21 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Wicklow Head SPA. Table 86 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Wicklow Head SPA during each defined season and the overall annual impact.

5.6.13.22 Impacts are assessed relative to the citation population of 1,912 individuals (with a background mortality of 279.2 individuals per annum), and the most recent count (2022) of 1,348 individuals (with a background mortality of 196.8 individuals per annum).

Table 88 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Wicklow Head SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	**Total predicted collision mortality (individuals per annum)**	**Predicted breeding adult collision mortalities attributed to Wicklow Head SPA (individuals per annum)**	**Increase in baseline mortality (%)**	
			Compared to citation population	Compared to most recent count
Breeding (May-July)	19.46	0.34	0.122	0.173
Post-breeding (Aug-Dec)	14.92	0.02	0.008	0.011
Pre-breeding (Jan-Apr)	7.69	0.01	0.005	0.007
Annual Total	**42.07**	**0.38**	**0.135**	**0.191**

Migration-free breeding season

5.6.13.23 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.13.24 It is estimated that 3.7% of predicted mortalities during the breeding season derive from Wicklow Head SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Wicklow Head SPA during the migration-free breeding season is less than one (0.34) breeding adults per annum (Table 88).

5.6.13.25 The population of kittiwake at Wicklow Head SPA has reduced since the citation colony count in 2002 of 1,912 individuals, having decreased to 1,348 individuals (2022). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.13.26 Using the citation colony count of 1,912 breeding adults and an annual background mortality of 279.2 individuals, the addition of 0.34 predicted breeding adult mortalities would result in a 0.122% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,348 and an annual background mortality of 196.8 adults, this results in an increase of 0.173% in baseline mortality during the breeding season (Table 88).

Non-breeding season

5.6.13.27 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Wicklow Head SPA and 0.2% during the pre-breeding season (see Apportioning Appendix C), the consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.02) and less than one (0.01) during the pre-breeding season per annum.

5.6.13.28 Based on the 2002 citation colony count of 1,912 breeding adults and using an annual background mortality of 279.2 individuals, the addition of 0.02 and 0.01 predicted breeding adult mortalities would result in a 0.008% and a 0.005% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 1,348 and an annual background mortality of 196.8 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 88).

5.6.13.29 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.04) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.013% and 0.018%, respectively (Table 88).

Annual Total

5.6.13.30 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Wicklow Head SPA, is less than one (0.38) kittiwake per annum. The addition of 0.38 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.135% and. 0.191% respectively (Table 88).

5.6.13.31 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Wicklow Head SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Wicklow Head SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.13.32 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Wicklow Head SPA.

5.6.13.33 Based on the separate assessments of kittiwake from Wicklow Head SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.42) breeding adult mortality (Table 89). This represents an increase in baseline mortality of 0.149% when considering the citation colony count and an increase in baseline mortality of 0.212% 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 kittiwake feature of Wicklow Head SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Wicklow Head SPA. Conclusions against all conservation objectives are provided in Table 90.

Table 89 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Wicklow Head SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.42	0.149	0.212

Table 90. Assessment conclusions for kittiwake at Wicklow Head SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing; Disturbance occurs at levels that do not significantly impact on breeding population;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Wicklow Head SPA in relation to potential displacement affects and collision risk from Dublin Array alone.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Wicklow Head SPA.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to availability of nesting sites from Dublin Array alone.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to breeding site disturbance from Dublin Array alone.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of

Conservation Objective	Conclusion
	interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to barrier effects from Dublin Array alone.

5.6.14 Skerries Islands SPA

Features and Effects for Assessment

5.6.14.1 Potential for LSE alone had been identified for the following for Skerries Islands SPA:

- Herring gull
  - Collision risk (O&M)
- Cormorant
  - Direct disturbance and displacement (C&D)

5.6.14.2 As discussed in Paragraph 5.6.2.13, any impacts resulting from disturbance from the activities associated with the construction works will be short-term, temporary and reversible in nature, lasting only for the duration of activities. Birds are expected to return to the area once these activities have ceased. The significance of vessel disturbance will be negligible. There is, therefore, no potential for an AEoI to the population conservation objectives of Skerries Islands SPA to potential disturbance to cormorant from Dublin Array. Therefore, subject to natural change, the feature will be maintained in the long term with respect to the potential for disturbance.

Assessment Information

5.6.14.3 The conservation objective (as described in Appendix A) for Skerries Islands is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.14.4 Based on the above conservation objective, the specific target for those screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- The long-term SPA population trend is stable or increasing;

- The productivity rate is sufficient to maintain a stable or increasing population;
- The long-term winter population trend is stable or increasing;
- There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population; and
- There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population target

Herring Gull

Collision Risk (Operation and Maintenance)

5.6.14.5 Skerries Islands SPA is 30.2 km (around land) from Dublin Array, within the MMFR ± 1SD of herring gull (58.8±26.8km; Woodward *et al*., 2019). Herring gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.14.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Herring gull have been assessed during the breeding season of March to August and the non-breeding season of September to February in relation to Skerries Islands SPA. Table 91 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Skerries Islands SPA during each defined season and the overall annual impact.

5.6.14.7 Impacts are assessed relative to the citation population of 600 individuals (with a background mortality of 99.6 individuals per annum), and the most recent count (2010) of 20 individuals (with a background mortality of 3.3 individuals per annum).

Breeding season

5.6.14.8 The predicted herring gull collision mortality during the breeding season is 16.14 individuals (see CRM). Assuming that 48% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 31%. Therefore, the total predicted number of breeding adult collisions is 5.04 per annum during the breeding season.

5.6.14.9 It is estimated that 0.1% of predicted mortalities during the breeding season derive from Skerries Islands SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Skerries Islands SPA during the breeding season is less than one (0.01) breeding adults per annum (Table 91).

5.6.14.10 The population of herring gull at Skerries Islands SPA has reduced since the citation colony count in 1999 of 600 individuals, having decreased to 20 individuals (2010). It is noted that there has not been a count since 2010, and there is therefore the potential that no herring gull currently breed at Skerries Island SPA. The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

Table 91 Herring gull predicted collision mortalities during the operation and maintenance phase attributed to Skerries Islands SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Skerries Islands SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Mar – Aug)	16.14	0.01	0.007	0.218
Non-breeding (Sep – Feb)	19.87	<0.01 (0.002)	0.002	0.064
Annual Total	**36.01**	**0.01**	**0.009**	**0.282**

5.6.14.11 Using the citation colony count of 600 breeding adults and an annual background morality of 99.6 individuals, the addition of 0.01 predicted breeding adult mortalities would result in a 0.007% increase in baseline mortality during the breeding season. When considering the most up to date counts of 20 and an annual background mortality of 3.3 adults, this results in an increase of 0.218% in baseline mortality during the breeding season (Table 91).

Non-breeding season

5.6.14.12 The predicted herring gull collision mortality during the non-breeding season is 19.87 individuals. Based on the non-breeding seasonal regional population size, less than 0.1% (0.01%) of predicted mortalities during the non-breeding season are estimated to derive from Skerries Islands SPA (see Apportioning Appendix C), the consequent predicted collision mortality of adult herring gull during the non-breeding season is predicted at less than one (0.002) per annum.

5.6.14.13 Based on the 1999 citation colony count of 600 breeding adults and using an annual background morality of 99.6 individuals, the addition of 0.002 predicted breeding adult mortalities would result in a 0.002% increase in baseline mortality during the non-breeding. When considering the most up to date counts of 20 and an annual background mortality of 3.3 adults, this results in an increase of 0.064% non-breeding season (Table 91).

Annual Total

5.6.14.14 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Skerries Islands SPA, is less than one (0.01) herring gull per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.009% and. 0.282% respectively (Table 91).

5.6.14.15 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull feature of Skerries Islands SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Skerries Islands SPA. Conclusions against all conservation objectives are provided in Table 92.

Table 92. Collision risk assessment conclusions for herring gull at Skerries Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the herring gull feature of Skerries Islands SPA in relation to potential collision risk from Dublin Array alone.
The long-term winter population trend is stable or increasing;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the herring gull feature of Skerries Islands SPA.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population target; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the herring gull at Skerries Islands SPA in relation to prey biomass availability from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the herring gull at Skerries Islands SPA in relation to availability of nesting sites from Dublin Array alone.

5.6.15 Aberdaron Coast and Bardsey Island SPA / Glannau Aberdaron ac Ynys Enlli

Features and Effects for Assessment

5.6.15.1 Potential for LSE alone had been identified for the following for Aberdaron Coast and Bardsey Island SPA:

Manx Shearwater

Direct disturbance and displacement (C&D)

Direct disturbance and displacement (O&M)

Assessment Information

5.6.15.2 The conservation objective (as described in Appendix A) for Aberdaron Coast and Bardsey Island SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.15.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- Breeding population of Manx Shearwater (confined to Ynys Enlli) is stable or increasing;
- Reproductive rates remain stable;
- Deaths from the lighthouse attractions, fencing and other infrastructure are minimal;
- No ground predators are introduced;
- Nesting birds are not disturbed by restoration works on boundary walls or recreational activities; and
- All factors affecting the achievement of these conditions are under control.

Manx Shearwater

Direct Disturbance and Displacement

5.6.15.4 Aberdaron Coast and Bardsey Island SPA is 74.9 km (around land) from Dublin Array, within the MMFR +1SD of Manx shearwater (1,346.8+1,018.7 km; Woodward *et al*., 2019). Manx shearwater have been screened into the assessment for displacement risk on a precautionary basis based on feedback from ABPmer (2023).

5.6.15.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Manx shearwater have been assessed during the breeding season of April to August, the post-breeding season of September to early October, and the pre-breeding season of late March, in relation Aberdaron Coast and Bardsey Island SPA.

5.6.15.6 Impacts are assessed relative to the citation population of 13,860 individuals (with a background mortality of 1,801.8 individuals per annum), and the most recent count (2015) of 41,350 individuals (with a background mortality of 5,375.5 individuals per annum).

Construction and Decommissioning

5.6.15.7 The potential Manx shearwater displacement mortality from the construction and decommissioning of Dublin Array attributed to Aberdaron Coast and Bardsey Island SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.15.8 The potential Manx shearwater displacement mortality from the operation of Dublin Array attributed to Aberdaron Coast and Bardsey Island SPA is presented in Table 93 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Aberdaron Coast and Bardsey Island SPA is also found in Table 94.

Table 93 Predicted Manx shearwater displacement mortalities attributed to Aberdaron Coast and Bardsey Island SPA during the operation and maintenance phase of Dublin Array.

Defined Season	**Abundance of adults apportioned to SPA (plus 2km buffer)**	**Estimated increase in mortality (breeding adults per annum)** 30% displacement, 1% mortality	**% increase in baseline mortality (citation count)** 30% displacement, 1% mortality	**% increase in baseline mortality (recent count)** 30% displacement, 1% mortality
Breeding (Apr-Aug)	226	0.68	0.038	0.013
Post-breeding (Sep-early Oct)	5	0.01	0.001	<0.001 (0.0003)
Pre-breeding (late Mar)	<1 (0.1)	<0.01 (0.0003)	<0.001 (0.00002)	<0.001 (0.00001)
Annual Total	**28**	**0.69**	**0.038**	**0.013**

Table 94 The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Aberdaron Coast and Bardsey Island SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.0	0.1	0.1	0.1	0.3	1	1	1	1	2	2	2	3	3
	20	0.1	0.1	0.2	0.3	1	1	2	2	3	3	4	4	5	6
	30	0.1	0.2	0.3	0.4	1	2	3	3	4	5	6	7	8	8
	40	0.1	0.2	0.3	1	1	2	3	4	6	7	8	9	10	11
	50	0.1	0.3	0.4	1	1	3	4	6	7	8	10	11	13	14
	60	0.2	0.3	1	1	2	3	5	7	8	10	12	13	15	17
	70	0.2	0.4	1	1	2	4	6	8	10	12	14	16	18	20
	80	0.2	0.4	1	1	2	4	7	9	11	13	16	18	20	22
	90	0.3	1	1	1	3	5	8	10	13	15	18	20	23	25
	100	0.3	1	1	1	3	6	8	11	14	17	20	22	25	28

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per Table 27.

Breeding Season

5.6.15.9 The estimated Manx shearwater mean peak abundance during the breeding season is 2,198 individuals. Assuming that 54% of the Manx shearwater population are adults (Furness, 2015), the total mean peak abundance of breeding adults potentially impacted by displacement is 1,187 per annum during the breeding season (Table 93). Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 1,187 per annum during the breeding season.

5.6.15.10 It is estimated that 19.0% of adults during the breeding season derive from Aberdaron Coast and Bardsey Island SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Aberdaron Coast and Bardsey Island SPA during the breeding season potentially impacted by displacement is 226 breeding adults per annum (Table 93).

5.6.15.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult Manx shearwater from Aberdaron Coast and Bardsey Island SPA is estimated to be less than one (0.68) breeding adults per annum (Table 93).

5.6.15.12 The population of Manx shearwater at Aberdaron Coast and Bardsey Island SPA from the 1996 citation colony count was 13,860, whereas the 2015 SMP count was 41,350 individuals. The assessment of the potential impact on the colony has been carried out using both the citation and the most recent count (Table 93).

5.6.15.13 Using the citation colony count of 13,860 breeding adults and an annual background mortality of 1,801.8 individuals, the addition of 0.68 predicted breeding adult mortalities would result in a 0.038% increase in baseline mortality during the breeding season. When considering the alternative recent count of 41,350 breeding adults and an annual background mortality of 5,375.5 adults, this results in an increase of 0.013% in baseline mortality during the breeding season (Table 93).

Non-breeding Season

5.6.15.14 The estimated Manx shearwater mean peak abundance during the post-breeding season is 176 individuals and 4 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 2.62% of predicted mortalities are estimated to derive from Aberdaron Coast and Bardsey Island SPA during both the pre- and post-breeding seasons (see Apportioning Appendix C).

5.6.15.15 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent predicted displacement mortality of adult Manx shearwater from Aberdaron Coast and Bardsey Island SPA during the post-breeding season is predicted at less than one (0.01) and less than one (0.0003) during the pre-breeding season per annum.

5.6.15.16 Based on the 1996 citation colony count of 13,860 breeding adults and using an annual background mortality of 1,801.8 individuals, the addition of 0.01 and 0.0003 predicted breeding adult mortalities would result in a 0.001% and less than 0.001% (0.00002%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most recent count of 41,350 breeding adults and an annual background mortality of 5,375.5 adults, this results in an increase of less than 0.001% (0.0003%) and less than 0.001% (0.00001%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 93).

5.6.15.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the alternative recent count the baseline mortality rate increases by 0.001% and less than 0.001% (0.0003%), respectively (Table 93).

Annual Total

5.6.15.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Aberdaron Coast and Bardsey Island SPA, is less than one (0.08) Manx shearwater per annum. The addition of 0.69 predicted mortalities per annum would increase baseline mortality against the citation and the alternative recent count recent counts by 0.038% and 0.013% respectively (Table 93).

5.6.15.19 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Manx shearwater feature of Aberdaron Coast and Bardsey Island SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the Manx shearwater feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of Manx shearwater in Aberdaron Coast and Bardsey Island SPA. Conclusions against all conservation objectives are provided in Table 95.

Table 95. Displacement assessment conclusions for Manx shearwater at Aberdaron Coast and Bardsey Island SPA.

Conservation Objective	Conclusion
Breeding population of Manx Shearwater (confined to Ynys Enlli) is stable or increasing;	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the Manx shearwater feature of at Aberdaron Coast and Bardsey Island SPA in relation to potential displacement effects from Dublin Array alone.
Reproductive rates remain stable;	
Deaths from the lighthouse attractions, fencing and other infrastructure are minimal;	There is no potential pathway from the proposed development. There is, therefore, no

Conservation Objective	Conclusion
No ground predators are introduced;	potential for an AEoI to the COs of the Manx shearwater at Aberdaron Coast and Bardsey Island SPA in relation to availability of roosting resources from Dublin Array alone.
Nesting birds are not disturbed by restoration works on boundary walls or recreational activities; and	
All factors affecting the achievement of these conditions are under control.	

5.6.16 Saltee Islands SPA

Features and Effects for Assessment

5.6.16.1 Potential for LSE alone has been identified for the following features of Saltee Islands SPA:

- Gannet
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Razorbill
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Guillemot
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
- Lesser black backed gull

- Collision risk (O&M)

Assessment Information

5.6.16.2 The conservation objective (as described in Appendix A) is to maintain the favourable conservation condition of the qualifying bird species of the Saltee Islands SPA.

5.6.16.3 Based on the above conservation objective, the specific target for these species, in order for favourable conservation status to be achieved, is when:

- No significant decline in breeding population abundance: apparently occupied nests.
- No significant decline in productivity rate.
- No significant decline in distribution: breeding colonies.
- No significant decline in prey biomass available. No significant increase in barriers to connectivity.
- No significant increase in disturbance at the breeding site.
- 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

Gannet

Direct Disturbance and Displacement

5.6.16.4 Saltee Islands SPA is 143.6 km (around land) from Dublin Array, within the MMFR +1SD of gannet (315.2±194.2 km; Woodward *et al*., 2019). Gannet have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Dierschke *et al.,* 2016).

5.6.16.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of September to November, and the pre-breeding season of December to March, in relation to Saltee Islands SPA.

5.6.16.6 Impacts are assessed relative to the citation population of 4,892 individuals (with a background mortality of 396.3 individuals per annum), and the most recent count (2014) of 9,444 individuals (with a background mortality of 765.0 individuals per annum).

Construction and Decommissioning

5.6.16.7 The potential gannet displacement mortality from the construction and decommissioning of Dublin Array attributed to Saltee Islands SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.16.8 The potential gannet displacement mortality from the operation of Dublin Array attributed to Saltee Islands SPA is presented in Table 96 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Saltee Islands SPA is also found in Table 97.

Table 96 Predicted gannet displacement mortalities attributed to Saltee Islands SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)			% increase in baseline mortality (citation count)			% increase in baseline mortality (recent count)		
		70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality
Breeding (Mar-Sep)	17	0.12	0.10 – 0.14	0.36	0.030	0.026 – 0.034	0.090	0.015	0.013 – 0.018	0.046
Post-breeding (Sep-Nov)	<1 (0.37)	<0.01 (0.003)	<0.01 (0.002) – <0.01 (0.003)	0.01	0.001	0.001 – 0.001	0.002	<0.001 (0.0003)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Pre-breeding (Dec-Mar)	<1 (0.40)	<0.01 (0.003)	<0.01 (0.002) – <0.01 (0.003)	0.01	0.001	0.001 – 0.001	0.002	<0.001 (0.0004)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Annual Total	**18**	**0.12**	**0.11 – 0.14**	**0.38**	**0.031**	**0.028 – 0.036**	**0.094**	**0.016**	**0.013 – 0.018**	**0.048**

Table 97 The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Saltee Islands SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.02	0.04	0.05	0.09	0.18	0.36	1	1	1	1	1	1	2	2
	20	0.04	0.07	0.11	0.18	0.36	1	1	1	2	2	3	3	3	4
	30	0.05	0.11	0.16	0.27	1	1	2	2	3	3	4	4	5	5
	40	0.07	0.14	0.22	0.36	1	1	2	3	4	4	5	6	6	7
	50	0.09	0.18	0.27	0.45	1	2	3	4	5	5	6	7	8	9
	60	0.11	0.22	0.32	1	1	2	3	4	5	6	8	9	10	11
	70	0.13	0.25	0.38	1	1	3	4	5	6	8	9	10	11	13
	80	0.14	0.29	0.43	1	1	3	4	6	7	9	10	12	13	14
	90	0.16	0.32	0.49	1	2	3	5	6	8	10	11	13	15	16
	100	0.18	0.36	1	1	2	4	5	7	9	11	13	14	16	18

Outputs highlighted in in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023), those highlighted in dark green represent the overlapping predicted annual mortality estimates from both the NatureScot guidance (2023) and Applicant Approach and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.16.9 The estimated gannet mean peak abundance during the breeding season is 700 individuals. Assuming that 55% of the gannet population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 346.5 per annum during the breeding season (Table 96).

5.6.16.10 It is estimated that 4.9% of adults during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement from Saltee Islands SPA is 17 per annum during the breeding season (Table 96).

5.6.16.11 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent potential mortality for breeding adult gannet from Saltee Islands SPA is estimated to be less than one (0.12) breeding adults per annum. Table 96 presents a range of potential displacement consequent mortalities.

5.6.16.12 The population of gannet at Saltee Islands SPA has increased since the citation colony count in 2004 of 4,892 individuals, increasing to 9,444 individuals (2013-2014). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 96).

5.6.16.13 Using the citation colony count of 4,892 breeding adults and an annual background mortality of 396.3 individuals, the addition of 0.12 predicted breeding adult mortalities would result in a 0.030% increase in baseline mortality during the breeding season. When considering the most up to date counts of 9,444 breeding adults and an annual background mortality of 765.0 adults, this results in an increase of 0.015% in baseline mortality during the breeding season (Table 96).

Non-breeding Season

5.6.16.14 The estimated gannet mean peak abundance during the non-breeding season is 48 individuals. Based on the non-breeding seasonal regional population size, 1.8% of predicted mortalities during the post-breeding season and 1.5% of predicted mortalities during the pre-breeding season are estimated to derive from Saltee Islands SPA (see Apportioning Appendix C).

5.6.16.15 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent predicted displacement mortality of adult gannet from Saltee Islands SPA during both the post-breeding season and pre-breeding season is less than one (0.003) and less than one (0.003) per annum.

5.6.16.16 Based on the 2004 citation colony count of 4,892 breeding adults and using an annual background mortality of 396.3 individuals, the addition of 0.003 predicted breeding adult mortalities during the post-breeding season and 0.003 breeding adult mortalities during the pre-breeding season would result in a 0.001% increase in baseline mortality during the post-breeding season and a 0.001% increase in baseline mortality during the pre-breeding season. When considering the most up to date counts of 9,444 breeding adults and an annual background mortality of 765.0 adults, this results in a less than 0.001% (0.0003%) increase in baseline mortality during the post-breeding season and a less than 0.001% (0.0004%) increase in baseline mortality during the pre-breeding season. (Table 96).

Annual Total

5.6.16.17 The predicted resultant mortality (when using a 70% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is less than one (0.12) gannet per annum. The addition of 0.12 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.031% and 0.016% respectively (Table 96).

5.6.16.18 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Saltee Islands SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of gannet in the Saltee Islands SPA.

5.6.16.19 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the productivity rate, distribution, prey biomass, barriers to connectivity and disturbance conservation objectives.

5.6.16.20 Therefore, there will no long-term change to gannet breeding population abundance (apparently occupied nests), productivity rate, distribution of breeding colonies, prey biomass, connectivity, and disturbance at the breeding site and immediately adjacent marine areas due to displacement effects on gannet at Saltee Islands SPA.

Collision Risk (Operation and Maintenance)

5.6.16.21 Saltee Islands SPA is 143.6 km (around land) from Dublin Array, within the MMFR ± 1SD of gannet (315.2±194.2 km; Woodward *et al.,* 2019). Gannet have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.,* 2014).

5.6.16.22 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of October to November, and the pre-breeding season of December to February in relation to Saltee Islands SPA. Table 98 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Saltee Islands SPA during each defined season and the overall annual impact.

5.6.16.23 Impacts are assessed relative to the citation population of 4,892 individuals (with a background mortality of 396.3 individuals per annum), and the most recent count (2014) of 9,444 individuals (with a background mortality of 765.0 individuals per annum).

Breeding season

5.6.16.24 The predicted gannet collision mortality during the breeding season is 3.23 individuals (see CRM). Assuming that 55% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total predicted number of breeding adult collisions is 3.23 per annum during the breeding season.

5.6.16.25 It is estimated that 4.9% of predicted mortalities during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Saltee Islands SPA during the breeding season is less than one (0.08) breeding adults per annum (Table 98).

5.6.16.26 The population of gannet at Saltee Islands SPA has increased since the citation colony count in 2004 of 4,892 individuals, having increased to 9,444 individuals (2013-2014). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.16.27 Using the citation colony count of 4,892 breeding adults and an annual background mortality of 396.3 individuals, the addition of 0.08 predicted breeding adult mortalities would result in a 0.020% increase in baseline mortality during the breeding season. When considering the most up to date counts of 9,444 and an annual background mortality of 765.0 adults, this results in an increase of 0.010% in baseline mortality during the breeding season (Table 98).

Table 98 Gannet predicted collision mortalities during the operation and maintenance phase attributed to Saltee Islands SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Saltee Islands SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Mar-Sep)	3.23	0.08	0.020	0.010
Post-breeding (Sep-Nov)	0.11	<0.01 (0.002)	0.001	0.001
Pre-breeding (Dec-Mar)	0.11	<0.01 (0.002)	0.001	<0.001 (0.0002)
Annual Total	**3.45**	**0.08**	**0.021**	**0.011**

Non-breeding season

5.6.16.28 The predicted gannet collision mortality during the post-breeding season is 0.11 individuals and 0.11 individuals during the pre-breeding season. Based on the non-breeding seasonal regional population size, 1.8% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA and1.5% during the pre-breeding season (see Apportioning Appendix C), the consequent predicted collision mortality of adult gannet during the post-breeding season is predicted at less than one (0.002) and less than one (0.002) during the pre-breeding season per annum.

5.6.16.29 Based on the 2004 citation colony count of 4,892 breeding adults and using an annual background mortality of 396.3 individuals, the addition of 0.002 and 0.002 predicted breeding adult mortalities would result in a 0.001% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 9,444 and an annual background mortality of 765.0 adults, this results in an increase of 0.001% and 0.0002% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 98).

5.6.16.30 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.004) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.001%, respectively (Table 98).

Annual total

5.6.16.31 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is less than one (0.08) gannet per annum. The addition of 0.08 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.021% and 0.011% respectively (Table 98).

5.6.16.32 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Saltee Islands SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of gannet in the Saltee Islands SPA.

5.6.16.33 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting effect on the integrity of the SPA in relation to the productivity rate, distribution, prey biomass, barriers to connectivity and disturbance conservation objectives.

5.6.16.34 Therefore, there will no long-term change to gannet breeding population abundance (apparently occupied nests), productivity rate, distribution of breeding colonies, prey biomass, connectivity, and disturbance at the breeding site and immediately adjacent marine areas due to collision effects on gannet at Saltee Islands SPA.

Combined Collision Risk and Disturbance and Displacement

5.6.16.35 Gannet have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the gannet population at Saltee Islands SPA.

5.6.16.36 Based on the separate assessments of gannet from Saltee Islands SPA above, the combined predicted annual impact from collision risk and displacement (70% displacement, 1% mortality) is less than one (0.20) breeding adult mortality (Table 99). This represents an increase in baseline mortality of 0.050% when considering the citation colony count and an increase in baseline mortality of 0.026% 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 gannet feature of Saltee Islands SPA in relation to combined collision risk and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of gannet in the Saltee Islands SPA. Conclusions against all conservation objectives are provided in Table 100.

Table 99 Annual gannet increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Saltee Island SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.20	0.050	0.026

Table 100. Assessment conclusions for gannet at Saltee Islands SPA.

Conservation Objective	Conclusion
No significant decline in breeding population abundance: apparently occupied nests.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the gannet feature of Saltee Islands SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
No significant decline in distribution: breeding colonies	
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	
No significant decline in productivity rate.	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the gannet feature of Saltee Island SPA.

Conservation Objective	Conclusion
No significant decline in prey biomass available.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the gannet at Saltee Islands SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the gannet at Saltee Islands SPA in relation to barrier effects from Dublin Array alone.
No significant increase in disturbance at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the gannet at Saltee Islands SPA in relation to breeding/roost site disturbance from Dublin Array alone.

Kittiwake

Direct Disturbance and Displacement

5.6.16.37 Saltee Islands SPA is 143.6km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.16.38 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Saltee Islands SPA.

5.6.16.39 Impacts are assessed relative to the citation population of 4,250 individuals (with a background mortality of 620.5 individuals per annum), and the most recent count (2015-2018) of 2,076 individuals (with a background mortality of 303.1 individuals per annum).

Construction and Decommissioning

5.6.16.40 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Saltee Islands SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.16.41 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Saltee Islands SPA is presented in Table 101 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Saltee Islands SPA can also be found in Table 102.

Table 101 Predicted kittiwake displacement mortalities attributed to Saltee Islands SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	1	<0.01 (0.002)	0.01	<0.001 (0.0003)	0.001	0.001	0.002
Post-breeding (Aug-Dec)	2	0.01	0.01	0.001	0.002	0.002	0.005
Pre-breeding (Jan-Apr)	2	0.01	0.02	0.001	0.004	0.002	0.007
Annual Total	**5**	**0.01**	**0.04**	**0.002**	**0.007**	**0.005**	**0.014**

Table 102 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Saltee Islands SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.01	0.01	0.02	0.03	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	1
	20	0.01	0.02	0.03	0.05	0.10	0.20	0.30	0.40	1	1	1	1	1	1
	30	0.02	0.03	0.05	0.08	0.15	0.30	0.45	1	1	1	1	1	1	2
	40	0.02	0.04	0.06	0.10	0.20	0.40	1	1	1	1	1	2	2	2
	50	0.03	0.05	0.08	0.13	0.25	1	1	1	1	2	2	2	2	3
	60	0.03	0.06	0.09	0.15	0.30	1	1	1	2	2	2	2	3	3
	70	0.04	0.07	0.11	0.18	0.35	1	1	1	2	2	2	3	3	4
	80	0.04	0.08	0.12	0.20	0.40	1	1	2	2	2	3	3	4	4
	90	0.05	0.09	0.14	0.23	0.45	1	1	2	2	3	3	4	4	5
	100	0.05	0.10	0.15	0.25	1	1	2	2	3	3	4	4	5	5

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.16.42 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals. Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.16.43 It is estimated that 0.2% of adults during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Saltee Islands SPA potentially impacted by displacement is one (0.64) per annum during the breeding season (Table 102).

5.6.16.44 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Saltee Islands SPA is estimated to be less than one (0.002) breeding adults per annum. Table 102 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.16.45 The population of kittiwake at Saltee Islands SPA has reduced since the citation colony count in 1998-2000 of 4,250 individuals to 2,076 individuals (2015 - 2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 101).

5.6.16.46 Using the citation colony count of 4,250 breeding adults and an annual background mortality of 620.5 individuals, the addition of 0.002 predicted breeding adult mortalities would result in a less than 0.001% (0.0003%) increase in baseline mortality during the breeding season. When considering the most up to date counts of 2,076 breeding adults and an annual background mortality of 303.1 adults, this results in an increase of 0.001% in baseline mortality during the breeding season (see Table 101).

Non-breeding Season

5.6.16.47 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA and 0.3% during the pre-breeding season (see Apportioning Appendix C).

5.6.16.48 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Saltee Islands SPA during the post-breeding season is predicted at less than one (0.01), and less than one (0.01) during the pre-breeding season per annum.

5.6.16.49 Based on the 1998-2000 citation colony count of 4,250 breeding adults and using an annual background mortality of 620.5 individuals, the addition of 0.01 and 0.01 predicted breeding adult mortalities would result in a 0.001% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 2,076 and an annual background mortality of 303.1 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 101).

5.6.16.50 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.002% and 0.004%, respectively

Annual Total

5.6.16.51 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Saltee Islands SPA during operation and maintenance, is less than one (0.01) kittiwake per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.002% and 0.005% respectively (see Table 101).

5.6.16.52 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Saltee Islands SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk.

5.6.16.53 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the productivity rate, distribution, prey biomass, barriers to connectivity and disturbance conservation objectives.

5.6.16.54 Therefore, there will no long-term change to kittiwake breeding population abundance (apparently occupied nests), productivity rate, distribution of breeding colonies, prey biomass, connectivity, and disturbance at the breeding site and immediately adjacent marine areas due to displacement effects on kittiwake at Saltee Islands SPA.

Collision Risk (Operation and Maintenance)

5.6.16.55 Saltee Islands SPA is 143.6km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.16.56 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Saltee Islands SPA. Table 101 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Saltee Islands SPA during each defined season and the overall annual impact.

5.6.16.57 Impacts are assessed relative to the citation population of 4,892 individuals (with a background mortality of 396.3 individuals per annum), and the most recent count (2014) of 9,444 individuals (with a background mortality of 765.0 individuals per annum).

Migration-free breeding season

5.6.16.58 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.16.59 It is estimated that 0.2% of predicted mortalities during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Saltee Islands SPA during the migration-free breeding season is less than one (0.02) breeding adults per annum (Table 101).

5.6.16.60 The population of kittiwake at Saltee Islands SPA has reduced since the citation colony count in 1998-2000 of 4,250 individuals, having decreased to 2,076 individuals (2015-2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.16.61 Using the citation colony count of 4,250 breeding adults and an annual background mortality of 620.5 individuals, the addition of 0.02 predicted breeding adult mortalities would result in a 0.003% increase in baseline mortality during the breeding season. When considering the most up to date counts of 2,076 and an annual background mortality of 303.1 adults, this results in an increase of 0.007% in baseline mortality during the breeding season (Table 103).

Table 103 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Saltee Islands SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Saltee Islands SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	0.02	0.003	0.007
Post-breeding (Aug-Dec)	14.92	0.03	0.005	0.011
Pre-breeding (Jan-Apr)	7.69	0.02	0.004	0.007
Annual Total	**42.07**	**0.08**	**0.012**	**0.025**

Non-breeding season

5.6.16.62 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA and 0.3% during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.03) and less than one (0.02) during the pre-breeding season per annum.

5.6.16.63 Based on the 1998-2000 citation colony count of 4,250 breeding adults and using an annual background mortality of 620.5 individuals, the addition of 0.03 and 0.02 predicted breeding adult mortalities would result in a 0.005% and a 0.004% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 2,076 and an annual background mortality of 303.1 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 103).

5.6.16.64 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.06) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.009% and 0.018%, respectively (Table 103).

Annual total

5.6.16.65 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is less than one (0.08) kittiwake per annum. The addition of 0.08 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.012% and. 0.025% respectively (Table 103).

5.6.16.66 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Saltee Islands SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of kittiwake in the Saltee Islands SPA.

5.6.16.67 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the productivity rate, distribution, prey biomass, barriers to connectivity and disturbance conservation objectives.

5.6.16.68 Therefore, there will no long-term change to kittiwake breeding population abundance (apparently occupied nests), productivity rate, distribution of breeding colonies, prey biomass, connectivity, and disturbance at the breeding site due to collision effects on kittiwake at Saltee Islands SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.16.69 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Saltee Islands SPA.

5.6.16.70 Based on the separate assessments of kittiwake from Saltee Islands SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.09) breeding adult mortality (Table 104). This represents an increase in baseline mortality of 0.015% when considering the citation colony count and an increase in baseline mortality of 0.030% 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 kittiwake feature of Saltee Islands SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of kittiwake in the Saltee Islands SPA. Conclusions against all conservation objectives are provided in Table 105.

Table 104 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Saltee Islands SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.09	0.015	0.030

Table 105. Assessment conclusions for kittiwake at Saltee Islands SPA.

Conservation Objective	Conclusion
No significant decline in breeding population abundance: apparently occupied nests.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Saltee Islands SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
No significant decline in distribution: breeding colonies.	
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	
No significant decline in productivity rate.	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Saltee Island SPA.

Conservation Objective	Conclusion
No significant decline in prey biomass available.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Saltee Islands SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Saltee Islands SPA in relation to barrier effects from Dublin Array alone.
No significant increase in disturbance at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Saltee Islands SPA in relation to breeding/roost site disturbance from Dublin Array alone.

Razorbill

Direct Disturbance and Displacement

5.6.16.71 Saltee Islands SPA is 143.6 km (around land) from Dublin Array, within the MMFR +1SD of razorbill (88.7+75.9 km; Woodward *et al*., 2019). Razorbill have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

5.6.16.72 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Razorbill have been assessed during the breeding season of April to July, the post-breeding season of August to October, the migration-free winter season of November to December, and the pre-breeding season of January to March, in relation to Saltee Islands SPA.

5.6.16.73 Impacts are assessed relative to the citation population of 5,010 individuals (with a background mortality of 526.1 individuals per annum), and the most recent count (2015) of 6,519 individuals (with a background mortality of 684.5 individuals per annum).

Construction and Decommissioning

5.6.16.74 The potential razorbill displacement mortality from the construction and decommissioning of Dublin Array attributed to Saltee Islands SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.16.75 The potential razorbill displacement mortality from the operation of Dublin Array attributed to Saltee Islands SPA is presented in Table 106 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual razorbill displacement mortalities during operations and maintenance attributed to Saltee Islands SPA is also found in Table 107.

Table 106 Predicted razorbill displacement mortalities attributed to Saltee Islands SPA during the operation and maintenance phase of Dublin Array.

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Apr-Jul)	10	0.05	0.03 - 0.15	0.19 – 0.31	0.010	0.006-0.028	0.036 – 0.059	0.008	0.005-0.021	0.027 – 0.046
Post-breeding (Aug-Oct)	21	0.11	0.06 – 0.30	0.13 – 0.38	0.020	0.012-0.057	0.024 – 0.073	0.016	0.009-0.044	0.019 – 0.056
Pre-breeding (Jan-Mar)	5	0.02	0.02 – 0.07	0.03 – 0.09	0.005	0.003-0.013	0.006 – 0.017	0.004	0.002-0.010	0.004 – 0.013
Winter (Nov-Dec)	5	0.02	0.02 – 0.07	0.03 – 0.09	0.005	0.003-0.013	0.006 – 0.017	0.004	0.002-0.010	0.004 – 0.013
Annual Total	**41**	**0.21**	**0.12 – 0.58**	**0.37 – 0.87**	**0.040**	**0.024-0.111**	**0.071 – 0.166**	**0.030**	**0.018-0.085**	**0.055 – 0.128**

Table 107 The full displacement matrix of potential annual razorbill displacement mortalities during operations and maintenance attributed to Saltee Islands SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.04	0.08	0.12	0.21	0.41	1	1	2	2	2	3	3	4	4
	20	0.08	0.16	0.25	0.41	1	2	2	3	4	5	6	7	7	8
	30	0.12	0.25	0.37	1	1	2	4	5	6	7	9	10	11	12
	40	0.16	0.33	0.49	1	2	3	5	7	8	10	11	13	15	16
	50	0.21	0.41	1	1	2	4	6	8	10	12	14	16	18	21
	60	0.25	0.49	1	1	2	5	7	10	12	15	17	20	22	25
	70	0.29	1	1	1	3	6	9	11	14	17	20	23	26	29
	80	0.33	1	1	2	3	7	10	13	16	20	23	26	30	33
	90	0.37	1	1	2	4	7	11	15	18	22	26	30	33	37
	100	0.41	1	1	2	4	8	12	16	21	25	29	33	37	41

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.16.76 The estimated razorbill mean peak abundance during the breeding season is 1,068 individuals. Assuming that 57% of the razorbill population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 566 per annum during the breeding season (Table 106).

5.6.16.77 It is estimated that 2% of adults during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Saltee Islands SPA potentially impacted by displacement is 10 per annum during the breeding season (Table 106).

5.6.16.78 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult razorbill from Saltee Islands SPA is estimated to be less than one (0.05) breeding adults per annum. Table 106 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.16.79 The population of razorbill at Saltee Islands SPA from the 1998-2000 citation colony count was 5,010, whereas the 2015 SMP count was 6,519 individuals. The assessment of the potential impact on the colony has been carried out using both the citation and the most recent count (Table 106).

5.6.16.80 Using the citation colony count of 5,010 breeding adults and an annual background mortality of 526.1 individuals, the addition of 0.05 predicted breeding adult mortalities would result in a 0.010% increase in baseline mortality during the breeding season. When considering the alternative recent count of 6,519 breeding adults and an annual background mortality of 684.5 adults, this results in an increase of 0.008% in baseline mortality during the breeding season (Table 106).

Non-breeding Season

5.6.16.81 The estimated razorbill mean peak abundance during the post-breeding season is 2,070 individuals, 478 during the pre-breeding season, and 281 during the migration-free winter season. Based on the non-breeding seasonal regional population size, 1.03% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA, 1.03% during the pre-breeding season, and 1.78% during the migration-free winter season (see Apportioning Appendix C).

5.6.16.82 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult razorbill from Saltee Islands SPA during the post-breeding season is predicted at less than one (0.11), less than one (0.02) during the pre-breeding season, and less than one (0.02) during the migration-free winter season per annum.

5.6.16.83 Based on the 1998-2000 citation colony count of 5,010 breeding adults and using an annual background mortality of 526.1 individuals, the addition of 0.11, 0.02 and 0.02 predicted breeding adult mortalities would result in a 0.020%, 0.005%, and 0.005% increase in baseline mortality during the post-breeding, pre-breeding, and migration-free winter season, respectively. When considering the most recent count of 6,519 breeding adults and an annual background mortality of 684.5 adults, this results in an increase of 0.016%, 0.004%, and 0.004% in baseline mortality during the post-breeding, pre-breeding season, and migration-free winter season respectively (Table 106).

5.6.16.84 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.16) breeding adult per annum. When assessed against the citation population count and the alternative recent count the baseline mortality rate increases by 0.030% and 0.023%, respectively (Table 106).

Annual Total

5.6.16.85 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is less than one (0.21) razorbill per annum. The addition of 0.21 predicted mortalities per annum would increase baseline mortality against the citation and the alternative recent count recent counts by 0.040% and. 0.030% respectively (Table 106).

5.6.16.86 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill feature of Saltee Islands SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of razorbill in the Saltee Islands SPA. Conclusions against all conservation objectives are provided in Table 108.

Table 108. Displacement assessment conclusions for razorbill at Saltee Islands SPA.

Conservation Objective	Conclusion
No significant decline in breeding population abundance: apparently occupied nests.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the razorbill feature of Saltee Islands SPA in relation to potential displacement effects from Dublin Array alone.
No significant decline in distribution: breeding colonies.	
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	
No significant decline in productivity rate.	
No significant decline in prey biomass available.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support

Conservation Objective	Conclusion
	them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the razorbill at Saltee Islands SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the razorbill at Saltee Islands SPA in relation to barrier effects from Dublin Array alone.
No significant increase in disturbance at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the razorbill at Saltee Islands SPA in relation to breeding/roost site disturbance from Dublin Array alone.

Guillemot

Direct Disturbance and Displacement

5.6.16.87 Saltee Islands SPA is 143.6 km (around land) from Dublin Array, within the MMFR +1SD of guillemot (73.2±80.5 km; Woodward *et al*., 2019). Guillemot have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

5.6.16.88 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Guillemot have been assessed during the breeding season (March to July) and the non-breeding season (August to February) in relation to Saltee Islands SPA.

5.6.16.89 Impacts are assessed relative to the citation population of 28,724 individuals (with a background mortality of 1,752.2 individuals per annum), and the most recent count (2015) of 25,851 individuals (with a background mortality of 1,576.9 individuals per annum).

Construction and Decommissioning

5.6.16.90 The potential guillemot displacement mortality from the construction and decommissioning of Dublin Array attributed to Saltee Islands SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.16.91 The potential guillemot displacement mortality from the operation of Dublin Array attributed to Saltee Islands SPA is presented in Table 109 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual guillemot displacement mortalities during operations and maintenance attributed to Saltee Islands SPA is also found in Table 110.

Table 109 Predicted guillemot displacement mortalities attributed to Saltee Islands SPA during the operation and maintenance phase of Dublin Array.

Defined 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 – 2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1 -2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality	50% displacement, 1% mortality	30% -70% displacement, 1-2% mortality	60% displacement, 3 – 5 and 1 – 3% mortality
Breeding (Mar – Jul)	113	0.56	0.34-1.58	2.03 – 3.39	0.032	0.019-0.090	0.116 – 0.193	0.036	0.021-0.100	0.129 - 0.214
Non-Breeding (Aug – Feb)	40	0.20	0.12-0.56	0.24 – 0.72	0.011	0.007-0.032	0.039 – 0.116	0.013	0.008-0.036	0.043 – 0.129
Annual Total	**153**	**0.76**	**0.46 - 2.14**	**2.27 – 4.11**	**0.044**	**0.026-0.122**	**0.129 – 0.234**	**0.048**	**0.029-0.136**	**0.144– 0.261**

Table 110 The full displacement matrix of potential annual guillemot displacement mortalities during operations and maintenance attributed to Saltee Islands SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.15	0.31	0.46	1	2	3	5	6	8	9	11	12	14	15
	20	0.31	1	1	2	3	6	9	12	15	18	21	24	28	31
	30	0.46	1	1	2	5	9	14	18	23	28	32	37	41	46
	40	1	1	2	3	6	12	18	24	31	37	43	49	55	61
	50	1	2	2	4	8	15	23	31	38	46	54	61	69	77
	60	1	2	3	5	9	18	28	37	46	55	64	73	83	92
	70	1	2	3	5	11	21	32	43	54	64	75	86	96	107
	80	1	2	4	6	12	24	37	49	61	73	86	98	110	122
	90	1	3	4	7	14	28	41	55	69	83	96	110	124	138
	100	2	3	5	8	15	31	46	61	77	92	107	122	138	153

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Applicant Approach, those highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.16.92 The estimated guillemot mean peak abundance during the breeding season is 18,687 individuals. Assuming that 57% of the guillemot population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 7%, the total proportion of breeding adults in the population is estimated at 53%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 9,906.0 per annum during the breeding season.

5.6.16.93 It is estimated that 1.1% of adults during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Saltee Islands SPA potentially impacted by displacement is 113 per annum during the breeding season (Table 109).

5.6.16.94 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult guillemot from Saltee Islands SPA is estimated to be one (0.56) breeding adults per annum. Table 109 presents a range of potential displacement consequent mortalities as per SNCB guidance.

5.6.16.95 The population of guillemot at Saltee Islands SPA has reduced since the citation colony count in 1998-2000 of 28,724 individuals, decreasing to 25,851 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 109).

5.6.16.96 Using the citation colony count of 28,724 breeding adults and an annual background mortality of 1,752.2 individuals, the addition of 0.56 predicted breeding adult mortalities would result in a 0.032% increase in baseline mortality during the breeding season. When considering the most up to date counts of 25,851 breeding adults and an annual background mortality of 1,776.9 adults, this results in an increase of 0.036% in baseline mortality during the breeding season (Table 109).

Non-breeding Season

5.6.16.97 The estimated guillemot mean peak abundance during the non-breeding season is 2,063 individuals. Based on the non-breeding seasonal regional population size, 1.94% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA (see Apportioning Appendix C).

5.6.16.98 When applying a displacement rate of 50% and a mortality rate of 1%, the consequent predicted displacement mortality of adult guillemot from Saltee Islands SPA during the post-breeding season is predicted at less than one (0.20) during the migration-free winter season per annum.

5.6.16.99 Based on the 1998-2000 citation colony count of 28,724 breeding adults and using an annual background mortality of 1,752.2 individuals, the addition of 0.20 predicted breeding adult mortalities would result in a 0.011% increase in baseline mortality during the non-breeding season. When considering the most up to date counts of 25,851 breeding adults and an annual background mortality of 1,756.9 adults, this results in an increase 0.013% increase in baseline mortality during the non-breeding season (Table 109).

Annual Total

5.6.16.100 The predicted resultant mortality (when using a 50% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is one (0.76) guillemot per annum. The addition of 0.76 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.044% and. 0.048% respectively (Table 109).

5.6.16.101 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot feature of Saltee Islands SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of guillemot in the Saltee Islands SPA. Conclusions against all conservation objectives are provided in Table 111.

Table 111. Displacement assessment conclusions for guillemot at Saltee Islands SPA

Conservation Objective	Conclusion
No significant decline in breeding population abundance: apparently occupied nests.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the guillemot feature of Saltee Islands SPA in relation to potential displacement effects from Dublin Array alone.
No significant decline in distribution: breeding colonies.	
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	
No significant decline in productivity rate.	
No significant decline in prey biomass available.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the guillemot at Saltee Islands SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses

Conservation Objective	Conclusion
	(i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the guillemot at Saltee Islands SPA in relation to barrier effects from Dublin Array alone.
No significant increase in disturbance at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the guillemot at Saltee Islands SPA in relation to breeding/roost site disturbance from Dublin Array alone.

Lesser black-backed gull

Collision Risk (Operation and Maintenance)

5.6.16.102 Saltee Islands SPA is 143.6km (around land) from Dublin Array, within the MMFR ± 1SD of lesser black-backed gull (127.0±109.0 km; Woodward *et al*., 2019). Lesser black-backed gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.16.103 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Lesser black-backed gull have been assessed during the breeding season of April to August, the post-breeding season of August to October, the pre-breeding season of March to April, and the migration-free winter season of November to February in relation to Saltee Islands SPA. Table 112 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Saltee Islands SPA during each defined season and the overall annual impact.

5.6.16.104 Impacts are assessed relative to the citation population of 328 individuals (with a background mortality of 37.7 individuals per annum), and the most recent count (2014) of 262 individuals (with a background mortality of 30.1 individuals per annum).

Breeding season

5.6.16.105 The predicted lesser black-backed gull collision mortality during the migration-free breeding season is 3.28 individuals (see CRM).Assuming that 60% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 39%. Therefore, the total predicted number of breeding adult collisions is 1.28 per annum during the breeding season.

5.6.16.106 It is estimated that 1% of predicted mortalities during the breeding season derive from Saltee Islands SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Saltee Islands SPA during the migration-free breeding season is less than one (0.01) breeding adults per annum (Table 112).

5.6.16.107 The population of lesser black-backed gull at Saltee Islands SPA has reduced since the citation colony count in 1998-2000 of 328 individuals, having decreased to 262 individuals (2014). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.16.108 Using the citation colony count of 328 breeding adults and an annual background morality of 37.7 individuals, the addition of 0.01 predicted breeding adult mortalities would result in a 0.023% increase in baseline mortality during the breeding season. When considering the most up to date counts of 262 and an annual background mortality of 30.1 adults, this results in an increase of 0.029% in baseline mortality during the breeding season (Table 112).

Table 112 Lesser black-backed gull predicted collision mortalities during the operation and maintenance phase attributed to Saltee Islands SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	**Total predicted collision mortality (individuals per annum)**	**Predicted breeding adult collision mortalities attributed to Saltee Islands SPA (individuals per annum)**	**Increase in baseline mortality (%)**	
			Compared to citation population	Compared to most recent count
Breeding (Apr-Aug)	3.28	0.01	0.023	0.029
Post-breeding (Aug - Oct)	0.27	<0.01 (0.0004)	0.003	0.004
Winter (Nov – Feb)	0.37	<0.01 (0.002)	0.013	0.016
Pre-breeding (Mar-Apr)	0.15	<0.01 (0.0002)	0.002	0.002
Annual Total	**4.07**	**0.01**	**0.030**	**0.038**

Non-breeding season

5.6.16.109 The predicted lesser black-backed gull collision mortality during the post-breeding season is 0.27 individuals, 0.15 during the pre-breeding season and 0.37 during the winter season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Saltee Islands SPA, 0.2% during the pre-breeding season and 0.5% during the winter season (see Apportioning Appendix C), the consequent predicted collision mortality of adult lesser black-backed gull during the post-breeding season is predicted at less than one (0.0004), less than one (0.0002) during the pre-breeding season and less than one (0.002) during the winter season per annum.

5.6.16.110 Based on the 1998-2000 citation colony count of 328 breeding adults and using an annual background morality of 37.7 individuals, the addition of 0.0004, 0.0002, 0.002 predicted breeding adult mortalities would result in a 0.003%, 0.002% and 0.013% increase in baseline mortality during the post-breeding, pre-breeding and winter season, respectively. When considering the most up to date counts of 262 and an annual background mortality of 30.1 adults, this results in an increase of 0.004%, 0.002% and 0.016% in baseline mortality during the post-breeding, pre-breeding and winter season, respectively (Table 112).

5.6.16.111 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.002) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.007% and 0.008%, respectively (Table 112).

Annual Total

5.6.16.112 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Saltee Islands SPA, is less than one (0.01) lesser black-backed gull per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.030% and. 0.038% respectively (Table 112).

5.6.16.113 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the lesser black-backed gull feature of Saltee Islands SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the lesser black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of lesser black-backed gull in the Saltee Islands SPA. Conclusions against all conservation objectives are provided in Table 113.

Table 113. Collision risk assessment conclusions for lesser black-backed gull at Saltee Islands SPA.

Conservation Objective	Conclusion
No significant decline in breeding population abundance: apparently occupied nests.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential
No significant decline in distribution: breeding colonies.	

Conservation Objective	Conclusion
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	for an AEoI to the population conservation objectives of the lesser black-backed gull feature of Saltee Islands SPA in relation to potential collision risk from Dublin Array alone.
No significant decline in productivity rate.	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the lesser black-backed gull feature of Saltee Island SPA.
No significant decline in prey biomass available.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Saltee Islands SPA in relation to prey biomass availability from Dublin Array alone.
No significant increase in barriers to connectivity.	For most collision risk species 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) lesser black-backed gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Saltee Island SPA in relation to barrier effects from Dublin Array alone.
No significant increase in disturbance at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Saltee Islands SPA in relation to breeding/roost site disturbance from Dublin Array alone.

5.6.17 Copeland Islands SPA

Features and Effects for Assessment

5.6.17.1 Potential for LSE alone had been identified for the following for Copeland Islands SPA:

- Manx shearwater
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)

Assessment Information

5.6.17.2 The conservation objectives (as described in Appendix A) for Copeland Islands SPA is to maintain the favourable condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.17.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- The population of the qualifying species is maintained or enhanced (There is no significant decrease in the Manx Shearwater breeding population against national trends [UK]);
- Fledgling success is sufficient to maintain or enhance the population;
- The range of habitats utilised by the qualifying species is maintained or enhanced;
- The integrity of the site is maintained;
- There is no significant disturbance of the species; and
- The following are maintained in the long term:
- The population of the species as a viable component of the site
- The distribution of species within the site
- The distribution and extent of habitats supporting the species
- The structure, function, and supporting processes of habitats supporting the species

Manx Shearwater

Direct Disturbance and Displacement

5.6.17.4 Copeland Islands SPA is 160.2 km (around land) from Dublin Array, within the MMFR +1SD of Manx shearwater (1,346.8+1,018.7 km; Woodward *et al*., 2019). Manx shearwater have been screened into the assessment for displacement risk on a precautionary basis based on ABPmer (2023) feedback.

5.6.17.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Manx shearwater have been assessed during the breeding season of April to August, the post-breeding season of September to early October, and the pre-breeding season of late March, in relation to Copeland Islands SPA.

5.6.17.6 Impacts are assessed relative to the citation population of 9,600 individuals (with a background mortality of 1,248.0 individuals per annum), and the most recent count (2022) of 9,700 individuals (with a background mortality of 1,261.0 individuals per annum).

Construction and Decommissioning

5.6.17.7 The potential Manx shearwater displacement mortality from the construction and decommissioning of Dublin Array attributed to Copeland Islands SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.17.8 The potential Manx shearwater displacement mortality from the operation of Dublin Array attributed to Copeland Islands SPA is presented in Table 114 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Copeland Islands SPA is also found in Table 115.

Breeding Season

5.6.17.9 The estimated Manx shearwater mean peak abundance during the breeding season is 2,198 individuals. Assuming that 54% of the Manx shearwater population are adults (Furness, 2015), the total mean peak abundance of breeding adults potentially impacted by displacement is 1,187 per annum during the breeding season (Table 114).

5.6.17.10 It is estimated that 1.0% of predicted mortalities during the breeding season derive from Copeland Islands SPA (see Apportioning Appendix C). Therefore, total mean peak abundance of breeding adults from Copeland Islands SPA potentially impacted by displacement is 12 breeding adults per annum during the breeding season (Table 114).

5.6.17.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult Manx shearwater from Copeland Islands SPA is estimated to be less than one (0.03) breeding adults per annum (Table 114).

5.6.17.12 The population of Manx shearwater at Copeland Islands SPA from the 2009 citation colony count was 9,600, whereas the 2022 SMP count was 9,700 individuals. The assessment of the potential impact on the colony has been carried out using both the citation and the most recent count (Table 114).

5.6.17.13 Using the citation colony count of 9,600 breeding adults and an annual background mortality of 1,248.0 individuals, the addition of 0.03 predicted breeding adult mortalities would result in a 0.003% increase in baseline mortality during the breeding season. When considering the alternative recent count of 9,700 breeding adults and an annual background mortality of 1,261.0 adults, this results in an increase of 0.003% in baseline mortality during the breeding season (Table 114).

Table 114 Predicted Manx shearwater displacement mortalities attributed to Copeland Islands SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum) 30% displacement, 1% mortality	% increase in baseline mortality (citation count) 30% displacement, 1% mortality	% increase in baseline mortality (recent count) 30% displacement, 1% mortality
Breeding (Apr-Aug)	12	0.03	0.003	0.003
Post-breeding (Sep-early Oct)	1	<0.01 (0.003)	<0.001 (0.0003)	<0.001 (0.00001)
Pre-breeding (late Mar)	<1 (0.02)	<0.01 (0.0001)	<0.001 (0.0003)	<0.001 (0.00001)
Annual Total	**13**	**0.04**	**0.003**	**0.003**

Table 115 The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Copeland Islands SPA.

	Mortalities (%)														
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.01	0.03	0.04	0.1	0.1	0.3	0.4	1	1	1	1	1	1	1
	20	0.03	0.1	0.1	0.1	0.3	1	1	1	1	2	2	2	2	3
	30	0.04	0.1	0.1	0.2	0.4	1	1	2	2	2	3	3	4	4
	40	0.1	0.1	0.2	0.3	1	1	2	2	3	3	4	4	5	5
	50	0.1	0.1	0.2	0.3	1	1	2	3	3	4	5	5	6	7
	60	0.1	0.2	0.2	0.4	1	2	2	3	4	5	5	6	7	8
	70	0.1	0.2	0.3	0.5	1	2	3	4	5	5	6	7	8	9
	80	0.1	0.2	0.3	1	1	2	3	4	5	6	7	8	9	10
	90	0.1	0.2	0.4	1	1	2	4	5	6	7	8	9	11	12
	100	0.1	0.3	0.4	1	1	3	4	5	7	8	9	10	12	13

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per Table 27.

Non-breeding Season

5.6.17.14 The estimated Manx shearwater mean peak abundance during the post-breeding season is 176 individuals and 4 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.62% of predicted mortalities during the post- and pre-breeding seasons are estimated to derive from Copeland Islands SPA (see Apportioning Appendix C).

5.6.17.15 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent predicted displacement mortality of adult Manx shearwater from Copeland Islands SPA during the post-breeding season is predicted at less than one (0.003) and less than one (0.0001) during the pre-breeding season per annum.

5.6.17.16 Based on the 2009 citation colony count of 9,600 breeding adults and using an annual background mortality of 1,248.0 individuals, the addition of 0.003 and 0.0001 predicted breeding adult mortalities would result in a less than 0.001% (0.0003%) and less than 0.001% (0.00001%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most recent count of 9,700 breeding adults and an annual background mortality of 1,261.0 adults, this results in an increase of less than 0.001% (0.0003%) and less than 0.001% (0.00001%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 114).

5.6.17.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.003) breeding adult per annum. When assessed against the citation population count and the alternative recent count the baseline mortality rate increases by less than 0.001% (0.0003%) and less than 0.001% (0.0003%), respectively (Table 114).

Annual Total

5.6.17.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Copeland Islands SPA, is less than one (0.04) Manx shearwater per annum. The addition of 0.04 predicted mortalities per annum would increase baseline mortality against the citation and the alternative recent count recent counts by 0.003% and 0.003% respectively (Table 114).

5.6.17.19 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Manx shearwater feature of Copeland Islands SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the Manx shearwater feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain the favourable conservation condition of Manx shearwater in Copeland Islands SPA. There will be no significant decrease in the Manx shearwater breeding population against the UK national trend. Conclusions against all conservation objectives are provided in Table 116.

Table 116. Displacement assessment conclusions for Manx shearwater at Copeland Islands SPA.

Conservation Objective	Conclusion
The population of the qualifying species is maintained or enhanced (There is no significant decrease in the Manx Shearwater breeding population against national trends [UK]);	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the Manx shearwater feature of Copeland Islands SPA in relation to potential displacement effects from Dublin Array alone.
Fledgling success is sufficient to maintain or enhance the population;	
There is no significant disturbance of the species;	
The population of the species is maintained as a viable component of the site in the long term;	
The distribution of species within the site is maintained in the long-term;	
The integrity of the site is maintained;	
The range of habitats utilised by the qualifying species is maintained or enhanced;	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the Manx shearwater at Copeland Islands SPA in relation to barrier effects from Dublin Array alone.
The distribution and extent of habitats supporting the species is maintained in the long-term; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the Manx shearwater at Copeland Islands SPA in relation to the distribution and extent of habitats supporting the species from Dublin Array alone.
The structure, function, and supporting processes of habitats supporting the species is maintained in the long-term.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is,

Conservation Objective	Conclusion
	therefore, no potential for an AEoI to the COs of the Manx shearwater at Copeland Islands SPA in relation to the structure, function, and supporting processes of habitats supporting the species from Dublin Array alone.

5.6.18 Skomer, Skokholm, the seas off Pembrokeshire / Sgomer Sgogwm a Moroedd Penfro SPA

Features and Effects for Assessment

5.6.18.1 Potential for LSE alone has been identified for the following for Skomer, Skokholm and the Seas off Pembrokeshire SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Manx shearwater
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)

Assessment Information

5.6.18.2 The conservation objective (as described in Appendix A) for Skomer, Skokholm, the seas off Pembrokeshire SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.18.3 Based on the above conservation objective, the specific target for the screened-in features of the SPA, in order for favourable conservation status to be achieved, is when:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.
- The distribution of the population should be maintained, or where appropriate, increasing.
- There should be sufficient habitat, of sufficient quality, to support the population in the long term.

- Factors affecting the population or its habitat should be under appropriate control

5.6.18.4 Although kittiwake is only named feature of the seabird assemblage, for the purpose of this assessment they have been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from Dublin Array alone on this feature, but more as an important component of the seabird assemblage.

Kittiwake

Direct Disturbance and Displacement

5.6.18.5 Skomer, Skokholm and the Seas off Pembrokeshire SPA is 176.0km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.18.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Skomer, Skokholm and the Seas off Pembrokeshire SPA.

5.6.18.7 Impacts are assessed relative to the most recent count (2021) of 2,878 individuals (with a background mortality of 420.2 individuals per annum).

Construction and Decommissioning

5.6.18.8 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.18.9 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA is presented in Table 117 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA can also be found in Table 118.

Table 117 Predicted kittiwake displacement mortalities attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2 km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (recent count)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	1	<0.01 (0.002)	0.01	<0.001 (0.0004)	0.001
Post-breeding (Aug-Dec)	2	0.01	0.02	0.002	0.005
Pre-breeding (Jan-Apr)	3	0.01	0.03	0.002	0.007
Annual Total	**6**	**0.02**	**0.06**	**0.005**	**0.014**

Table 118 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.01	0.01	0.02	0.03	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	1	1
	20	0.01	0.02	0.04	0.06	0.12	0.24	0.36	0.48	1	1	1	1	1	1
	30	0.02	0.04	0.05	0.09	0.18	0.36	1	1	1	1	1	1	2	2
	40	0.02	0.05	0.07	0.12	0.24	0.48	1	1	1	1	2	2	2	2
	50	0.03	0.06	0.09	0.15	0.30	1	1	1	2	2	2	2	3	3
	60	0.04	0.07	0.11	0.18	0.36	1	1	1	2	2	3	3	3	4
	70	0.04	0.08	0.13	0.21	0.42	1	1	2	2	3	3	3	4	4
	80	0.05	0.10	0.14	0.24	0.48	1	1	2	2	3	3	4	4	5
	90	0.05	0.11	0.16	0.27	1	1	2	2	3	3	4	4	5	5
	100	0.06	0.12	0.18	0.30	1	1	2	2	3	4	4	5	5	6

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.18.10 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals, with an estimated 0.2% of kittiwake during the breeding season deriving from Skomer, Skokholm and the Seas off Pembrokeshire SPA (Apportioning Appendix C). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season (Table 117).

5.6.18.11 It is estimated that 1.0% of predicted mortalities during the breeding season derive from Skomer, Skokholm and the Seas off Pembrokeshire SPA (see Apportioning Appendix C of this HDA). Therefore, the total mean peak abundance of breeding adults from Skomer, Skokholm and the Seas off Pembrokeshire SPA potentially impacted by displacement is one (0.60) per annum during the breeding season (Table 117).

5.6.18.12 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Skomer, Skokholm and the Seas off Pembrokeshire SPA is estimated to be less than one (0.002) breeding adults per annum. Table 117 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.18.13 The most recent colony count (2021) of the kittiwake population at Skomer, Skokholm and the Seas off Pembrokeshire SPA is 2,878 individuals. The assessment of the potential impact on the colony has been carried out using the most recent count as there is no available citation count for this feature (Table 117).

5.6.18.14 When considering the most up to date counts of 2,878 breeding adults and an annual background mortality of 420.2 adults, this results in an increase of less than 0.001% (0.0004%) in baseline mortality during the breeding season (see Table 117).

Non-breeding Season

5.6.18.15 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.3% of predicted mortalities during the post-breeding season are estimated to derive from Skomer, Skokholm and the Seas off Pembrokeshire SPA and 0.4% during the pre-breeding season (see Apportioning Appendix C).

5.6.18.16 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Skomer, Skokholm and the Seas off Pembrokeshire SPA during the post-breeding season is predicted at less than one (0.01), and less than one (0.01) during the pre-breeding season per annum.

5.6.18.17 When considering the most up to date counts of 2,878 and an annual background mortality of 420.2 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 117).

5.6.18.18 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.02) breeding adult per annum. When assessed against the most recent colony count the baseline mortality rate increases by 0.004%.

Annual Total

5.6.18.19 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA during operation and maintenance, is less than one (0.02) kittiwake per annum. The addition of 0.02 predicted mortalities per annum would increase baseline mortality against the most recent counts by 0.005% (see Table 117).

5.6.18.20 For the most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the assemblage, of which kittiwake is a qualifying interest of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the assemblage will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term ~~change~~ effect to the conservation objective to maintain or restore the favourable conservation of breeding seabird assemblage at Skomer, Skokholm and the Seas off Pembrokeshire SPA.

5.6.18.21 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the available habitat conservation objectives.

5.6.18.22 There will also be no long-term effect to the conservation objective to maintain or increase the distribution of the population and habitat and to reduce or control the factors affecting the population or its habitat.

Collision Risk (Operation and Maintenance)

5.6.18.23 Skomer, Skokholm and the Seas off Pembrokeshire SPA is 176.0 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al.*, 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.*, 2014).

5.6.18.24 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Skomer, Skokholm and the Seas off Pembrokeshire SPA. Table 119 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA during each defined season and the overall annual impact.

5.6.18.25 Impacts are assessed relative to the most recent count (2021) of 2,878 individuals (with a background mortality of 420.2 individuals per annum).

Table 119 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA and resultant increase in baseline mortality compared to the most recent population count.

Defined season (months)	**Total predicted collision mortality (individuals per annum)**	**Predicted breeding adult collision mortalities attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA (individuals per annum)**	**Increase in baseline mortality (%)** Compared to most recent count
Breeding (May-Jul)	19.46	0.02	0.004
Post-breeding (Aug-Dec)	14.92	0.05	0.011
Pre-breeding (Jan-Apr)	7.69	0.03	0.007
Annual Total	**42.07**	**0.10**	**0.023**

Migration-free breeding season

5.6.18.26 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.18.27 It is estimated that 0.2% of predicted mortalities during the breeding season derive from Skomer, Skokholm and the Seas off Pembrokeshire SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA during the migration-free breeding season is less than one (0.02) breeding adults per annum (Table 119).

5.6.18.28 As kittiwake is an assemblage feature, there is not citation count. Therefore the assessment of the potential impact on the colony has been carried out using the most recent count only.

5.6.18.29 When considering the 2021 population count of 2,878 and an annual background mortality of 420.2 adults, the addition of 0.02 predicted breeding adult mortalities would result in a 0.004% increase in baseline mortality during the breeding season (Table 119).

Non-breeding season

5.6.18.30 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.3% of predicted mortalities during the post-breeding season are estimated to derive from Skomer, Skokholm and the Seas off Pembrokeshire SPA and 0.4% during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.05) and less than one (0.03) during the pre-breeding season per annum.

5.6.18.31 When considering the 2021 population count of 2,878 and an annual background mortality of 420.2 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 119).

5.6.18.32 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.08) breeding adult per annum. When assessed against the most recent colony count the baseline mortality rate increases by 0.018% (Table 119).

Annual Total

5.6.18.33 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA, is less than one (0.10) kittiwake per annum. The addition of 0.10 predicted mortalities per annum would increase baseline mortality against most recent counts 0.023% (Table 119).

5.6.18.34 For the most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the assemblage feature, of which kittiwake is a qualifying interest in, of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the assemblage feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

5.6.18.35 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the available habitat conservation objectives.

5.6.18.36 There will also be no long-term effect to the conservation objective to maintain or increase the distribution of the population and habitat and to reduce or control the factors affecting the population or its habitat.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.18.37 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Skomer, Skokholm and the Seas off Pembrokeshire SPA.

5.6.18.38 Based on the separate assessments of kittiwake from Skomer, Skokholm and the Seas off Pembrokeshire SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.11) breeding adult mortality (Table 120). This represents an increase in baseline mortality of 0.027% 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 assemblage feature, of which kittiwake is a qualifying interest, of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the assemblage feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term. Conclusions against all conservation objectives are provided in Table 121.

Table 120 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Skomer, Skokholm and the Seas off Pembrokeshire SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)
		Most recent population
Annual Total	0.11	0.027

Table 121. Assessment conclusions for kittiwake at Skomer, Skokholm and the Seas off Pembrokeshire SPA.

Conservation Objective	Conclusion
The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
The distribution of the population should be maintained, or where appropriate, increasing.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the kittiwake feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone.
There should be sufficient habitat, of sufficient quality, to support the population in the long term.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to there being sufficient habitat, of sufficient quality, to support the population from Dublin Array alone.
Factors affecting the population or its habitat should be under appropriate control	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. And as discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the population or its habitat conservation objectives of the kittiwake feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone.

Manx Shearwater

Direct Disturbance and Displacement

5.6.18.39 Skomer, Skokholm, the seas off Pembrokeshire SPA is 176.0km (around land) from Dublin Array, within the MMFR +1SD of Manx shearwater (1,346.8+1,018.7km; Woodward *et al*., 2019). Manx shearwater have been screened into the assessment for displacement risk on a precautionary basis, based on feedback from ABPmer (2023).

5.6.18.40 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Manx shearwater have been assessed during the breeding season of April to August, the post-breeding season of September to early October, and the pre-breeding season of late March, in relation to Skomer, Skokholm, the seas off Pembrokeshire SPA.

5.6.18.41 Impacts are assessed relative to the citation population of 301,936 individuals (with a background mortality of 39,251.7 individuals per annum), and the most recent count (2018) of 910,312 individuals (with a background mortality of 118,340.6 individuals per annum).

Construction and Decommissioning

5.6.18.42 The potential Manx shearwater displacement mortality from the construction and decommissioning of Dublin Array attributed to Skomer, Skokholm and the Seas off Pembrokeshire SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.18.43 The potential Manx shearwater displacement mortality from the operation of Dublin Array attributed to Skomer, Skokholm, the seas off Pembrokeshire SPA is presented in Table 122 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Skomer, Skokholm, the seas off SPA is also found in Table 123.

Table 122 Predicted Manx shearwater displacement mortalities attributed to Skomer, Skokholm, the seas off Pembrokeshire SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum) 30% displacement, 1% mortality	% increase in baseline mortality (citation count) 30% displacement, 1% mortality	% increase in baseline mortality (recent count) 30% displacement, 1% mortality
Breeding (Apr-Aug)	864.2	2.59	0.007	0.002
Post-breeding (Sep-early Oct)	102	0.30	0.001	<0.001 (0.0003)
Pre-breeding (late Mar)	2	0.01	<0.001 (.00002)	<0.001 (0.00001)
Annual Total	**798**	**2.90**	**0.007**	**0.002**

Table 123 The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Skomer, Skokholm, the seas off Pembrokeshire SPA.

	Mortalities (%)														
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	1	2	2	4	8	16	24	32	40	48	56	64	72	80
	20	2	3	5	8	16	32	48	64	80	96	112	128	144	160
	30	2	5	7	12	24	48	72	96	120	144	168	192	215	239
	40	3	6	10	16	32	64	96	128	160	192	223	255	287	319
	50	4	8	12	20	40	80	120	160	200	239	279	319	359	399
	60	5	10	14	24	48	96	144	192	239	287	335	383	431	479
	70	6	11	17	28	56	112	168	223	279	335	391	447	503	559
	80	6	13	19	32	64	128	192	255	319	383	447	511	575	638
	90	7	14	22	36	72	144	215	287	359	431	503	575	646	718
	100	8	16	24	40	80	160	239	319	399	479	559	638	718	798

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per Table 27.

Breeding Season

5.6.18.44 The estimated Manx shearwater mean peak abundance during the breeding season is 2,198 individuals. Assuming that 54% of the Manx shearwater population are adults (Furness, 2015), the total mean peak abundance of breeding adults potentially impacted by displacement is 1,187 per annum during the breeding season (Table 122).

5.6.18.45 It is estimated that 72.8% of predicted mortalities during the breeding season derive from Skomer, Skokholm, the seas off Pembrokeshire SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Skomer, Skokholm and the Seas off Pembrokeshire SPA potentially impacted by displacement is 864 breeding adults per annum during the breeding season (Table 122).

5.6.18.46 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult Manx shearwater from Skomer, Skokholm, the seas off Pembrokeshire SPA is estimated to be two (2.59) breeding adults per annum (Table 122).

5.6.18.47 The population of Manx shearwater at Skomer, Skokholm, the seas off Pembrokeshire SPA from the 1982 citation colony count was 301,936, whereas the 2018 SMP count was 910,312 individuals. The assessment of the potential impact on the colony has been carried out using both the citation and the most recent count (Table 122).

5.6.18.48 Using the citation colony count of 301,936 breeding adults and an annual background mortality of 39,251.7 individuals, the addition of 2.59 predicted breeding adult mortalities would result in a 0.007% increase in baseline mortality during the breeding season. When considering the alternative recent count of 910,312 breeding adults and an annual background mortality of 118,340.6 adults, this results in an increase of 0.002% in baseline mortality during the breeding season (Table 122).

Non-breeding Season

5.6.18.49 The estimated Manx shearwater mean peak abundance during the post-breeding season is 176 individuals and 4 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 57.73% of predicted mortalities during the post-breeding season are estimated to derive from Skomer, Skokholm, the seas off Pembrokeshire SPA and 57.73% during the pre-breeding season (see Apportioning Appendix C).

5.6.18.50 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent predicted displacement mortality of adult Manx shearwater from Skomer, Skokholm, the seas off Pembrokeshire SPA during the post-breeding season is predicted at less than one (0.30) and less than one (0.01) during the pre-breeding season per annum.

5.6.18.51 Based on the 1982 citation colony count of 301,936 breeding adults and using an annual background mortality of 39,251.7 individuals, the addition of 0.30 and 0.01 predicted breeding adult mortalities would result in a 0.001% and less than 0.001% (0.00002%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most recent count of 910,312 breeding adults and an annual background mortality of 118,340.6 adults, this results in an increase of less than 0.001% (0.0003%) and less than 0.001% (0.00001%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 122).

5.6.18.52 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.31) breeding adult per annum. When assessed against the citation population count and the alternative recent count the baseline mortality rate increases by 0.001% and less than 0.001% (0.0003%), respectively (Table 122).

Annual Total

5.6.18.53 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Skomer, Skokholm, the seas off Pembrokeshire SPA, is two (2.90) Manx shearwater per annum. The addition of 2.90 predicted mortalities per annum would increase baseline mortality against the citation and the alternative recent count recent counts by 0.007% and 0.002% respectively (Table 122).

5.6.18.54 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Manx shearwater feature of Skomer, Skokholm, the seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the Manx shearwater feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of Manx shearwater at Skomer, Skokholm, the seas off Pembrokeshire SPA. Conclusions against all conservation objectives are provided in Table 124.

Table 124. Displacement assessment conclusions for Manx shearwater at Skomer, Skokholm, the seas off Pembrokeshire SPA

Conservation Objective	Conclusion
The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the Manx shearwater feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone.
The distribution of the population should be maintained, or where appropriate, increasing.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the Manx shearwater feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone.

Conservation Objective	Conclusion
There should be sufficient habitat, of sufficient quality, to support the population in the long term.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the Manx shearwater at Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to there being sufficient habitat, of sufficient quality, to support the population from Dublin Array alone.
Factors affecting the population or its habitat should be under appropriate control	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. And as discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the population or its habitat conservation objectives of the Manx shearwater feature of Skomer, Skokholm and the Seas off Pembrokeshire SPA in relation to potential displacement effects from Dublin Array alone.

5.6.19 Grassholm SPA

Features and Effects for Assessment

5.6.19.1 Potential for LSE alone has been identified for the following feature of Grassholm SPA:

- Gannet
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)

Assessment Information

5.6.19.2 The conservation objective (as described in Appendix D) for Grassholm SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.19.3 Based on the above conservation objective, the specific target for the screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

- The population will not fall below 30,000 pairs in three consecutive years.
- The population will not drop by more than 25% of the previous years' 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.

Gannet

Direct Disturbance and Displacement

5.6.19.4 Grassholm SPA is 173.12 km (around land) from Dublin Array, within the MMFR +1SD of gannet (315.2±194.2 km; Woodward *et al*., 2019). Gannet have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Dierschke *et al.,* 2016).

5.6.19.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of September to November, and the pre-breeding season of December to March, in relation to Grassholm SPA.

5.6.19.6 Impacts are assessed relative to the citation population of 66,000 individuals (with a background mortality of 5,382.6 individuals per annum), and the most recent count (2015) of 72,022 individuals (with a background mortality of 5,833.8 individuals per annum).

Construction and Decommissioning

5.6.19.7 The potential gannet displacement mortality from the construction and decommissioning of Dublin Array attributed to Grassholm SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.19.8 The potential gannet displacement mortality from the operation of Dublin Array attributed to Grassholm SPA is presented in Table 125 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Grassholm SPA is found in Table 126.

Table 125 Predicted gannet displacement mortalities attributed to Grassholm SPA during the operation and maintenance phase of Dublin Array.

Defined Season	**Abundance of adults apportioned to SPA (plus 2km buffer)**	**Estimated increase in mortality (breeding adults per annum)**			**% increase in baseline mortality (citation count)**			**% increase in baseline mortality (recent count)**		
		70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality
Breeding (Mar-Sep)	92	0.64	0.55 – 0.73	1.92	0.012	0.010 – 0.014	0.036	0.011	0.009 – 0.013	0.033
Post-breeding (Sep-Nov)	3	0.02	0.02 – 0.02	0.06	<0.001 (0.0004)	<0.001 (0.0003) – 0.001	0.001	<0.001 (0.0003)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Pre-breeding (Dec-Mar)	3	0.02	0.02 – 0.02	0.06	<0.001 (0.0004)	<0.001 (0.0003) – 0.001	0.001	<0.001 (0.0004)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Annual Total	**98**	**0.68**	**0.58 – 0.78**	**2.02**	**0.013**	**0.011 – 0.015**	**0.038**	**0.012**	**0.010 – 0.014**	**0.035**

Table 126 The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Grassholm SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.10	0.20	0.29	0.49	1	2	3	4	5	6	7	8	9	10
	20	0.20	0.39	1	1	2	4	6	8	10	12	14	16	18	20
	30	0.29	1	1	1	3	6	9	12	15	18	21	24	26	29
	40	0.39	1	1	2	4	8	12	16	20	24	27	31	35	39
	50	0.49	1	1	2	5	10	15	20	25	29	34	39	44	49
	60	1	1	2	3	6	12	18	24	29	35	41	47	53	59
	70	1	1	2	3	7	14	21	27	34	41	48	55	62	69
	80	1	2	2	4	8	16	24	31	39	47	55	63	71	78
	90	1	2	3	4	9	18	26	35	44	53	62	71	79	88
	100	1	2	3	5	10	20	29	39	49	59	69	78	88	98

Outputs highlighted in in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023), those highlighted in dark green represent the overlapping predicted annual mortality estimates from both the NatureScot guidance (2023) and Applicant Approach and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.19.9 The estimated gannet mean peak abundance during the breeding season is 700 individuals. Assuming that 55% of the gannet population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 346.5 per annum during the breeding season.

5.6.19.10 It is estimated that 26% of predicted mortalities during the breeding season derive from Grassholm SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Grassholm SPA potentially impacted by displacement is 92 per annum during the breeding season (Table 125).

5.6.19.11 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent potential mortality for breeding adult gannet from Grassholm SPA is estimated to be one (0.64) breeding adults per annum. Table 125 presents a range of potential displacement consequent mortalities.

5.6.19.12 The population of gannet at Grassholm SPA has increased since the citation colony count in 2001 of 66,000 individuals, increasing to 72,022 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 125).

5.6.19.13 Using the citation colony count of 66,000 breeding adults and an annual background mortality of 5,346.0 individuals, the addition of 0.64 predicted breeding adult mortalities would result in a 0.012% increase in baseline mortality during the breeding season. When considering the most up to date counts of 72,022 breeding adults and an annual background mortality of 5,833.8 adults, this results in an increase of 0.011% in baseline mortality during the breeding season (Table 125).

Non-breeding Season

5.6.19.14 The estimated gannet mean peak abundance during the post-breeding season is 21 individuals and during the pre-breeding season is 27 individuals. Based on the non-breeding seasonal regional population size, 11.2% of predicted mortalities during the post-breeding season and 13.4% of predicted mortalities during the pre-breeding season are estimated to derive from Grassholm SPA (see Apportioning Appendix C).

5.6.19.15 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent predicted displacement mortality of adult gannet from Grassholm SPA is predicted at less than one (0.02) per annum during the post-breeding season and less than one (0.02) per annum during the pre-breeding season.

5.6.19.16 Based on the 2001 citation colony count of 66,000 breeding adults and using an annual background mortality of 5,346.0 individuals, the addition of 0.02 predicted mortalities during the post-breeding season and 0.02 predicted mortalities during the pre-breeding season would result in a less than 0.001% (0.0004%) increase in baseline mortality during the post-breeding season and a less than 0.001% (0.0004%) increase in baseline mortality during the pre-breeding season. When considering the most up to date counts of 72,022 breeding adults and an annual background mortality of 5,833.8 adults, this results in a less than 0.001% (0.0003%) increase in baseline mortality during the post-breeding season and a less than 0.001% (0.0004%) increase in baseline mortality during the pre-breeding season (Table 125).

Annual Total

5.6.19.17 The predicted resultant mortality (when using a 70% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Grassholm SPA, is one (0.68) gannet per annum. The addition of 0.68 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.013% and 0.012% respectively (Table 125).

5.6.19.18 For both citation and most recent count, the predicted increase in baseline mortality of less than 1% would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Grassholm SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the following conservation objectives: the gannet population will not fall below 30,000 pairs in three consecutive years; the gannet population will not drop by more than 25% of the previous years' figures in any one year; there will be no decline in the gannet population significantly greater than any decline in the North Atlantic Population as a whole.

Collision Risk (Operation and Maintenance)

5.6.19.19 Grassholm SPA is 173.12 km (around land) from Dublin Array, within the MMFR ± 1SD of gannet (315.2±194.2 km; Woodward *et al*., 2019). Gannet have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al.,* 2014).

5.6.19.20 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of October to November, and the pre-breeding season of December to February in relation to Grassholm SPA (UK). Table 127 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Grassholm SPA during each defined season and the overall annual impact.

5.6.19.21 Impacts are assessed relative to the citation population of 66,000 individuals (with a background mortality of 5,382.6 individuals per annum), and the most recent count (2015) of 72,022 individuals (with a background mortality of 5,833.8 individuals per annum).

Table 127 Gannet predicted collision mortalities during the operation and maintenance phase attributed to Grassholm SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	**Total predicted collision mortality (individuals per annum)**	**Predicted breeding adult collision mortalities attributed to Grassholm SPA (individuals per annum)**	**Increase in baseline mortality (%)**	
			Compared to citation population	Compared to most recent count
Breeding (Mar-Sep)	3.23	0.42	0.008	0.007
Post-breeding (Sep-Nov)	0.11	0.02	<0.001 (0.0003)	<0.001 (0.0003)
Pre-breeding (Dec-Mar)	0.11	0.01	<0.001 (0.0001)	<0.001 (0.0001)
Annual Total	**3.45**	**0.45**	**0.008**	**0.008**

Breeding season

5.6.19.22 The predicted gannet collision mortality during the breeding season is 3.23 individuals (see CRM). Assuming that 55% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total predicted number of breeding adult collisions is 1.60 per annum during the breeding season.

5.6.19.23 It is estimated that 26.4% of predicted mortalities during the breeding season derive from Grassholm SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Grassholm SPA during the breeding season is less than one (0.42) breeding adults per annum (Table 127).

5.6.19.24 The population of gannet at Grassholm SPA has increased since the citation colony count in 2001 of 66,000 individuals, having increased to 72,022 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.19.25 Using the citation colony count of 66,000 breeding adults and an annual background mortality of 5,346.0 individuals, the addition of 0.42 predicted breeding adult mortalities would result in a 0.008% increase in baseline mortality during the breeding season. When considering the most up to date counts of 72,022 and an annual background mortality of 5,833.8 adults, this results in an increase of 0.007% in baseline mortality during the breeding season (Table 127).

Non-breeding season

5.6.19.26 The predicted gannet collision mortality during the post-breeding season is 0.11 individuals and 0.11 individuals during the pre-breeding season. Based on the non-breeding seasonal regional population size, 13.4% of predicted mortalities during the post-breeding season and 11.2% of predicted mortalities during the pre-breeding season are estimated to derive from Grassholm SPA (see Apportioning Appendix C). The consequent predicted collision mortality of adult gannet during the post-breeding season is predicted at less than one (0.02) and less than one (0.01) during the pre-breeding season per annum.

5.6.19.27 Based on the 2001 citation colony count of 66,000 breeding adults and using an annual background mortality of 5,346.0 individuals, the addition of 0.02 and 0.01 predicted breeding adult mortalities would result in a less than 0.001% (0.0003%) and less than 0.001% (0.0001%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 72,022 and an annual background mortality of 5,833.8 adults, this results in an increase of less than 0.001% (0.0003%) and less than 0.001% (0.0001%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 127).

5.6.19.28 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.03) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.001%, respectively (Table 127).

Annual total

5.6.19.29 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Grassholm SPA, is less than one (0.45) gannet per annum. The addition of 0.45 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.008% and 0.008% respectively (Table 127).

5.6.19.30 For both citation and most recent count, the predicted increase in baseline mortality of less than 1% would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Grassholm SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the following conservation objectives: the gannet population will not fall below 30,000 pairs in three consecutive years; the gannet population will not drop by more than 25% of the previous years' figures in any one year; there will be no decline in the gannet population significantly greater than any decline in the North Atlantic Population as a whole.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.19.31 Gannet have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the gannet population at Grassholm SPA.

5.6.19.32 Based on the separate assessments of gannet from Grassholm SPA above, the combined predicted annual impact from collision risk and displacement (70% displacement, 1% mortality) is one (1.06) breeding adult mortality (Table 128). This represents an increase in baseline mortality of 0.020% when considering the citation colony count and an increase in baseline mortality of 0.018% 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 gannet feature of Grassholm SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the following conservation objectives: the gannet population will not fall below 30,000 pairs in three consecutive years; the gannet population will not drop by more than 25% of the previous years' figures in any one year; there will be no decline in the gannet population significantly greater than any decline in the North Atlantic Population as a whole. Conclusions against all conservation objectives are provided in Table 129.

Table 128 Annual gannet increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Grassholm SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	1.06	0.020	0.018

Table 129. Assessment conclusions for gannet at Grassholm SPA.

Conservation Objective	Conclusion
The population will not fall below 30,000 pairs in three consecutive years.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the gannet feature of Grassholm SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
The population will not drop by more than 25% of the previous years' 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.	

5.6.20 Helvick Head and Ballyquin SPA

Features and Effects for Assessment

5.6.20.1 Potential for LSE alone has been identified for the following for Helvick Head to Ballyquin SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)

Assessment Information

5.6.20.2 The conservation objective (as described in Appendix A) for Helvick Head to Ballyquin SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.20.3 Based on the above conservation objective, the specific target for those screened in feature of the SPA, in order for favourable conservation status to be achieved, is 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.

Kittiwake

Direct Disturbance and Displacement

5.6.20.4 Helvick Head and Ballyquin SPA is 162.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer (2023) feedback despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.20.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Helvick Head and Ballyquin SPA.

5.6.20.6 Impacts are assessed relative to the citation population of 2,074 individuals (with a background mortality of 302.8 individuals per annum), and the most recent count (2018) of 130 individuals (with a background mortality of 19.0 individuals per annum).

Construction and Decommissioning

5.6.20.7 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Helvick Head and Ballyquin SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.20.8 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Helvik Head and Ballyquin SPA is presented in Table 130 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Helvick Head and Ballyquin SPA can also be found in Table 131.

Table 130 Predicted kittiwake displacement mortalities attributed to Helvick Head and Ballyquin SPA during the operation and maintenance phase of Dublin Array.

Defined 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)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	<1 (0.02)	<0.01 (0.0001)	<0.01 (0.0002)	<0.001 (0.00002)	<0.001 (0.0001)	<0.001 (0.0003)	0.001
Post-breeding (Aug-Dec)	<1 (0.10)	<0.01 (0.0003)	<0.01 (0.001)	<0.001 (0.0001)	<0.001 (0.0003)	0.002	0.005
Pre-breeding (Jan-Apr)	<1 (0.15)	<0.01 (0.001)	<0.01 (0.001)	<0.001 (0.0002)	0.001	0.002	0.007
Annual Total	**<1 (0.27)**	**<0.01 (0.001)**	**<0.01 (0.002)**	**<0.001 (0.0003)**	**0.001**	**0.004**	**0.013**

Table 131 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Helvick Head and Ballyquin SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.000	0.001	0.001	0.001	0.003	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	20	0.001	0.001	0.002	0.003	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
	30	0.001	0.002	0.002	0.004	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.06	0.07	0.08
	40	0.001	0.002	0.003	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11
	50	0.001	0.003	0.004	0.01	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.12	0.14
	60	0.002	0.003	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.13	0.15	0.16
	70	0.002	0.004	0.01	0.01	0.02	0.04	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19
	80	0.002	0.004	0.01	0.01	0.02	0.04	0.06	0.09	0.11	0.13	0.15	0.17	0.19	0.22
	90	0.002	0.01	0.01	0.01	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.19	0.22	0.24
	100	0.003	0.01	0.01	0.01	0.03	0.05	0.08	0.11	0.14	0.16	0.19	0.22	0.24	0.27

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.20.9 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals, with an estimated 0.01% of kittiwake during the breeding season deriving from Helvick Head and Ballyquin SPA (Apportioning Appendix C). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.20.10 It is estimated that 0.01% of predicted mortalities during the breeding season derive from Helvick Head and Ballyquin SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Helvick Head and Ballyquin SPA potentially impacted by displacement is less than one (0.02) per annum during the breeding season (Table 130).

5.6.20.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Helvick Head and Ballyquin SPA is estimated to be less than one (0.0001) breeding adults per annum. Table 130 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.20.12 The population of kittiwake at Helvick Head and Ballyquin SPA has reduced since the citation colony count in 1999 of 2,074 individuals to 130 individuals (2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 130).

5.6.20.13 Using the citation colony count of 2,074 breeding adults and an annual background mortality of 302.8 individuals, the addition of 0.0001 predicted breeding adult mortalities would result in a less than 0.001% (0.00002%) increase in baseline mortality during the breeding season. When considering the most up to date counts of 130 breeding adults and an annual background mortality of 19.0 adults, this results in an increase of less than 0.001% (0.0003%) in baseline mortality during the breeding season (Table 130).

Non-breeding Season

5.6.20.14 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.01% of predicted mortalities during the post-breeding season are estimated to derive from Helvick Head and Ballyquin SPA and 0.02% during the pre-breeding season (see Apportioning Appendix C).

5.6.20.15 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Helvick Head and Ballyquin SPA during the post-breeding season is predicted at less than one(0.0003), and less than one (0.001) during the pre-breeding season per annum.

5.6.20.16 Based on the 1999 citation colony count of 2,074 breeding adults and using an annual background mortality of 302.8 individuals, the addition of 0.0003 and 0.001 predicted breeding adult mortalities would result in a less than 0.001% (0.0001%) and a less than 0.001% (0.0002%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 130 and an annual background mortality of 19.0 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 130).

5.6.20.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.001) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by less than 0.001% (0.0003%) and 0.004%, respectively

Annual Total

5.6.20.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Helvick Head and Ballyquin SPA during operation and maintenance, is less than one (0.001) kittiwake per annum. The addition of 0.001 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by less than 0.001% (0.0003%) and 0.004% respectively (see Table 130).

5.6.20.19 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Helvick Head and Ballyquin SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Helvick Head and Ballyquin SPA.

Collision Risk (Operation and Maintenance)

5.6.20.20 Helvick Head to Ballyquin SPA is 162.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.20.21 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Helvick Head to Ballyquin SPA. Table 132 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Helvick Head to Ballyquin SPA during each defined season and the overall annual impact.

5.6.20.22 Impacts are assessed relative to the citation population of 2,074 individuals (with a background mortality of 302.8 individuals per annum), and the most recent count (2018) of 130 individuals (with a background mortality of 19.0 individuals per annum).

Table 132 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Helvick Head to Ballyquin SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Helvick Head to Ballyquin SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	<0.01 (0.001)	<0.001 (0.0002)	0.003
Post-breeding (Aug-Dec)	14.92	<0.01 (0.002)	0.001	0.011
Pre-breeding (Jan-Apr)	7.69	<0.01 (0.001)	0.001	0.007
Annual Total	**42.07**	**<0.01 (0.004)**	**0.001**	**0.021**

Migration-free breeding season

5.6.20.23 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.20.24 It is estimated that less than 0.1% (0.01%) of predicted mortalities during the breeding season derive from Helvick Head to Ballyquin SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Helvick Head to Ballyquin SPA during the migration-free breeding season is less than one (0.001) breeding adults per annum (Table 132).

5.6.20.25 The population of kittiwake at Helvick Head to Ballyquin SPA has reduced since the citation colony count in 1999 of 2,074 individuals, having decreased to 130 individuals (2018). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.20.26 Using the citation colony count of 2,074 breeding adults and an annual background mortality of 302.8 individuals, the addition of 0.001 predicted breeding adult mortalities would result in a less than 0.001% (0.0002%) increase in baseline mortality during the breeding season. When considering the most up to date counts of 130 and an annual background mortality of 19.0 adults, this results in an increase of 0.003% in baseline mortality during the breeding season (Table 132).

Non-breeding season

5.6.20.27 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, less than 0.1% (0.01%) of predicted mortalities during the post-breeding season are estimated to derive from Helvick Head to Ballyquin SPA and less than 0.1% (0.02%) during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.002), and less than one (0.001) during the pre-breeding season per annum.

5.6.20.28 Based on the 1999 citation colony count of 2,074 breeding adults and using an annual background mortality of 302.8 individuals, the addition of 0.002 and 0.001 predicted breeding adult mortalities would result in a 0.001% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 130 and an annual background mortality of 19.0 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 132).

5.6.20.29 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.003) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.018%, respectively (Table 132).

Annual Total

5.6.20.30 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Helvick Head to Ballyquin SPA, is less than one (0.004) kittiwake per annum. The addition of 0.004 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.001% and. 0.021% respectively (Table 132).

5.6.20.31 For both the citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Helvick Head to Ballyquin SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Helvick Head and Ballyquin SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.20.32 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Helvick Head and Ballyquin SPA.

5.6.20.33 Based on the separate assessments of kittiwake from Helvick Head and Ballyquin SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.01) breeding adult mortality (Table 133). This represents an increase in baseline mortality of 0.002% when considering the citation colony count and an increase in baseline mortality of 0.026% 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 kittiwake feature of Helvick Head and Ballyquin SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Helvick Head and Ballyquin SPA.

Table 133 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Helvick Head and Ballyquin SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.01	0.002	0.026

5.6.21 Ailsa Craig SPA

Features and Effects for Assessment

5.6.21.1 Potential for LSE alone has been identified for the following for Ailsa Craig SPA:

- Gannet
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)
- Lesser black backed gull
  - Collision risk (O&M)

Assessment Information

5.6.21.2 The conservation objective (Appendix A) for Ailsa Craig SPA is to avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.

5.6.21.3 Based on the above conservation objective, the following are to be maintained in the long-term for the qualifying species:

- 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.

5.6.21.4 Although kittiwake is only a named feature of the seabird assemblage, for the purpose of this assessment it has been considered in a similar manner to qualifying species, though the conclusion is not whether an AEoI would result from Dublin Array alone on kittiwake as a feature, but as an important component of the seabird assemblage.

Gannet

Direct Disturbance and Displacement

5.6.21.5 Ailsa Craig SPA is 219.23 km (around land) from Dublin Array, within the MMFR +1SD of gannet (315.2±194.2 km; Woodward *et al*., 2019). Gannet have been screened into the assessment for displacement as they are susceptible to displacement due to their distribution and behaviours (Dierschke *et al.,* 2016).

5.6.21.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of September to November, and the pre-breeding season of December to March, in relation to Ailsa Craig SPA.

5.6.21.7 Impacts are assessed relative to the citation population of 46,000 individuals (with a background mortality of 3,726.0 individuals per annum), and the most recent count (2014) of 66,452 individuals (with a background mortality of 5,382.6 individuals per annum).

Construction and Decommissioning

5.6.21.8 The potential gannet displacement mortality from the construction and decommissioning of Dublin Array attributed to Ailsa Craig SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.21.9 The potential gannet displacement mortality from the operation of Dublin Array attributed to Ailsa Craig SPA is presented in Table 134 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Ailsa Craig SPA is also found in Table 135.

Table 134 Predicted gannet displacement mortalities attributed to Ailsa Craig SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum)			% increase in baseline mortality (citation count)			% increase in baseline mortality (recent count)		
		70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality	70% displacement, 1% mortality	60% - 80% displacement, 1% mortality	70% displacement, 3% mortality
Breeding (Mar-Sep)	57	0.40	0.34 – 0.45	1.19	0.011	0.009 – 0.012	0.032	0.007	0.006 – 0.008	0.022
Post-breeding (Sep-Nov)	3	0.02	0.02 – 0.02	0.05	0.001	<0.001 (0.0004) – 0.001	0.002	<0.001 (0.0003)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Pre-breeding (Dec-Mar)	3	0.02	0.02 – 0.02	0.06	0.001	<0.001 (0.0004) – 0.001	0.002	<0.001 (0.0004)	<0.001 (0.0003) – <0.001 (0.0004)	0.001
Annual Total	**63**	**0.44**	**0.37 – 0.50**	**1.29**	**0.012**	**0.010 – 0.013**	**0.035**	**0.008**	**0.007 – 0.009**	**0.024**

Table 135 The full displacement matrix of potential annual gannet displacement mortalities during operations and maintenance attributed to Ailsa Craig SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.06	0.13	0.19	0.32	1	1	2	3	3	4	4	5	6	6
	20	0.13	0.25	0.38	1	1	3	4	5	6	8	9	10	11	13
	30	0.19	0.38	1	1	2	4	6	8	9	11	13	15	17	19
	40	0.25	1	1	1	3	5	8	10	13	15	18	20	23	25
	50	0.32	1	1	2	3	6	9	13	16	19	22	25	28	32
	60	0.38	1	1	2	4	8	11	15	19	23	26	30	34	38
	70	0.44	1	1	2	4	9	13	18	22	26	31	35	40	44
	80	1	1	2	3	5	10	15	20	25	30	35	40	45	50
	90	1	1	2	3	6	11	17	23	28	34	40	45	51	57
	100	1	1	2	3	6	13	19	25	32	38	44	50	57	63

Outputs highlighted in in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023), those highlighted in dark green represent the overlapping predicted annual mortality estimates from both the NatureScot guidance (2023) and Applicant Approach and those highlighted in green represent the predicted annual mortality estimates as per the SNCB guidance (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.21.10 The estimated gannet mean peak abundance during the breeding season is 700 individuals, with an estimated 16.4% of gannet during the breeding season deriving from Ailsa Craig SPA (Apportioning Appendix C). Assuming that 55% of the gannet population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 347 per annum during the breeding season

5.6.21.11 It is estimated that 16.4% of predicted mortalities during the breeding season derive from Ailsa Craig SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Ailsa Craig SPA potentially impacted by displacement is 56.8 per annum during the breeding season (Table 134).

5.6.21.12 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent potential mortality for breeding adult gannet from Ailsa Craig SPA is estimated to be less than one (0.40). Table 135 presents a range of potential displacement consequent mortalities.

5.6.21.13 The population of gannet at Ailsa Craig SPA has increased since the citation colony count in 2001 of 46,000 individuals, increasing to 66,452 individuals (2014). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 134).

5.6.21.14 Using the citation colony count of 46,000 breeding adults and an annual background mortality of 3,726.0 individuals, the addition of 0.40 predicted breeding adult mortalities would result in a 0.011% increase in baseline mortality during the breeding season. When considering the most up to date counts of 66,452 breeding adults and an annual background mortality of 5,382.6 adults, this results in an increase of 0.007% in baseline mortality during the breeding season (Table 134).

Non-breeding Season

5.6.21.15 The estimated gannet mean peak abundance is 21 individuals during the post-breeding season and 27 individuals during the pre-breeding season. Based on the non-breeding seasonal regional population size, 12.4% of predicted mortalities during the post-breeding season and 10.3% of predicted mortalities during the pre-breeding season are estimated to derive from Ailsa Craig SPA (see Apportioning Appendix C).

5.6.21.16 When applying a displacement rate of 70% and a mortality rate of 1%, the consequent predicted displacement mortality of adult gannet from Ailsa Craig SPA is predicted at less than one (0.02) per annum and during the post-breeding season and less than one (0.02) per annum during the pre-breeding season.

5.6.21.17 Based on the 2001 citation colony count of 46,000 breeding adults and using an annual background mortality of 3,726.0 individuals, the addition of 0.02 predicted breeding adult mortalities during the post-breeding season and 0.02 predicted breeding adult mortalities during the pre-breeding season would result in a 0.001% increase in baseline mortality during the post-breeding season and a 0.001% increase in baseline mortality during the pre-breeding season. When considering the most up to date counts of 66,452 breeding adults and an annual background mortality of 5,382.6 adults, this results in an increase of less than 0.001% (0.0003%) during the post-breeding season and an increase of less than 0.001% (0.0004%) during the pre-breeding season (Table 134).

Annual Total

5.6.21.18 The predicted resultant mortality (when using a 70% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Ailsa Craig SPA, is less than one (0.45) gannet per annum. The addition of 0.45 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.012% and 0.008% respectively (Table 134).

5.6.21.19 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Ailsa Craig SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for displacement.

5.6.21.20 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting effect on the integrity of the SPA in relation to the available habitat and disturbance conservation objectives.

5.6.21.21 There will be no long-term effect to the following conservation objectives: to avoid deterioration of the habitat of gannet or significant disturbance to gannet, thus ensuring that the integrity of the site is maintained; to ensure for gannet that the population as a viable component of the site is maintained in the long-term; to ensure for gannet that the distribution within the site is maintained in the long-term; to ensure for gannet that the distribution, extent, structure, and function of supporting habitats are maintained in the long term; and that there is no significant disturbance of gannet.

Collision Risk (Operation and Maintenance)

5.6.21.22 Ailsa Craig SPA is 219.23 km (around land) from Dublin Array, within the MMFR ± 1SD of gannet (315.2±194.2 km; Woodward *et al*., 2019). Gannet have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.21.23 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Gannet have been assessed during the breeding season of March to September, the post-breeding season of October to November, and the pre-breeding season of December to February in relation to Ailsa Craig SPA. Table 136 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Ailsa Craig SPA during each defined season and the overall annual impact.

5.6.21.24 Impacts are assessed relative to the citation population of 46,000 individuals (with a background mortality of 3,726.0 individuals per annum), and the most recent count (2014) of 66,452 individuals (with a background mortality of 5,382.6 individuals per annum).

Table 136 Gannet predicted collision mortalities during the operation and maintenance phase attributed to Ailsa Craig SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Ailsa Craig SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Mar-Sep)	3.23	0.26	0.007	0.005
Post-breeding (Sep-Nov)	0.11	0.01	<0.001 (0.0002)	<0.001 (0.0002)
Pre-breeding (Dec-Mar)	0.11	0.01	<0.001 (0.0002)	<0.001 (0.0002)
Annual Total	**3.45**	**0.29**	**0.008**	**0.005**

Breeding season

5.6.21.25 The predicted gannet collision mortality during the breeding season is 3.23 individuals (see CRM). Assuming that 55% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 49.5%. Therefore, the total predicted number of breeding adult collisions is 1.60 per annum during the breeding season.

5.6.21.26 It is estimated that 16.4% of predicted mortalities during the breeding season derive from Ailsa Craig SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Ailsa Craig SPA during the breeding season is less than one (0.26) breeding adults per annum (Table 136).

5.6.21.27 The population of gannet at Ailsa Craig SPA has increased since the citation colony count in 2001 of 46,000 individuals, having increased to 66,452 individuals (2014). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.21.28 Using the citation colony count of 46,000 breeding adults and an annual background mortality of 3,726.0 individuals, the addition of 0.26 predicted breeding adult mortalities would result in a 0.007% increase in baseline mortality during the breeding season. When considering the most up to date counts of 66,452 and an annual background mortality of 5382.6 adults, this results in an increase of 0.005% in baseline mortality during the breeding season (Table 136).

Non-breeding season

5.6.21.29 The predicted gannet collision mortality is 0.11 individuals during the post-breeding season and 0.11 individuals during the pre-breeding season. Based on the non-breeding seasonal regional population size, 12.4% of predicted mortalities during the post-breeding season and 10.3% of predicted mortalities during the pre-breeding season are estimated to derive from Ailsa Craig SPA (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.01) and less than one (0.01) during the pre-breeding season per annum.

5.6.21.30 Based on the 2001 citation colony count of 46,000 breeding adults and using an annual background mortality of 3,726.0 individuals, the addition of 0.01 and 0.01 predicted breeding adult mortalities would result in a less than 0.001% (0.0002%) and a less than 0.001% (0.0002%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 66,452 and an annual background mortality of 5,382.6 adults, this results in an increase of less than 0.001% (0.0002%) and less than 0.001% (0.0002%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 136).

5.6.21.31 This results in a total predicted mortality from collision in the non-breeding season of less than one(0.03) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.001%, respectively (Table 136).

Annual total

5.6.21.32 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Ailsa Craig SPA, is less than one (0.29) gannet per annum. The addition of 0.29 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.008% and 0.005% respectively (Table 136).

5.6.21.33 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of Ailsa Craig SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for collision risk.

5.6.21.34 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the available habitat and disturbance conservation objectives.

5.6.21.35 There will be no long-term effect to the following conservation objectives: to avoid deterioration of the habitat of gannet or significant disturbance to gannet, thus ensuring that the integrity of the site is maintained; to ensure for gannet that the population as a viable component of the site is maintained in the long-term; to ensure for gannet that the distribution within the site is maintained in the long-term; to ensure for gannet that the distribution, extent, structure, and function of supporting habitats are maintained in the long term; and that there is no significant disturbance of gannet.

Combined Collision Risk and Disturbance and Displacement

5.6.21.36 Gannet have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the gannet population at Ailsa Craig SPA.

5.6.21.37 Based on the separate assessments of gannet from Ailsa Craig SPA above, the combined predicted annual impact from collision risk and displacement is one (0.66) breeding adult mortality (Table 137). This represents an increase in baseline mortality of 0.018% when considering the citation colony count and an increase in baseline mortality of 0.012% 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 gannet feature of Ailsa Craig SPA in relation to combined collision risk and displacement effects from the proposed development alone and therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. Conclusions against all conservation objectives are provided in Table 138.

Table 137 Annual gannet increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Ailsa Craig SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.66	0.018	0.012

Table 138. Assessment conclusions for gannet at Ailsa Craig SPA.

Conservation Objective	Conclusion
Population of the species as a viable component of the site.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the gannet feature of Ailsa Craig SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
No significant disturbance of the species.	
Distribution of the species within site.	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the gannet feature of Ailsa Craig SPA in relation to breeding site disturbance from Dublin Array alone.
Distribution and extent of habitats supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the gannet at Ailsa Craig SPA in relation to the distribution and extent of habitats supporting the species from Dublin Array alone.
Structure, function and supporting processes of habitats, supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the gannet at Ailsa Craig SPA in relation to the structure, function and supporting processes of habitats, supporting the species from Dublin Array alone.

Kittiwake

Direct Disturbance and Displacement

5.6.21.38 Ailsa Craig SPA is 219.2 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer (2023) feedback despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.21.39 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Ailsa Craig SPA.

5.6.21.40 Impacts are assessed relative to the citation population of 6,200 individuals (with a background mortality of 905.2 individuals per annum), and the most recent count (2021) of 980 individuals (with a background mortality of 143.1 individuals per annum).

Construction and Decommissioning

5.6.21.41 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Ailsa Craig SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.21.42 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Ailsa Craig SPA is presented in Table 139 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Ailsa Craig SPA can also be found in Table 140.

Table 139 Predicted kittiwake displacement mortalities attributed to Ailsa Craig SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2 km buffer)	Estimated increase in mortality (breeding adults per annum)		% increase in baseline mortality (citation count)		% increase in baseline mortality (recent count)	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	<1 (0.15)	<0.01 (0.001)	<0.01 (0.001)	<0.001 (0.0001)	<0.001 (0.0002)	<0.001 (0.0003)	0.001
Post-breeding (Aug-Dec)	1	<0.01 (0.002)	0.01	<0.001 (0.0003)	0.001	0.002	0.005
Pre-breeding (Jan-Apr)	1	<0.01 (0.004)	0.01	<0.001 (0.0004)	0.001	0.002	0.007
Annual Total	**2**	**0.01**	**0.02**	**0.001**	**0.002**	**0.004**	**0.013**

Table 140 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Ailsa Criag SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.002	0.004	0.01	0.01	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20
	20	0.004	0.01	0.01	0.02	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40
	30	0.01	0.01	0.02	0.03	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	1	1
	40	0.01	0.02	0.02	0.04	0.08	0.16	0.24	0.32	0.40	0.48	1	1	1	1
	50	0.01	0.02	0.03	0.05	0.10	0.20	0.30	0.40	1	1	1	1	1	1
	60	0.01	0.02	0.04	0.06	0.12	0.24	0.36	0.48	1	1	1	1	1	1
	70	0.01	0.03	0.04	0.07	0.14	0.28	0.42	1	1	1	1	1	1	1
	80	0.02	0.03	0.05	0.08	0.16	0.32	0.48	1	1	1	1	1	1	2
	90	0.02	0.04	0.05	0.09	0.18	0.36	1	1	1	1	1	1	2	2
	100	0.02	0.04	0.06	0.10	0.20	0.40	1	1	1	1	1	2	2	2

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.21.43 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals. Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season

5.6.21.44 It is estimated that 0.1% of predicted mortalities during the breeding season derive from Ailsa Craig SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Ailsa Craig SPA potentially impacted by displacement is less than one (0.15) per annum during the breeding season (Table 139).

5.6.21.45 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Ailsa Craig SPA is estimated to be less than one (0.001) breeding adults per annum. Table 139 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.21.46 The population of kittiwake at Ailsa Criag SPA has reduced since the citation colony count in 1990 of 6,200 individuals to 980 individuals (2021). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 139).

5.6.21.47 Using the citation colony count of 6,200 breeding adults and an annual background mortality of 905.2 individuals, the addition of 0.001 predicted breeding adult mortalities would result in a less than 0.001% (0.0001%) increase in baseline mortality during the breeding season. When considering the most up to date counts of 980 breeding adults and an annual background mortality of 143.1 adults, this results in an increase of less than 0.001% (0.0003%) in baseline mortality during the breeding season (see Table 139).

Non-breeding Season

5.6.21.48 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Ailsa Craig SPA and 0.1% during the pre-breeding season (see Apportioning Appendix C).

5.6.21.49 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Ailsa Craig SPA during the post-breeding season is predicted at less than one (0.002), and less than one (0.004) during the pre-breeding season per annum.

5.6.21.50 Based on the 1990 citation colony count of 6,200 breeding adults and using an annual background mortality of 905.2 individuals, the addition of 0.002 and 0.004 predicted breeding adult mortalities would result in a less than 0.001% (0.0003%) and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 980 and an annual background mortality of 143.1 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 139).

5.6.21.51 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.004%, respectively

Annual Total

5.6.21.52 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Ailsa Craig SPA during operation and maintenance, is less than one (0.01) kittiwake per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.001% and 0.004% respectively (see Table 139).

5.6.21.53 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Ailsa Craig SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Ailsa Craig SPA.

5.6.21.54 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the available habitat and disturbance conservation objectives.

5.6.21.55 There will be no long-term effect to the following conservation objectives: to avoid deterioration of the habitat of kittiwake or significant disturbance to kittiwake, thus ensuring that the integrity of the site is maintained; to ensure for kittiwake that the population as a viable component of the site is maintained in the long-term; to ensure for gannet that the distribution within the site is maintained in the long-term; to ensure for kittiwake that the distribution, extent, structure, and function of supporting habitats are maintained in the long term; and that there is no significant disturbance of kittiwake.

Collision Risk (Operation and Maintenance)

5.6.21.56 Ailsa Craig SPA is 219.2 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.21.57 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Ailsa Craig SPA. Table 141 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Ailsa Craig SPA during each defined season and the overall annual impact.

5.6.21.58 Impacts are assessed relative to the citation population of 6,200 individuals (with a background mortality of 905.2 individuals per annum), and the most recent count (2021) of 980 individuals (with a background mortality of 143.1 individuals per annum).

Table 141 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Ailsa Craig SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total predicted collision mortality (individuals per annum)	Predicted breeding adult collision mortalities attributed to Ailsa Craig SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (May-Jul)	19.46	0.01	0.001	0.003
Post-breeding (Aug-Dec)	14.92	0.02	0.002	0.011
Pre-breeding (Jan-Apr)	7.69	0.01	0.001	0.007
Annual Total	**42.07**	**0.03**	**0.003**	**0.022**

Migration-free breeding season

5.6.21.59 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 48%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.21.60 It is estimated that 0.1% of predicted mortalities during the breeding season derive from Ailsa Craig SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Ailsa Craig SPA during the migration-free breeding season is less than one (0.01) breeding adult per annum (Table 141).

5.6.21.61 The population of kittiwake at Ailsa Craig SPA has reduced since the citation colony count in 1990 of 6,200 individuals, having decreased to 980 individuals (2021). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.21.62 Using the citation colony count of 6,200 breeding adults and an annual background mortality of 905.2 individuals, the addition of 0.01 predicted breeding adult mortalities would result in a 0.001% increase in baseline mortality during the breeding season. When considering the most up to date counts of 980 and an annual background mortality of 143.1 adults, this results in an increase of 0.003% in baseline mortality during the breeding season (Table 141).

Non-breeding season

5.6.21.63 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.1% of predicted mortalities during the post-breeding season are estimated to derive from Ailsa Craig SPA and 0.1% during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.02) and less than one (0.01) during the pre-breeding season per annum.

5.6.21.64 Based on the 1990 citation colony count of 6,200 breeding adults and using an annual background mortality of 905.2 individuals, the addition of 0.02 and 0.01 predicted breeding adult mortalities would result in a 0.002% and a 0.001% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 980 and an annual background mortality of 143.1 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 141).

5.6.21.65 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.03) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.003% and 0.018%, respectively (Table 141).

Annual Total

5.6.21.66 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Ailsa Craig SPA, is less than one (0.03) kittiwake per annum. The addition of 0.03 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.003% and 0.022% respectively (Table 141).

5.6.21.67 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Ailsa Craig SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk.

5.6.21.68 Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the remaining conservation objectives. Therefore, there would be no resulting affect on the integrity of the SPA in relation to the available habitat and disturbance conservation objectives.

5.6.21.69 There will be no long-term effect to the following conservation objectives: to avoid deterioration of the habitat of kittiwake or significant disturbance to kittiwake, thus ensuring that the integrity of the site is maintained; to ensure for kittiwake that the population as a viable component of the site is maintained in the long-term; to ensure for kittiwake that the distribution within the site is maintained in the long-term; to ensure for kittiwake that the distribution, extent, structure, and function of supporting habitats are maintained in the long term; and that there is no significant disturbance of kittiwake.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.21.70 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Ailsa Craig SPA.

5.6.21.71 Based on the separate assessments of kittiwake from Ailsa Craig above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.04) breeding adult mortality (Table 142). This represents an increase in baseline mortality of 0.004% when considering the citation colony count and an increase in baseline mortality of 0.026% 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 kittiwake feature of Ailsa Craig SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. Conclusions against all conservation objectives are provided in Table 143.

Table 142 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Ailsa Craig SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.04	0.004	0.026

Table 143. Assessment conclusions for kittiwake at Ailsa Craig SPA.

Conservation Objective	Conclusion
Population of the species as a viable component of the site.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Ailsa Craig SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
No significant disturbance of the species.	
Distribution of the species within site.	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake feature of Ailsa Craig SPA in relation to breeding site disturbance from Dublin Array alone.
Distribution and extent of habitats supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ailsa Craig SPA in relation to the distribution and extent of habitats supporting the species from Dublin Array alone.
Structure, function and supporting processes of habitats, supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ailsa Craig SPA in relation to the structure, function and supporting processes of habitats, supporting the species from Dublin Array alone.

Lesser black-backed gull

Collision Risk (Operation and Maintenance)

5.6.21.72 Ailsa Craig SPA is 219.2 km (around land) from Dublin Array, within the MMFR ± 1SD foraging range of lesser black-backed gull (127.0±109.0 km; Woodward *et al*., 2019). Lesser black-backed gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.21.73 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Lesser black-backed gull have been assessed during the breeding season of April to August, the post-breeding season of August to October, the pre-breeding season of March to April, and the migration-free winter season of November to February in relation to Ailsa Craig SPA. Table 144 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Ailsa Craig SPA during each defined season and the overall annual impact.

5.6.21.74 Impacts are assessed relative to the citation population of 3,600 individuals (with a background mortality of 414.0 individuals per annum), and the most recent count (2019) of 378 individuals (with a background mortality of 43.5 individuals per annum).

Table 144 Lesser black-backed gull predicted collision induced mortalities during the operation and maintenance phase attributed to Ailsa Craig SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	Total collision induced mortality (individuals per annum)	Estimated number of collision induced mortality attributed to Ailsa Craig SPA (individuals per annum)	Increase in baseline mortality (%)	
			Compared to citation population	Compared to most recent count
Breeding (Apr-Aug)	3.28	0.01	0.002	0.018
Post-breeding (Aug - Oct)	0.27	<0.01 (0.001)	<0.001 (0.0001)	0.001
Winter (Nov – Feb)	0.37	<0.01 (0.003)	0.001	0.006
Pre-breeding (Mar-Apr)	0.15	<0.01 (0.0003)	<0.001 (0.0001)	0.001
Annual Total	**4.07**	**0.01**	**0.003**	**0.026**

Breeding season

5.6.21.75 The predicted lesser black-backed gull collision mortality during the migration-free breeding season is 3.28 individuals (see CRM). Assuming that 60% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 35%, the total proportion of breeding adults in the population is estimated at 39%. Therefore, the total predicted number of breeding adult collisions is 1.28 per annum during the breeding season.

5.6.21.76 It is estimated that 1% of predicted mortalities during the breeding season derive from Ailsa Craig SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Ailsa Craig SPA during the migration-free breeding season is less than one (0.01) breeding adults per annum (Table 144).

5.6.21.77 The population of lesser black-backed gull at Ailsa Craig SPA has reduced since the citation colony count in 1990 of 3,600 individuals, having decreased to 378 individuals (2019). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.21.78 Using the citation colony count of 3,600 breeding adults and an annual background morality of 414.0 individuals, the addition of 0.01 predicted breeding adult mortalities would result in a 0.002% increase in baseline mortality during the breeding season. When considering the most up to date counts of 378 and an annual background mortality of 43.5 adults, this results in an increase of 0.018% in baseline mortality during the breeding season (Table 144).

Non-breeding season

5.6.21.79 The predicted lesser black-backed gull collision mortality during the post-breeding season is 0.27 individuals, 0.15 during the pre-breeding season and 0.37 during the winter season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Ailsa Craig SPA, 0.2% during the pre-breeding season and 0.7% during the winter season (see Apportioning Appendix C), the consequent predicted collision mortality of adult lesser black-backed gull during the post-breeding season is predicted at less than one (0.001), less than one (0.0003) during the pre-breeding season, and less than one (0.003) during the winter season per annum.

5.6.21.80 Based on the 1990 citation colony count of 3,600 breeding adults and using an annual background morality of 414.0 individuals, the addition of 0.001, 0.0003 and 0.003 predicted breeding adult mortalities would result in a less than 0.001% (0.0001), less than 0.001% (0.0001%) and 0.001% increase in baseline mortality during the post-breeding, pre-breeding and winter season, respectively. When considering the most up to date counts of 378 and an annual background mortality of 43.5 adults, this results in an increase of 0.001%, 0.001% and 0.006% in baseline mortality during the post-breeding, pre-breeding and winter season, respectively (Table 144).

5.6.21.81 This results in a total predicted mortality from collision in the non-breeding season of less than one (0.004) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.001% and 0.008%, respectively (Table 144).

Annual Total

5.6.21.82 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Ailsa Craig SPA, is less than one (0.01) lesser black-backed gull per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.003% and. 0.026% respectively (Table 144).

5.6.21.83 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the lesser black-backed gull feature of Ailsa Craig SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the lesser black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table 145.

Table 145. Collision risk assessment conclusions for lesser black-backed gull at Ailsa Craig SPA

Conservation Objective	Conclusion
Population of the species as a viable component of the site.	For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the lesser black-backed gull feature of Ailsa Craig SPA in relation to potential displacement effects and collision risk from Dublin Array alone.
No significant disturbance of the species.	
Distribution of the species within site.	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull feature of Ailsa Craig SPA in relation to breeding site disturbance from Dublin Array alone.
Distribution and extent of habitats supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ailsa Craig SPA in relation to

Conservation Objective	Conclusion
	the distribution and extent of habitats supporting the species from Dublin Array alone.
Structure, function and supporting processes of habitats, supporting the species.	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on habitats that support potential prey species, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ailsa Craig SPA in relation to the structure, function and supporting processes of habitats, supporting the species from Dublin Array alone.

5.6.22 Old Head of Kinsale SPA

Features and Effects for Assessment

5.6.22.1 Potential for LSE alone has been identified for the following for Old Head of Kinsale SPA:

- Kittiwake
  - Disturbance and displacement (C&D)
  - Disturbance and displacement (O&M)
  - Collision risk (O&M)
  - Combined collision risk and direct disturbance and displacement (O&M)

Assessment Information

5.6.22.2 The conservation objective (Appendix A) for Old Head of Kinsale SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

5.6.22.3 Based on the above conservation objective, the specific target for those screened in feature of the SPA, in order for favourable conservation status to be achieved, is when:

5.6.22.4 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.

Kittiwake

Direct Disturbance and Displacement

5.6.22.5 Old Head of Kinsale SPA is 244.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for disturbance and displacement based on ABPmer feedback despite their low vulnerability to displacement impacts (Bradbury *et al*., 2014).

5.6.22.6 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Old Head of Kinsale SPA.

5.6.22.7 Impacts are assessed relative to the citation population of 1,902 individuals (with a background mortality of 277.7 individuals per annum), and the most recent count (2015) of 1,422 individuals (with a background mortality of 207.6 individuals per annum).

Construction and Decommissioning

5.6.22.8 The potential kittiwake displacement mortality from the construction and decommissioning of Dublin Array attributed to Old Head of Kinsale SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.22.9 The potential kittiwake displacement mortality from the operation and maintenance of Dublin Array attributed to Old Head of Kinsale SPA is presented in Table 146 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual kittiwake displacement mortalities during construction and decommissioning attributed to Old Head of Kinsale SPA can also be found in Table 147.

Table 146 Predicted kittiwake displacement mortalities attributed to Old Head of Kinsale SPA during the operation and maintenance phase of Dublin Array.

Defined 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)**	
		30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality	30% displacement, 1% mortality	30% displacement, 3% mortality
Breeding (May-Jul)	0	0.00	0.00	0.000	0.000	0.000	0.000
Post-breeding (Aug-Dec)	1	<0.01 (0.003)	0.01	0.001	0.004	0.002	0.005
Pre-breeding (Jan-Apr)	2	0.01	0.02	0.002	0.005	0.002	0.007
Annual Total	**3**	**0.01**	**0.03**	**0.003**	**0.009**	**0.004**	**0.012**

Table 147 The full displacement matrix of potential annual kittiwake displacement mortalities during operation and maintenance attributed to Old Head of Kinsale SPA.

	Mortalities (%)													
Displacement (%)	**%**	**1**	**2**	**3**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
	10	0.003	0.01	0.01	0.02	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30
	20	0.01	0.01	0.02	0.03	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	1	1
	30	0.01	0.02	0.03	0.05	0.09	0.18	0.27	0.36	0.45	1	1	1	1	1
	40	0.01	0.02	0.04	0.06	0.12	0.24	0.36	0.48	1	1	1	1	1	1
	50	0.02	0.03	0.05	0.08	0.15	0.30	0.45	1	1	1	1	1	1	2
	60	0.02	0.04	0.05	0.09	0.18	0.36	1	1	1	1	1	1	2	2
	70	0.02	0.04	0.06	0.11	0.21	0.42	1	1	1	1	1	2	2	2
	80	0.02	0.05	0.07	0.12	0.24	0.48	1	1	1	1	2	2	2	2
	90	0.03	0.05	0.08	0.14	0.27	1	1	1	1	2	2	2	2	3
	100	0.03	0.06	0.09	0.15	0.30	1	1	1	2	2	2	2	3	3

Outputs highlighted in light blue represent the predicted annual mortality estimates as per the NatureScot guidance (2023) (Table 27). See Section 5.6.3 (Disturbance and Displacement) for further details.

Breeding Season

5.6.22.10 The estimated kittiwake mean peak abundance during the breeding season is 622 individuals, with an estimated 0.03% of kittiwake during the breeding season deriving from Old Head of Kinsale SPA (Apportioning Appendix C). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total mean peak abundance of breeding adults potentially impacted by displacement is 297 per annum during the breeding season.

5.6.22.11 It is estimated that 0.03% of predicted mortalities during the breeding season derive from Old Head of Kinsale SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Old Head of Kinsale SPA potentially impacted by displacement is zero (0.0) per annum during the breeding season Table 146).

5.6.22.12 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult kittiwake from Old Head of Kinsale SPA is estimated to be zero (0.00) breeding adults per annum. Table 146 presents a range of potential displacement consequent mortalities as per NatureScot guidance.

5.6.22.13 The population of kittiwake at Old Head of Kinsale SPA has reduced since the citation colony count in 2001 of 1,902 individuals to 1,422 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count (Table 146).

5.6.22.14 Using the citation colony count of 1,902 breeding adults and an annual background mortality of 277.7 individuals, the addition of 0.00 predicted breeding adult mortalities would result in a 0.000% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,422 breeding adults and an annual background mortality of 207.6 adults, this results in an increase of 0.000% in baseline mortality during the breeding season (see Table 146).

Non-breeding Season

5.6.22.15 The estimated kittiwake mean peak abundance during the post-breeding season is 749 individuals, and 850 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Old Head of Kinsale SPA and 0.2% during the pre-breeding season (see Apportioning Appendix C).

5.6.22.16 When applying a displacement rate of 30% displacement and a mortality rate of 1%, the consequent predicted displacement mortality of adult kittiwake from Old Head of Kinsale SPA during the post-breeding season is predicted at less than one (0.003), and less than one (0.01) during the pre-breeding season per annum.

5.6.22.17 Based on the 2001 citation colony count of 1,902 breeding adults and using an annual background mortality of 277.7 individuals, the addition of 0.002 and 0.01 predicted breeding adult mortalities would result in a 0.001% and a 0.002% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 1,422 and an annual background mortality of 207.6 adults, this results in an increase of 0.002% and 0.002% in baseline mortality during the post-breeding and pre-breeding season, respectively (see Table 146).

5.6.22.18 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.01) breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.003% and 0.004%, respectively

Annual Total

5.6.22.19 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Old Head of Kinsale SPA during operation and maintenance, is less than one (0.01) kittiwake per annum. The addition of 0.01 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.003% and 0.004% respectively (see Table 146).

5.6.22.20 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. **T**here is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Old Head of Kinsale SPA in relation to potential displacement risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Old Head of Kinsale SPA.

Collision Risk (Operation and Maintenance)

5.6.22.21 Old Head of Kinsale SPA is 244.6 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (Bradbury *et al*., 2014).

5.6.22.22 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA feature vary by season. Kittiwake have been assessed during the migration-free breeding season of May to July, the post-breeding season of August to December, and the pre-breeding season of January to April in relation to Old Head of Kinsale SPA. Table 148 provides the predicted collision resultant mortality from the operation of Dublin Array attributed to Old Head of Kinsale SPA during each defined season and the overall annual impact.

5.6.22.23 Impacts are assessed relative to the citation population of 1,902 individuals (with a background mortality of 277.7 individuals per annum), and the most recent count (2015) of 1,422 individuals (with a background mortality of 207.6 individuals per annum).

Table 148 Kittiwake predicted collision mortalities during the operation and maintenance phase attributed to Old Head of Kinsale SPA and resultant increase in baseline mortality compared to citation and most recent population counts.

Defined season (months)	**Total predicted collision mortality (individuals per annum)**	**Predicted breeding adult collision mortalities attributed to Old Head of Kinsale SPA (individuals per annum)**	**Increase in baseline mortality (%)**	
			Citation population (baseline mortality)	Compared to most recent count
Breeding (May-Jul)	19.46	<0.01 (0.002)	0.001	0.001
Post-breeding (Aug-Dec)	14.92	0.02	0.008	0.011
Pre-breeding (Jan-Apr)	7.69	0.02	0.006	0.007
Annual Total	**42.07**	**0.04**	**0.015**	**0.019**

Migration-free breeding season

5.6.22.24 The predicted kittiwake collision mortality during the migration-free breeding season is 19.46 individuals (see CRM). Assuming that 53% of the population are adults (Furness, 2015) and using an adult sabbatical rate (the proportion of birds not breeding in a given year) of 10%, the total proportion of breeding adults in the population is estimated at 47.7%. Therefore, the total predicted number of breeding adult collisions is 9.28 per annum during the breeding season.

5.6.22.25 It is estimated that less than 0.1% (0.03%) of predicted mortalities during the breeding season derive from Old Head of Kinsale SPA (see Apportioning Appendix C). Therefore, the predicted breeding adult mortalities attributed to Old Head of Kinsale SPA during the migration-free breeding season is less than one (0.002) breeding adults per annum (Table 148).

5.6.22.26 The population of kittiwake at Old Head of Kinsale SPA has reduced since the citation colony count in 2001 of 1,902 individuals, having decreased to 1,422 individuals (2015). The assessment of the potential impact on the colony has been carried out using both the citation and most recent count.

5.6.22.27 Using the citation colony count of 1,902 breeding adults and an annual background mortality of 277.7 individuals, the addition of 0.002 predicted breeding adult mortalities would result in a 0.001% increase in baseline mortality during the breeding season. When considering the most up to date counts of 1,422 and an annual background mortality of 207.6 adults, this results in an increase of 0.001% in baseline mortality during the breeding season (Table 148).

Non-breeding season

5.6.22.28 The predicted kittiwake collision mortality during the post-breeding season is 14.92 individuals and 7.69 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 0.2% of predicted mortalities during the post-breeding season are estimated to derive from Old Head of Kinsale SPA and 0.2% during the pre-breeding season (see Apportioning Appendix C). The consequent predicted collision mortality of adult kittiwake during the post-breeding season is predicted at less than one (0.02) and less than one (0.02) during the pre-breeding season per annum.

5.6.22.29 Based on the 2001 citation colony count of 1,902 breeding adults and using an annual background mortality of 277.7 individuals, the addition of 0.02 and 0.02 predicted breeding adult mortalities would result in a 0.008% and a 0.006% increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most up to date counts of 1,422 and an annual background mortality of 207.6 adults, this results in an increase of 0.011% and 0.007% in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 148).

5.6.22.30 This results in a total predicted mortality from collision in the non-breeding season of 0.04 breeding adult per annum. When assessed against the citation population count and the most recent colony count the baseline mortality rate increases by 0.014% and 0.018%, respectively (Table 148).

Annual Total

5.6.22.31 The predicted resultant mortality across all defined seasons from Dublin Array, attributed to Old Head of Kinsale SPA, is 0.04 kittiwake per annum. The addition of 0.04 predicted mortalities per annum would increase baseline mortality against the citation and most recent counts by 0.015% and. 0.019% respectively.

5.6.22.32 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Old Head of Kinsale SPA in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Old Head of Kinsale SPA.

Combined Collision Risk and Disturbance and Displacement (Operation and Maintenance)

5.6.22.33 Kittiwake have been screened in for both collision risk and displacement assessments during the O&M phase, therefore there is a potential for these two potential impacts to additively affect the kittiwake population at Old Head of Kinsale SPA.

5.6.22.34 Based on the separate assessments of kittiwake from Old Head of Kinsale SPA above, the combined predicted annual impact from collision risk and displacement (30% displacement, 1% mortality) is less than one (0.05) breeding adult mortality (Table 149). This represents an increase in baseline mortality of 0.024% when considering the citation colony count and an increase in baseline mortality of 0.018% 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 kittiwake feature of Old Head of Kinsale SPA in relation to combined potential collision and displacement effects from O&M phases from the proposed development alone and therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to potential for adverse effects from collision and displacement combined. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation of kittiwake at Old Head of Kinsale SPA.

Table 149 Annual kittiwake increase in baseline mortality due to combined collision, disturbance and displacement mortalities at Old Head of Kinsale SPA.

Total Annual Mortalities Attributed to the SPA	Predicted breeding adult mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.05	0.024	0.018

5.6.23 Rum SPA

Features and Effects for Assessment

5.6.23.1 Potential for LSE alone had been identified for the following for Rum SPA:

- Manx shearwater
  - Direct disturbance and displacement (C&D)
  - Direct disturbance and displacement (O&M)

Assessment Information

5.6.23.2 The conservation objectives (as described in Appendix A) for Rum SPA is to ensure that the qualifying features of Rum SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status.

5.6.23.3 Based on the above conservation objective, to ensure that the integrity of Rum SPA is restored in the context of environmental changes, the following conditions must be met:

- The populations of the qualifying features are viable components of Rum SPA;
- The distributions of the qualifying features throughout the site are maintained by avoiding significant disturbance of the species;
- The supporting habitats and processes relevant to qualifying features and their prey/food resources are maintained, or where appropriate, restored at Rum SPA.

Manx Shearwater

Direct Disturbance and Displacement

5.6.23.4 Rum SPA is 441.9 km (around land) from Dublin Array, within the MMFR +1SD of Manx shearwater (1,346.8+1,018.7 km; Woodward *et al.*, 2019). Manx shearwater have been screened into the assessment for displacement risk on a precautionary basis based on feedback from ABPmer (2023).

5.6.23.5 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. Manx shearwater have been assessed during the breeding season of April to August, the post-breeding season of September to early October, and the pre-breeding season of late March, in relation to Rum SPA.

5.6.23.6 Impacts are assessed relative to the citation population of 122,000 individuals (with a background mortality of 15,860.0 individuals per annum), and the most recent count (2021) of 577,788 individuals (with a background mortality of 75,112.4 individuals per annum).

Construction and Decommissioning

5.6.23.7 The potential Manx shearwater displacement mortality from the construction and decommissioning of Dublin Array attributed to Rum SPA has been screened in. Following standard practice in UK offshore wind applications, potential construction and decommissioning displacement mortalities are precautionarily assessed at 50% of those that take place during the operation and maintenance phase, as the project is not at full operational capacity during these phases, resulting in with impacts being spatially and temporally limited. Based on this assumption, the worst-case potential displacement mortalities will arise from the operation and maintenance assessment. Therefore, only the potential displacement from operation and maintenance has been assessed below, as the conclusions will be overestimates for the potential disturbance from construction and decommissioning.

Operation and Maintenance

5.6.23.8 The potential Manx shearwater displacement mortality from the operation of Dublin Array attributed to Rum SPA is presented in Table 150 for each defined season as well as the overall annual impact. The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Rum SPA is also found in Table 151.

Table 150 Predicted Manx shearwater displacement mortalities attributed to Rum SPA during the operation and maintenance phase of Dublin Array.

Defined Season	Abundance of adults apportioned to SPA (plus 2km buffer)	Estimated increase in mortality (breeding adults per annum) 30% displacement, 1% mortality	% increase in baseline mortality (citation count) 30% displacement, 1% mortality	% increase in baseline mortality (recent count) 30% displacement, 1% mortality
Breeding (Apr-Aug)	87	0.26	<0.001 (0.003)	0.002
Post-breeding (Sep-early Oct)	65	0.19	0.001	<0.001 (0.0003)
Pre-breeding (late Mar)	2	<0.01 (0.004)	<0.001 (0.00003)	<0.001 (0.00001)
Annual Total	**154**	**0.45**	**0.001**	**0.003**

Table 151 The full displacement matrix of potential annual Manx shearwater displacement mortalities during operations and maintenance attributed to Rum SPA.

	Mortalities (%)													
Displacement (%)	%	1	2	3	5	10	20	30	40	50	60	70	80	90	100
	10	0.2	0.3	0.5	1	2	3	5	6	8	9	11	12	14	15
	20	0.3	1	1	2	3	6	9	12	15	18	22	25	28	31
	30	0.5	1	1	2	5	9	14	18	23	28	32	37	42	46
	40	1	1	2	3	6	12	18	25	31	37	43	49	55	62
	50	1	2	2	4	8	15	23	31	39	46	54	62	69	77
	60	1	2	3	5	9	18	28	37	46	55	65	74	83	92
	70	1	2	3	5	11	22	32	43	54	65	75	86	97	108
	80	1	2	4	6	12	25	37	49	62	74	86	99	111	123
	90	1	3	4	7	14	28	42	55	69	83	97	111	125	139
	100	2	3	5	8	15	31	46	62	77	92	108	123	139	154

Outputs highlighted in dark blue represent the predicted annual mortality estimates as per Table 27.

Breeding Season

5.6.23.9 The estimated Manx shearwater mean peak abundance during the breeding season is 2,198 individuals. Assuming that 54% of the Manx shearwater population are adults (Furness, 2015), the total mean peak abundance of breeding adults potentially impacted by displacement is 1,187 per annum during the breeding season (Table 150).

5.6.23.10 It is estimated that 7.2% of predicted mortalities during the breeding season derive from Rum SPA (see Apportioning Appendix C). Therefore, the total mean peak abundance of breeding adults from Rum SPA potentially impacted by displacement is 85.6 per annum during the breeding season (Table 150).

5.6.23.11 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent potential mortality for breeding adult Manx shearwater from Rum SPA is estimated to be less than one (0.26) breeding adult per annum (Table 150).

5.6.23.12 The population of Manx shearwater at Rum SPA from the 1982 citation colony count was 122,000, whereas the 2021 SMP count was 577,788 individuals. The assessment of the potential impact on the colony has been carried out using both the citation and the most recent count (Table 150).

5.6.23.13 Using the citation colony count of 122,000 breeding adults and an annual background mortality of 15,860.0 individuals, the addition of 0.26 predicted breeding adult mortalities would result in a 0.0003% increase in baseline mortality during the breeding season. When considering the alternative recent count of 577,788 breeding adults and an annual background mortality of 75,112.4 adults, this results in an increase of 0.002% in baseline mortality during the breeding season (Table 150).

Non-breeding Season

5.6.23.14 The estimated Manx shearwater mean peak abundance during the post-breeding season is 176 individuals and 4 during the pre-breeding season. Based on the non-breeding seasonal regional population size, 36.64% of predicted mortalities are estimated to derive from Rum SPA during the pre- and post-breeding seasons (see Apportioning Appendix C).

5.6.23.15 When applying a displacement rate of 30% and a mortality rate of 1%, the consequent predicted displacement mortality of adult Manx shearwater from Rum SPA during the post-breeding season is predicted at less than one (0.19) and less than one (0.004) during the pre-breeding season per annum.

5.6.23.16 Based on the 1982 citation colony count of 122,000 breeding adults and using an annual background mortality of 15,860.0 individuals, the addition of 0.19 and 0.004 predicted breeding adult mortalities would result in a 0.001% and less than 0.001% (0.0003%) increase in baseline mortality during the post-breeding and pre-breeding season, respectively. When considering the most recent count of 577,788 breeding adults and an annual background mortality of 75,112.4 adults, this results in an increase of less than 0.001% (0.00003%) and less than 0.001% (0.00001%) in baseline mortality during the post-breeding and pre-breeding season, respectively (Table 150).

5.6.23.17 This results in a total predicted mortality from displacement in the non-breeding season of less than one (0.20) breeding adult per annum. When assessed against the citation population count and the alternative recent count the baseline mortality rate increases by 0.001% and less than 0.001% (0.0003%), respectively (Table 150).

Annual Total

5.6.23.18 The predicted resultant mortality (when using a 30% displacement and 1% mortality rate) across all defined seasons from Dublin Array, attributed to Rum SPA, is less than one (0.45) Manx shearwater per annum. The addition of 0.45 predicted mortalities per annum would increase baseline mortality against the citation and the alternative recent count recent counts by 0.001% and 0.002% respectively (Table 150).

5.6.23.19 For both citation and most recent count, the predicted increase in baseline mortality is less than 1% and would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the Manx shearwater feature of Rum SPA in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the Manx shearwater feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objective to ensure that Manx shearwater at Rum SPA are in favourable condition and make an appropriate contribution to achieving Favourable Conservation Status. Conclusions against all conservation objectives are provided in Table 152.

Table 152. Displacement assessment conclusions for Manx shearwater at Rum SPA.

<table>
<tr><th>Conservation Objective</th><th>Conclusion</th></tr>
<tr><td>The populations of the qualifying features are viable components of Rum SPA;</td><td rowspan="2">For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objectives of the Manx shearwater feature of Rum SPA in relation to potential displacement effects from Dublin Array alone.</td></tr>
<tr><td>The distributions of the qualifying features throughout the site are maintained by avoiding significant disturbance of the species;</td></tr>
<tr><td>The supporting habitats and processes relevant to qualifying features and their prey/food resources are maintained, or where appropriate, restored at Rum SPA.</td><td>As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the Manx shearwater at Rum SPA in relation to prey biomass availability from Dublin Array alone.</td></tr>
</table>

5.6.24 Additional SPAs (non-breeding season only)

Guillemot

5.6.24.1 Displacement impacts are considered for nine SPAs for guillemot which have been screened in for the non-breeding season only. The apportionment of impacts is presented in Table 153, with impacts on SPA populations presented in Table 154.

Table 153 Apportionment of displacement moralities for guillemot in the non-breeding season

SPA	SPA weighting (%)	Abundance of adults apportioned to SPA (array area plus 2km buffer)	Seasonal estimated mortality apportioned to SPA		
			30%:1% - 70%:2%	60%:1%/3%	50%, 1%
Cape Wrath SPA [UK9001231]	4.1	84.7	0.25 - 1.19	0.51 - 1.52	0.42
Flannan Isle SPA [UK9001021]	1.5	30.4	0.09 - 0.43	0.18 - 0.55	0.15
Handa SPA [UK9001241]	5.7	117.6	0.35 - 1.65	0.71 - 2.12	0.59
Mingulay and Berneray SPA [UK9001121]	2.0	41.9	0.13 - 0.59	0.25 - 0.75	0.21
North Colonsay and Western Cliffs SPA [UK9003171]	2.0	41.8	0.13 - 0.59	0.25 - 0.75	0.21
Rathlin Island SPA [UK9020011]	13.1	270.6	0.81 - 3.79	1.62 - 4.87	1.35
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051]	2.4	50.5	0.15 - 0.71	0.3 - 0.91	0.25
St Kilda SPA [UK9001031]	2.4	48.6	0.15 - 0.68	0.29 - 0.87	0.24
Sule Skerry and Sule Stack SPA [UK9002181]	1.1	23.6	0.07 - 0.33	0.14 - 0.43	0.12

Table 154 Guillemot displacement impacts in the non-breeding season

SPA	% increase in baseline mortality (citation count)					% increase in baseline mortality (recent count)				
	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3 %	50%, 1%
Cape Wrath SPA [UK9001231]	13,700	835.7	0.030 - 0.142	0.061 - 0.182	0.051	38,109	2,324.6	0.011 - 0.051	0.022 - 0.066	0.018
Flannan Isle SPA [UK9001021]	21,930	1,337.7	0.007 - 0.032	0.014 - 0.041	0.011	5,632	343.6	0.027 - 0.124	0.053 - 0.159	0.044
Handa SPA [UK9001241]	98,686	6,019.8	0.006 - 0.027	0.012 - 0.035	0.010	57,595	3,513.3	0.010 - 0.047	0.020 - 0.060	0.017
Mingulay and Berneray SPA [UK9001121]	61,800	3,769.8	0.003 - 0.016	0.007 - 0.020	0.006	34,948	2,131.8	0.006 - 0.028	0.012 - 0.035	0.010
North Colonsay and Western Cliffs SPA [UK9003171]	13,312	812.0	0.015 - 0.072	0.031 - 0.093	0.026	20,189	1,231.5	0.010 - 0.048	0.020 - 0.061	0.017
Rathlin Island SPA [UK9020011]	41,887	2,555.1	0.032 - 0.148	0.064 - 0.191	0.053	381,970	23,300.2	0.003 - 0.016	0.007 - 0.021	0.006
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a	15,262	931.0	0.016 - 0.076	0.033 - 0.098	0.027	37,044	2,259.7	0.007 - 0.031	0.013 - 0.040	0.011

SPA	% increase in baseline mortality (citation count)					% increase in baseline mortality (recent count)				
	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%
Moroedd Penfro SPA [UK9014051]										
St Kilda SPA [UK9001031]	6,294	383.9	0.038 - 0.177	0.076 - 0.228	0.063	15,211	927.9	0.016 - 0.073	0.031 - 0.094	0.026
Sule Skerry and Sule Stack SPA [UK9002181]	6,298	384.2	0.018 - 0.086	0.037 - 0.111	0.031	10,068	614.1	0.012 - 0.054	0.023 - 0.069	0.019

5.6.24.2 The predicted displacement consequent mortality based on 50% displacement and 1% mortality represents a less than 1% increase in baseline mortality for all SPAs when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot features of these SPAs in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Razorbill

5.6.24.3 Displacement impacts are considered for six SPAs for razorbill which have been screened in for the non-breeding season only. The apportionment of impacts is presented in Table 155 with impacts on SPA populations presented in Table 156.

Table 155 Apportionment of displacement moralities for razorbill in the non-breeding season

SPA	Season	SPA weighting (%)	Abundance of adults apportioned to SPA (array area plus 2km buffer)	Seasonal estimated mortality apportioned to SPA		
				30%:1% - 70%:2%	60%:1%/3%	50%, 1%
Cape Wrath SPA [UK9001231]	Autumn	0.7	13.7	0.04 - 0.19	0.08 - 0.25	0.07
	Winter	1.1	3.2	0.01 - 0.19	0.02 - 0.06	0.02
	Spring	0.7	3.2	0.01 - 0.19	0.02 - 0.06	0.02
	Total	-	20.0	0.06 - 0.19	0.12 - 0.36	0.10
Handa SPA [UK9001241]	Autumn	1.6	33.8	0.10 - 0.19	0.20 - 0.61	0.17
	Winter	2.8	7.9	0.02 - 0.19	0.05 - 0.14	0.04
	Spring	1.6	7.8	0.02 - 0.19	0.05 - 0.14	0.04
	Total	-	49.5	0.15 - 0.19	0.30 - 0.89	0.25
Mingulay and Berneray SPA [UK9001121]	Autumn	3.2	66.2	0.20 - 0.19	0.40 - 1.19	0.33
	Winter	5.5	15.5	0.05 - 0.19	0.09 - 0.28	0.08
	Spring	3.2	15.3	0.05 - 0.19	0.09 - 0.28	0.08
	Total	-	97.0	0.29 - 0.19	0.58 - 1.75	0.48
Rathlin Island SPA [UK9020011]	Autumn	4.9	100.8	0.30 - 0.19	0.60 - 1.81	0.50
	Winter	8.4	23.6	0.07 - 0.19	0.14 - 0.42	0.12
	Spring	4.9	23.3	0.07 - 0.19	0.14 - 0.42	0.12
	Total	-	147.6	0.44 - 0.19	0.89 - 2.66	0.74
Shiant Isles SPA [UK9001041]	Autumn	1.3	27.8	0.08 - 0.19	0.17 - 0.5	0.14
	Winter	2.3	6.5	0.02 - 0.19	0.04 - 0.12	0.03

SPA	Season	SPA weighting (%)	Abundance of adults apportioned to SPA (array area plus 2km buffer)	Seasonal estimated mortality apportioned to SPA 30%:1% - 70%:2%	60%:1%/3%	50%, 1%
	Spring	1.3	6.4	0.02 - 0.19	0.04 - 0.12	0.03
	Total	-	40.7	0.12 - 0.19	0.24 - 0.73	0.20
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051]	Autumn	1.9	39.3	0.12 - 0.19	0.24 - 0.71	0.20
	Winter	3.3	9.2	0.03 - 0.19	0.06 - 0.17	0.05
	Spring	1.9	9.1	0.03 - 0.19	0.05 - 0.16	0.05
	Total	-	57.5	0.17 - 0.19	0.35 - 1.04	0.29

Table 156 Razorbill displacement impacts in the non-breeding season

SPA	Season	% increase in baseline mortality (citation count)					% increase in baseline mortality (recent count)				
		Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%
Cape Wrath SPA [UK9001231]	Autumn	13,700	1,438.5	0.003 - 0.013	0.006 - 0.017	0.005	3,246	340.8	0.012 - 0.056	0.024 - 0.072	0.020
	Winter			0.001 - 0.003	0.001 - 0.004	0.001			0.003 - 0.013	0.006 - 0.017	0.005
	Spring			0.001 - 0.003	0.001 - 0.004	0.001			0.003 - 0.013	0.006 - 0.017	0.005
	Total			0.004 - 0.020	0.008 - 0.025	0.007			0.018 - 0.082	0.035 - 0.106	0.029
Handa SPA [UK9001241]	Autumn	16,394	1,721.4	0.007 - 0.033	0.012 - 0.035	0.010	8,207	861.7	0.030 - 0.139	0.024 - 0.071	0.020
	Winter			0.002 - 0.008	0.003 - 0.008	0.002			0.007 - 0.032	0.006 - 0.017	0.005
	Spring			0.002 - 0.008	0.003 - 0.008	0.002			0.007 - 0.032	0.005 - 0.016	0.005
	Total			0.010 - 0.048	0.017 - 0.052	0.014			0.044 - 0.203	0.034 - 0.103	0.029
Mingulay and Berneray SPA [UK9001121]	Autumn	16,890	1,773.5	0.014 - 0.064	0.022 - 0.067	0.019	11,811	1,240.2	0.058 - 0.272	0.032 - 0.096	0.027
	Winter			0.003 - 0.015	0.005 - 0.016	0.004			0.014 - 0.064	0.007 - 0.022	0.006
	Spring			0.003 - 0.015	0.005 - 0.016	0.004			0.013 - 0.063	0.007 - 0.022	0.006
	Total			0.020 - 0.094	0.033 - 0.098	0.027			0.085 - 0.398	0.047 - 0.141	0.039
Rathlin Island SPA	Autumn	8,922	936.8	0.021 - 0.098	0.065 - 0.194	0.054	22,421	2,354.2	0.089 - 0.414	0.026 - 0.077	0.021

SPA	Season	% increase in baseline mortality (citation count)					% increase in baseline mortality (recent count)				
		Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%	Population count	Background mortality	30%:1% - 70%:2%	60%:1%/3%	50%, 1%
[UK9020011]	Winter			0.005 - 0.023	0.015 - 0.045	0.013			0.021 - 0.097	0.006 - 0.018	0.005
	Spring			0.005 - 0.023	0.015 - 0.045	0.012			0.020 - 0.096	0.006 - 0.018	0.005
	Total			0.031 - 0.144	0.095 - 0.284	0.079			0.130 - 0.606	0.038 - 0.113	0.031
Shiant Isles SPA [UK9001041]	Autumn	10,950	1,149.8	0.006 - 0.027	0.015 - 0.044	0.012	8,029	843.0	0.024 - 0.114	0.020 - 0.059	0.016
	Winter			0.001 - 0.006	0.003 - 0.010	0.003			0.006 - 0.027	0.005 - 0.014	0.004
	Spring			0.001 - 0.006	0.003 - 0.010	0.003			0.006 - 0.026	0.005 - 0.014	0.004
	Total			0.008 - 0.040	0.021 - 0.064	0.018			0.036 - 0.167	0.029 - 0.087	0.024
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051]	Autumn	5,990	629.0	0.008 - 0.038	0.037 - 0.112	0.031	11,922	1,251.81	0.035 - 0.161	0.019 - 0.056	0.016
	Winter			0.002 - 0.009	0.009 - 0.026	0.007			0.008 - 0.038	0.004 - 0.013	0.004
	Spring			0.002 - 0.009	0.009 - 0.026	0.007			0.008 - 0.037	0.004 - 0.013	0.004
	Total			0.012 - 0.056	0.055 - 0.165	0.046			0.051 - 0.236	0.028 - 0.083	0.023

5.6.24.4 The predicted displacement consequent mortality based on 50% displacement and 1% mortality represents a less than 1% increase in baseline mortality for all SPAs when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill features of these SPAs in relation to potential displacement effects from Dublin Array alone. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Kittiwake

5.6.24.5 Combined collision and displacement impacts are considered for three SPAs for kittiwake which have been screened in for the non-breeding season only. The apportionment of impacts is presented in Table 157 with impacts on SPA populations presented in Table 158.

Table 157 Apportionment of combined collision and displacement moralities for kittiwake in the non-breeding season

SPA	Season	SPA weighting (%)	Moralities attributed to SPA	
			Displacement (30% displacement, 1% mortality) plus collision	Displacement (30% displacement, 3% mortality) plus collision
Cape Wrath SPA [UK9001231]	Autumn	2.2	0.4	0.5
	Spring	2.9	0.3	0.4
	Total	-	0.7	0.9
North Colonsay and Western Cliffs SPA [UK9003171]	Autumn	1.2	0.2	0.3
	Spring	1.6	0.2	0.2
	Total	-	0.4	0.5
Rathlin Island SPA [UK9020011]	Autumn	1.7	0.3	0.4
	Spring	2.2	0.3	0.4
	Total	-	0.6	0.8

Table 158 Kittiwake combined collision and displacement impacts in the non-breeding season

SPA	Season	SPA weighting (%)	% increase in baseline mortality (citation)				% increase in baseline mortality (recent count)			
			Population count	Background mortality	Displacement (30% displacement, 1% mortality) plus collision	Displacement (30% displacement, 3% mortality) plus collision	Population count	Background mortality	Displacement (30% displacement, 1% mortality) plus collision	Displacement (30% displacement, 3% mortality) plus collision
Cape Wrath SPA [UK9001231]	Autumn	2.2	19,400	2,832.4	0.013	0.017	7,244	1,057.6	0.036	0.045
	Spring	2.9			0.010	0.016			0.028	0.042
	Total	-			0.024	0.033			0.064	0.087
North Colonsay and Western Cliffs SPA [UK9003171]	Autumn	1.2	9,024	1,317.5	0.016	0.020	9,201	1,343.3	0.015	0.019
	Spring	1.6			0.012	0.018			0.012	0.018
	Total	-			0.028	0.038			0.027	0.037
Rathlin Island SPA [UK9020011]	Autumn	1.7	13,644	1,992.0	0.015	0.018	19,258	2,811.7	0.010	0.013
	Spring	2.2			0.016	0.021			0.011	0.015
	Total	-			0.030	0.040			0.021	0.028

5.6.24.6 The predicted collision and displacement consequent mortalities (based on 30% displacement and 1% mortality) represents a less than 1% increase in baseline mortality for all SPAs when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. Though the impact exceeds the 0.05% threshold to consider the impact for an in-combination assessment for the Cape Wrath SPA, the predicted impact does not account for macro-avoidance in collision estimates and therefore is considered over precautionary by double counting impacts. When accounting for macro-avoidance, it is considered that all impacts are sufficiently small that they will make no material contribution to an in-combination impact.

5.6.24.7 There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake features of these SPAs in relation to potential collision and displacement effects from Dublin Array alone. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for displacement and collision risk. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Herring gull

5.6.24.8 Collision impacts are considered for one SPA for herring gull which has been screened in for the non-breeding season only. The apportionment of impacts and impacts on the SPA population is presented in Table 159.

Table 159 Apportioned non-breeding season collision impacts for herring gull

SPA	SPA weighting (%)	Estimated adult mortalities	% increase in background mortality (citation)			% increase in background mortality (recent count)		
			Population count	Background mortality	Impact	Population count	Background mortality	Impact
Morecambe Bay and Duddon Estuary SPA [UK9020326]	1.9	0.4	20,000	3320.0	0.011	1,546	256.6	0.144

5.6.24.9 The predicted collision mortality represents a less than 1% increase in baseline mortality for this SPA when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull features of these SPAs in relation to potential collision risk from Dublin Array alone. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Lesser black-backed gull

5.6.24.10 Collision impacts are considered for four SPAs for lesser black-backed gull which have been screened in for the non-breeding season only. The apportionment of impacts and impacts on the SPA population is presented in Table 160Table .

Table 160 Apportioned non-breeding season collision impacts for lesser black-backed gull

SPA	Season	SPA weighting (%)	Estimated adult mortalities	% increase in background mortality (citation)			% increase in background mortality (recent count)		
				Population count	Background mortality	Impact	Population count	Background mortality	Impact
Isles of Scilly SPA [UK9020288]	Autumn	3.9	0.0	9,844	1,132.1	0.001	2,072	238.3	0.004
	Winter	13.0	0.0			0.004			0.020
	Spring	3.9	0.0			0.001			0.002
	Total	-	0.1			0.006			0.027
Morecambe Bay and Duddon Estuary SPA [UK9020326]	Autumn	5.8	0.0	9,450	1,086.8	0.001	1,724	198.3	0.008
	Winter	19.0	0.1			0.006			0.036
	Spring	5.8	0.0			0.001			0.004
	Total	-	0.1			0.009			0.048
Ribble and Alt Estuaries SPA [UK9005103]	Autumn	9.6	0.0	3,600	414.0	0.006	4,638	533.4	0.005
	Winter	31.6	0.1			0.028			0.022
	Spring	9.6	0.0			0.003			0.003
	Total	-	0.2			0.038			0.029
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051]	Autumn	11.2	0.0	40,600	4,669.0	0.001	15,974	1,837.0	0.002
	Winter	36.8	0.1			0.003			0.007
	Spring	11.2	0.0			0.000			0.001
	Total	-	0.2			0.004			0.010

5.6.24.11 The predicted collision mortality represents a less than 1% increase in baseline mortality for these SPAs when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the lesser black-backed gull feature of these SPAs in relation to potential collision effects from Dublin Array alone. Therefore, subject to natural change, the lesser black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Great black-backed gull

5.6.24.12 Collision impacts are considered for one SPA for great black-backed gull which has been screened in for the non-breeding season only. The apportionment of impacts and impacts on the SPA population is presented in Table 161Table .

Table 161 Apportioned non-breeding season collision impacts for great black-backed gull

SPA	SPA weighting (%)	Estimated adult mortalities	% increase in background mortality (citation)			% increase in background mortality (recent count)		
			Population count	Background mortality	Impact	Population count	Background mortality	Impact
Isles of Scilly SPA [UK9020288]	3.4	0.2	1,882	216.4	0.082	1,618	186.1	0.096

5.6.24.13 The predicted collision mortality represents a less than 1% increase in baseline mortality for this SPA when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the great black-backed gull features of this SPA in relation to potential collision effects from Dublin Array alone. Therefore, subject to natural change, the great black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

Gannet

5.6.24.14 Combined collision and displacement impacts are considered for three SPAs for gannet which have been screened in for the non-breeding season only. The apportionment of impacts is presented in Table 162Table with impacts on SPA populations presented in Table 163Table .

Table 162 Apportionment of combined collision and displacement moralities for gannet in the non-breeding season

SPA	Season	SPA weighting (%)	Seasonal estimated mortality apportioned to SPA			
			Displacement (60%, 1%) + collisions	Displacement (70%, 1%) + collisions	Displacement (70%, 3%) + collisions	Displacement (80%, 1%) + collisions
North Rona and Sula Sgeir SPA [UK9001011]	Autumn	3.4	0.01	0.01	0.02	0.01
	Spring	2.9	0.01	0.01	0.02	0.01
	Total	-	0.02	0.02	0.04	0.02
St Kilda SPA [UK9001031]	Autumn	22.3	0.05	0.06	0.12	0.06
	Spring	18.5	0.05	0.06	0.13	0.06
	Total	-	0.10	0.11	0.25	0.12
Sule Skerry and Sule Stack SPA [UK9002181]	Autumn	1.7	<0.01 (0.004)	<0.01 (0.004)	0.01	0.00
	Spring	1.5	<0.01 (0.004)	0.01	0.01	0.01
	Total	-	0.01	0.01	0.02	0.01

Table 163 Gannet combined collision and displacement impacts in the non-breeding season

SPA	Season	% increase in background mortality (citation count)						% increase in background mortality (recent count)					
		Population count	Background mortality	Displacement (60%, 1%) + collisions	Displacement (70%, 1%) + collisions	Displacement (70%, 3%) + collisions	Displacement (80%, 1%) + collisions	Population count	Background mortality	Displacement (60%, 1%) + collisions	Displacement (70%, 1%) + collisions	Displacement (70%, 3%) + collisions	Displacement (80%, 1%) + collisions
North Rona and Sula Sgeir SPA [UK9001011]	Autumn	20,800	1,684.8	0.001	0.001	0.001	0.001	18,990	1,538.2	0.001	0.001	0.001	0.001
	Spring			0.001	0.001	0.001	0.001			0.001	0.001	0.001	0.001
	Total			0.001	0.001	0.002	0.001			0.001	0.001	0.002	0.001
St Kilda SPA [UK9001031]	Autumn	310,000	25,110.0	<0.001 (0.0002)	<0.001 (0.0002)	0.001	<0.001 (0.0002)	12,0580	9,767.0	0.001	0.001	0.001	0.001
	Spring			<0.001 (0.0002)	<0.001 (0.0002)	0.001	<0.001 (0.0002)			0.001	0.001	0.001	0.001
	Total			0.0004	<0.001 (0.0004)	0.001	0.001			0.001	0.001	0.003	0.001
Sule Skerry and Sule Stack SPA [UK9002181]	Autumn	11,800	955.8	<0.001 (0.0004)	0.001	0.001	0.001	9,000	729.0	0.001	0.001	0.001	0.001
	Spring			<0.001 (0.0004)	0.001	0.001	0.001			0.001	0.001	0.001	0.001
	Total			0.001	0.001	0.002	0.001			0.001	0.001	0.003	0.001

5.6.24.15 The predicted collision and displacement consequent mortality represents a less than 1% increase in baseline mortality for these SPAs when considering both the citation and most recent count. Predicted impacts would therefore be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the gannet feature of these SPAs in relation to potential combined collision and displacement effects from Dublin Array alone. Therefore, subject to natural change, the gannet feature will be maintained in the long term with respect to the potential for combined collision and displacement effects. There will be no long-term effect to the conservation objectives to maintain or increase the size of the population, allowing for natural variability, and maintain its sustainability in the long term.

6 In Combination Assessment

6.1.1.1 As detailed in Section 3.4, Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are also considered.

6.1.1.2 In the case of projects, in-combination impacts 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 Planning Act.

6.1.1.3 OPR, 2021 states that for In-combination assessments, effects must examine plans or projects that are:

- Projects completed;
- Projects approved but not started or uncompleted;
- Projects proposed, i.e. for which an application for approval or consent has been made, including refusals subject to appeal and not yet determined;
- Proposals in adopted plans; and
- Proposals in finalised draft plans formally published or submitted for consultation or adoption.

6.1.1.4 Full details on the criteria, tiers and process used for screening the in-combination assessment can be found in the SISAA.

6.1.1.5 The process of screening other plans and projects was based on a longlist of reasonably foreseeable plans and projects (as defined above and meeting the criteria set out in OPR, 2021) reduced to a shortlist for assessment based on whether there exists a spatial or temporal overlap between the potential effects of the plans/projects and the potential effects of Dublin Array. For the purposes of the in combination assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (refer to Volume 2, Chapter 6: Project Description).

6.1.1.6 The plans and projects screened in for in combination assessment are presented below with the full list of plans and projects screened presented in Appendix D: In combination Long Lists.

6.1.1.7 In-combination assessments are presented using the following receptor headings, capturing all relevant sites for which they are designated:

- Subtidal and intertidal benthic ecology;
- Migratory fish.
- Marine mammals;
- Onshore ecology; and
- Offshore and intertidal ornithology.

6.2 Subtidal and intertidal benthic ecology

6.2.1.1 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 17 km buffering the array area and Offshore ECC has been applied. 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. Based on the project-specific plume modelling, the maximum spring tidal excursion at the proposed development area is approximately 16 km from the point of release (Physical Processes Modelling Report). Therefore, a study area of a 17 km buffer around Dublin Array is considered to be precautionary and to encapsulate the area within which all of the potential significant effects on migratory fish might occur. A screening range of 17 km 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.

6.2.1.2 The plans/projects shortlisted for LSE on subtidal and benthic ecology features of designated sites, screened in due to potential effect pathways are presented in Table 164.

Table 164 Projects screened in for in combination assessment for subtidal and intertidal benthic ecology

Plan or Project	Project details	Distance Array area	Distance ECC	Accidental Pollution	Suspended Sediment and Deposition	Physical Habitat Loss	Habitat Disturbance	Invasive Species	EMF	Conclusion In-Combination
Dublin Port Company MP2 Project - Jetty construction and dredging	Tier 1 – Consented Licence: FS006893, Permit S0024-02 (2022-2032), Permit S0024-03 (2022-2029)	5.5	8.1	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the planned MP2 project construction and dredging activities with Dublin Array (the MP2 dredge disposal activities are planned to occur 5.5 km west of the Array area and 8.1 km north of the Offshore ECC). Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the planned MP2 project construction and dredging activities with Dublin Array (the MP2 dredge disposal activities are planned to occur 5.5 km west of the Array area and 8.1 km north of the Offshore ECC). Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	The introduction of invasive species are not predicted to occur and due to the distance between Dublin Array and the MP2 project, there is no potential for an in-combination effect with Dublin Array.	EMF no source or pathway for effects to occur due to nature of the project.	Included for assessments relating to accidental pollution and suspended sediment and deposition.
Dublin Port Company Maintenance Dredging	Tier 1 – Consented Licence: FS007132, dredging at various locations in Dublin Port from 2022-2029	16.8	16.8	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the planned Dublin Port dredging activities with Dublin Array (the Dublin Port dredging activities are planned to occur within Dublin Port, located 16.8 north of the Dublin Array Offshore ECC). Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the planned Dublin Port dredging activities with Dublin Array (the Dublin Port dredging activities are planned to occur within Dublin Port, located to the north of the Dublin Array Offshore ECC). Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	The introduction of invasive species is not predicted to occur and due to the distance between Dublin Array and the Dublin Port dredging activities there is no potential for an in-combination effect with Dublin Array.	EMF no source or pathway for effects to occur due to nature of the project.	Included for assessments relating to accidental pollution and suspended sediment and deposition.
Dublin Port Company 3FM Project	Tier 3 – Pre-consent, to commence in 2026 (planned programme 2026-2040)	17.6	13.2	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the proposed Dublin Port works	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap from the proposed Dublin Port works	The introduction of invasive species is not predicted to occur and due to the distance between Dublin Array and the	EMF no source or pathway for effects to occur due to nature of the project.	Included for assessments relating to accidental pollution and suspended

Plan or Project	Project details	Distance		Accidental Pollution	Suspended Sediment and Deposition	Physical Habitat Loss	Habitat Disturbance	Invasive Species	EMF	Conclusion In-Combination
		Array area	ECC							
				the in-combination assessment for this effect.	included in the in-combination assessment for this effect.	with Dublin Array. Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	with Dublin Array. Therefore, due to the lack of direct overlap, there is no potential for an in-combination effect with Dublin Array.	Dublin Port dredging activities there is no potential for an in-combination effect with Dublin Array.		sediment and deposition.
Codling Wind Park OWF	Tier 3 - Pre-consent, commencement in 2027 with construction lasting 2-3 years.	2.5	9.6	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to occur within the immediate vicinity of the works at Dublin Array. As cable corridors cross there is potential for an in-combination effect with Dublin Array.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The introduction of invasive species may occur through the introduction of hard substrates in the form of foundation installation. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to relating to all impacts.
EXA Atlantic subsea cable	Tier 1 - Operational subsea cable	1.7	8.7	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	The introduction of invasive species is not predicted to occur and there is no potential for an in-combination effect with Dublin Array.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to accidental pollution, suspended sediment and deposition and EMF.
Aqua Comms CeltixConnect 1 (CC-1) subsea cable	Tier 1 - Operational subsea cable	8.1	11.3	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	The introduction of invasive species is not predicted to occur and there is no potential for an in-combination effect with Dublin Array.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to accidental pollution, suspended sediment and deposition and EMF.

Plan or Project	Project details	Distance Array area	ECC	Accidental Pollution	Suspended Sediment and Deposition	Physical Habitat Loss	Habitat Disturbance	Invasive Species	EMF	Conclusion In-Combination
ESB ZAYO Emerald Bridge Fibres subsea cable	Tier 1 - Operational subsea cable	16.5	20.5	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The dates of O&M activities may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	Physical habitat loss is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	Habitat disturbance is anticipated to only occur within the immediate vicinity of the works at Dublin Array. There is no direct overlap and no potential for an in-combination effect with Dublin Array.	The introduction of invasive species is not predicted to occur and there is no potential for an in-combination effect with Dublin Array.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to accidental pollution, suspended sediment and deposition and EMF.
Mares Connect subsea cable	Tier 3 – Pre-application	0	0	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The proposed dates of the works may overlap with that of Dublin Array. Therefore, combined with the proximity to Dublin Array, it is included in the in-combination assessment for this effect.	The introduction of invasive species is not predicted to occur and there is no potential for an in-combination effect with Dublin Array.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to all impacts.

6.2.2 Rockabill to Dalkey Island SAC

6.2.2.1 The screening and assessment for effects on the benthic ecology features of Rockabill to Dalkey Island SAC concluded that exposure of Qualifying Interests of the SAC to impacts is possible from indirect effects. Based on the project alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from physical habitat loss
- Cumulative effects from accidental pollution;
- Cumulative increases in SSC and associated sediment deposition;
- Cumulative effects from habitat disturbance;
- Cumulative effects of invasive species; and
- Cumulative effects of EMF

Cumulative effects from physical habitat loss

6.2.2.2 As presented in Table 164, the project identified for this effect in association with the proposed development is Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in project and Dublin Array occurring simultaneously.

6.2.2.3 While there is a small overlap (0.16 km2) between the Offshore ECC and Rockabill to Dalkey Island SAC, this overlap area does not encompass any Annex I reef habitat as mapped by NPWS (2013a). However, should Annex I geogenic reef be found within the boundary of Rockabill to Dalkey Island SAC the Applicant commits to avoidance of these features to preclude direct impacts to these reefs from cable installation and protection within the Offshore ECC. This approach, allied to the minor overlap of the Offshore ECC and SAC, will result in no potential for risk of habitat loss and no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition.

6.2.2.4 In addition, as the Codling Wind Park OWF cable corridor does not encroach on the nearshore reef habitat located between Killiney in the north to Bray in the south which is outwith any protected site. Consequently, no in-combination effects will occur on ex situ reef habitat.

Cumulative effects from accidental pollution

6.2.2.5 The projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.2.6 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with the identified projects.

6.2.2.7 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). The use of these appropriate preventative measures mitigates the risk of this type of pollution incident. No discharges (continuous or intermittent) of chemicals or construction materials, which may be toxic or persistent within the marine environment, are proposed during the lifetime of Dublin Array. Other projects considered in this in-combination assessment are subject to similar obligations and commitments, and there will be no significant effects from those projects (see Dublin Port Company, 2019 & 2022; Codling Wind Park, 2024; MERC Consultants, 2018).

6.2.2.8 Additionally, as described within the Dublin Array project alone benthic assessments in Section 5.2, the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SAC are identified.

6.2.2.9 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the identified projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.2.10 As presented in Table 164, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

6.2.2.11 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance) and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (maximum of <100 m - see the Physical Processes assessments), the SSC levels predicted within the SSC plumes from all three projects being assessed here will be below background levels recorded during storm events. Because of this, it is considered that all benthic Qualifying Interests designated in the Rockabill to Dalkey Island SAC 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.

6.2.2.12 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging within Dublin harbour with disposal at designated sites in adjacent coastal waters. Codling Wind Park OWF incorporates a maximum of up to 75 WTGs, three export cables and up to three OSPs. While the Codling Wind Park Array is 17 km from the SAC boundary, the cable route crosses the site. Dates for construction have been identified as 2027 to 2029/2030 which overlap with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable crossings, installation would need to be sequential, although landfall could be attained at the same time.

6.2.2.13 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase. For offshore infrastructure, turbines are to be removed in a reversal of construction methodology with pilings cut off at or below the seabed to a depth so as not to become uncovered in the future, cables and scour protection left in situ with all hazardous materials to be removed or contained prior to removal from site. Similarly, the Offshore Substation Platform (OSP) will be removed and returned to shore for decommissioning and disposal. Consequently, impacts will be at a reduced magnitude given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ. Therefore, the same projects are considered for this stage of development, and the same conclusions are drawn.

6.2.2.14 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Table 165 Consideration of potential for cumulative effects from increases in SSC and associated sediment deposition as a result of activities as Tier 1 Projects

	Justification
Step 1: Drivers	Capital dredging and disposal, seabed preparation works (including sand wave clearance) and O&M activities.
Step 2: Pressures	Temporary increases in SSC and associated sediment deposition and smothering of designated benthic features within Rockabill to Dalkey Island SAC.
Step 3: States	Subtidal benthic Qualifying Interests designated in the Rockabill to Dalkey Island SAC.
Step 4: Impacts	The potential effects from such works would be temporary increases in SSC and associated sediment deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (maximum of <100 m), the SSC levels predicted within the SSC plumes from all five projects being assessed here will be below background levels

	Justification
	recorded during storm events. Because of this, it is considered that all benthic Qualifying Interests designated in the Rockabill to Dalkey Island SAC 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.
Step 5: Responses	No additional mitigation is considered necessary to prevent significant effects.
Conclusion	When factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative effects of habitat disturbance

6.2.2.15 As presented in Table 164, the project identified for this effect in association with the proposed development is Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in project and Dublin Array occurring simultaneously.

6.2.2.16 The alone assessment of habitat in association with Dublin Array will be restricted to discrete areas within the project boundary and is therefore regarded as near field. Similar patterns are expected in relation Codling Wind Park. Consequently, with the exception of the location of Codling export cable corridor crossing that for Dublin Array, there will be negligible overlap between footprint between the two projects. Furthermore, as the overlap of the proposed two cable corridors do not encroach on the SAC no in-combination effects are anticipated.

6.2.2.17 Furthermore, as outlined for project alone, there is no spatial overlap between the inshore reef habitat and the SAC reef features and any potential impacts on biological connectivity (e.g. larval supply and recruitment) will be negligible due to the short-term nature of the disturbance allied to the small proportion of habitat affected and the natural temporal and spatial variability of such events (see Wahl, 2001; Watson and Barnes, 2014). Consequently, disturbance of ex situ reef habitat in combination with Codling Wind Park will not have an adverse effect on the structure and function of the reef features within Rockabill to Dalkey SAC or its conservation objectives.

6.2.2.18 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the Codling Wind Park in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the project considered in-combination.

Cumulative effects of invasive species

6.2.2.19 As presented in Table 164, the project identified for this effect in association with the proposed development is Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in project and Dublin Array occurring simultaneously.

6.2.2.20 There is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by IAS that otherwise may not have had a suitable habitat available.

6.2.2.21 Implementation of the Biosecurity Plan within the PEMP measures will ensure that the risk of potential introduction and spread of IAS will be minimised as far as is reasonably practicable for the proposed development. As such, the alone assessment indicates that the potential for risk of invasive species will not adversely affect the conservation target to conserve the Intertidal and Subtidal reef community complexes in Rockabill to Dalkey Island SAC in a natural condition. Similar biodiversity security measures will be implemented by Codling Wind Park.

6.2.2.22 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the Codling Wind Park in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from the project considered in-combination.

Cumulative effects of EMF

6.2.2.23 As presented in Table 164, the projects identified for this effect in association with the proposed development are three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in project and Dublin Array occurring simultaneously.

6.2.2.24 Electromagnetic fields are generated from power transmission in the cables and have the potential to impact electrosensitive species. Benthic species associated with subtidal and intertidal reef community complexes have the potential to be affected by EMF generated by operational cables. EMFs are only detectable above background levels in close proximity to the cables, with the extent of the impact being largely restricted by the burial of the cables.

6.2.2.25 As discussed in section 5.2.2.57 et seq. the alone assessment indicates that EMFs associated with export cable will have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid. Further to this, with the avoidance measure where the Applicant commits to avoidance of Annex I reef features within the boundaries of the SAC this will preclude direct impacts to these Annex I reef features. This approach will result in no potential for risk of habitat loss and no adverse effect on the conservation target to conserve the Qualifying Interests of the Rockabill to Dalkey Island SAC in a natural condition.

6.2.2.26 With the exception of the location of Codling Wind Farm export cable corridor potentially encroaching on that for Dublin Array, there will be negligible overlap between footprint between the projects considered. Furthermore, as the overlap of the proposed two cable corridors do not encroach on the SAC Annex I features no in-combination effects are anticipated.

6.2.2.27 Therefore, when factoring in the lack of potential adverse effect from Dublin Array 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 sites and features for this impact from any of the projects considered in-combination.

6.2.3 South Dublin Bay SAC

6.2.3.1 The screening and assessment for effects on the benthic ecology features of South Dublin Bay SAC concluded that exposure of exposure of Qualifying Interests of the SAC from effects is possible. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from accidental pollution; and
- Cumulative increases in SSC and associated sediment deposition.

6.2.3.2 Due to the proximity of the site to Dublin Array for various effects (South Dublin SAC is 6.4 km from offshore ECC and lies 13.6 km inshore of the array), the projects considered for the in-combination assessment for this site are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

Cumulative effects from accidental pollution

6.2.3.3 As presented, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.3.4 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with identified projects. The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). The use of appropriate preventative measures mitigates the risk of this type of pollution incident. 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 Dublin Array. It is anticipated that the other projects considered on this list will be subject to similar obligations and commitments, and there will be no significant effects from those projects (see Dublin Port Company, 2019 & 2022; Codling Wind Park, 2024; MERC Consultants, 2018).Additionally, as described within the benthic assessments (Section 5.2), the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SA are identified.

6.2.3.5 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.3.6 As presented, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.3.7 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance), and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (see the Physical Processes assessments), the SSC levels predicted within the SSC plumes from all three 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.

6.2.3.8 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging within Dublin harbour with disposal at designated sites in adjacent coastal waters. Owing to the early stage of the Codling Wind Park OWF within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. However, we know that for the Codling Wind Park OWF incorporates a maximum of up to 75 WTGs, three export cables and up to three OSPs have been identified as the offshore design parameters, which is of larger magnitude to that assessed for Dublin Array. Dates for construction have been identified as 2027 to 2029/2030, which overlaps with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable cross installation would need to be sequential, although landfall could be attained at the same time.

6.2.3.9 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase, however given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ, impacts will be at a reduced magnitude.

6.2.3.10 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

6.2.4 North Dublin Bay SAC

6.2.4.1 The screening and assessment for effects on the benthic ecology features of North Dublin Bay SAC concluded that exposure of Qualifying Interests of the SAC from effects is possible. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from accidental pollution; and
- Cumulative increases in SSC and associated sediment deposition;

6.2.4.2 Due to the proximity of the site to Dublin Array for various effects North Dublin SAC lies 11.5 km from the offshore ECC and lies 11.9 km inshore of the array) the projects considered for the in-combination assessment for this site are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

Cumulative effects from accidental pollution

6.2.4.3 As presented, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.4.4 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with the identified projects.

6.2.4.5 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP).

6.2.4.6 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 Dublin Array. It is anticipated that the other projects considered on this list will have similar mitigation measures and there will be no significant effects from those projects (see Dublin Port Company, 2019 & 2022; Codling Wind Park, 2024; MERC Consultants, 2018).

6.2.4.7 Additionally, as described within the Dublin Array project alone benthic assessments in Section 5.2, the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SAC are identified.

6.2.4.8 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.4.9 Increases in SSC are anticipated to extend up to approximately 10 km from the source. Therefore, a 17 km ZoI based on the maximum spring tidal excursion is considered precautionary and appropriate for any potential effects. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously within Dublin Bay.

6.2.4.10 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance) and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (see the Physical Processes assessments), the SSC levels predicted within the SSC plumes from all three 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.

6.2.4.11 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging of within Dublin harbour with disposal at designated sites in adjacent coastal waters. Owing to the early stage of the Codling Wind Park OWF within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. However, we know that for the Codling Windfarm design incorporates a maximum of up to 75 WTGs, three export cables and up to three OSPs have been identified as the offshore design parameters, which is of larger magnitude to that assessed for Dublin Array. Dates for construction have been identified as 2027 to 2029/2030, which overlap with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable cross installation would need to be sequential, although landfall could be attained at the same time.

6.2.4.12 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase, however given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ, impacts will be at a reduced magnitude.

6.2.4.13 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

6.2.5 Baldoyle Bay SAC

6.2.5.1 The screening and assessment for effects on the benthic ecology features of Baldoyle Bay SAC concluded that exposure of exposure of Qualifying Interests of the SAC from effects is possible. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from accidental pollution; and
- Cumulative increases in SSC and associated sediment deposition.

6.2.5.2 Due to the proximity of the site to Dublin Array for various effects (Baldoyle Bay SAC lies 16.1 km from the offshore ECC and lies 14.1 km inshore of the array), the projects considered for the in-combination assessment for this site are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

Cumulative effects from accidental pollution

6.2.5.3 As presented in Table 164 the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.5.4 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with identified projects.

6.2.5.5 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). 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 Dublin Array. It is anticipated that the other projects considered on this list will be subject to similar obligations and commitments, and there will be no significant effects from those projects (see Dublin Port Company, 2019 & 2022; Codling Wind Park, 2024; MERC Consultants, 2018).

6.2.5.6 Additionally, as described within the Dublin Array project alone benthic assessments in Section 5.2, the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SAC are identified.

6.2.5.7 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.5.8 Increases in SSC are anticipated to extend up to approximately 10 km from the source. Therefore, a 17 km ZoI based on the maximum spring tidal excursion is considered precautionary and appropriate for any potential effects. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously within Dublin Bay. However, the proposed project timelines are such that it is highly unlikely that the proposed construction programmes will overlap.

6.2.5.9 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance) and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (see the Physical Processes assessments), the SSC levels predicted within the SSC plumes from all three 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.

6.2.5.10 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging of within Dublin harbour with disposal at designated sites in adjacent coastal waters. Owing to the early stage of the Codling Wind Park OWF within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. However, we know that for the Codling Wind Park OWF design incorporates a maximum of up to 75 WTGs, three export cables and up to three OSPs have been identified as the offshore design parameters, which is of larger magnitude to that assessed for Dublin Array. Dates for construction have been identified as 2027 to 2029/2030, which overlap with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable cross installation would need to be sequential, although landfall could be attained at the same time.

6.2.5.11 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase, however given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ, impacts will be at a reduced magnitude.

6.2.5.12 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

6.2.6 Murrough Wetlands SAC

6.2.6.1 The screening and assessment for effects on the benthic ecology features of Murrough Wetlands SAC concluded that exposure of exposure of Qualifying Interests of the SAC from effects is possible. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from accidental pollution; and
- Cumulative increases in SSC and associated sediment deposition.

6.2.6.2 Due to the proximity of the site to Dublin Array for various effects (Murrough Wetlands lies 10.4 km from the offshore ECC and lies 8.2 km inshore of the array), the projects considered for the in-combination assessment for this site are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

Cumulative effects from accidental pollution

6.2.6.3 As presented Table 164, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.6.4 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with identified projects.

6.2.6.5 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). The use of these appropriate preventative measures mitigates the risk of this type of pollution incident. 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 Dublin Array. It is anticipated that the other projects considered on this list will be subject to similar obligations and commitments, and there will be no significant effects from those projects (see Dublin Port Company, 2019; Codling Wind Park, 2024; MERC Consultants, 2018).

6.2.6.6 Additionally, as described within the Dublin Array project alone benthic assessments in Section 5.2, the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SAC are identified.

6.2.6.7 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.6.8 Increases in SSC are anticipated to extend up to approximately 10 km from the source. Therefore, a 17 km ZoI based on the maximum spring tidal excursion is considered precautionary and appropriate for any potential effects. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously within Dublin Bay.

6.2.6.9 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance) and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities (see the Physical Processes assessments), the SSC levels predicted within the SSC plumes from all three 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.

6.2.6.10 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging of within Dublin harbour with disposal at designated sites in adjacent coastal waters. Owing to the early stage of the Codling Wind Park OWF within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. However, we know that for the Codling Wind Park OWF a maximum of up to 75 WTGs, three export cables and up to three OSPs have been identified as the offshore design parameters, which is of larger magnitude to that assessed for Dublin Array. Dates for construction have been identified as 2027 to 2029/2030, which overlap with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable cross installation would need to be sequential, although landfall could be attained at the same time.

6.2.6.11 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase, however given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ, impacts will be at a reduced magnitude.

6.2.6.12 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

6.2.7 Codling Fault Zone SAC

6.2.7.1 The screening and assessment for effects on the benthic ecology features of Codling Fault Zone SAC concluded that exposure of exposure of Qualifying Interests of the SAC from effects is possible. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 164, this site has been screened in for the following potential effects:

- Cumulative effects from accidental pollution; and
- Cumulative increases in SSC and associated sediment deposition;

6.2.7.2 Due to the proximity of the site to Dublin Array for various effects (Codling Fault Zone SAC lies 18.3 km from the offshore ECC and lies 14.5 km offshore of the array), the projects considered for the in-combination assessment for this site are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF. Due regard has been afforded to the possibility of the screened in projects, and Dublin Array occurring simultaneously.

Cumulative effects from accidental pollution

6.2.7.3 As presented in Table 164, the projects identified for this effect in association with the proposed development are Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging, Dublin Port Company 3FM Project, three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres), Mares Connect subsea cable and Codling Wind Park OWF.

6.2.7.4 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the marine environment during works associated with identified projects.

6.2.7.5 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). 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 Dublin Array. It is anticipated that the other projects considered on this list will be subject to similar obligations and commitments, and there will be no significant effects from those projects (see Dublin Port Company, 2019 & 2022; Codling Wind Park, 2024; MERC Consultants, 2018).

6.2.7.6 1.1.4 Additionally, as described within the Dublin Array project alone benthic assessments in Section 5.2, the level of contaminants within the sediments that are likely to be disturbed did not exceed the upper limits according to the Irish Sediment Quality Guidelines and therefore no project alone impacts are identified. Consequently, no in-combination effects on the SAC are identified. Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

Cumulative increases in SSC and associated sediment deposition

6.2.7.7 Increases in SSC are anticipated to extend up to approximately 10 km from the source. Therefore, a 17 km ZoI based on the maximum spring tidal excursion is considered precautionary and appropriate for any potential effects.

6.2.7.8 From the Tier 1 Projects (Dublin Port Company MP2 Project, Dublin Port Company Maintenance Dredging and three operational subsea cables (EXA Atlantic, Aqua Comms CeltixConnect 1 (CC-1) and ESB Zayo Emerald Bridge Fibres)), the cause of effects is primarily capital dredging and disposal, seabed preparation works (including sandwave clearance) and O&M activities. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and supporting habitats. With the exception of within the immediate vicinity of some of the activities the SSC levels predicted within the SSC plumes from all three projects being assessed here will be below background levels recorded during storm events (see Volume 3, Chapter 1: Marine Geology, Oceanography and Physical Processes). 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.

6.2.7.9 From the Tier 3 Projects (Dublin Port Company 3FM Project, Mares Connect subsea cable and Codling Wind Park OWF), the cause of effects are primarily dredging and disposal and simultaneous cable laying in Dublin Bay. Dublin Port 3FM Project involves dredging of within Dublin harbour with disposal at designated sites in adjacent coastal waters. Owing to the early stage of the Codling Wind Park OWF within the planning process, site-specific information relating to cumulative increases in SSC and associated deposition is very limited. However, we know that for the Codling Wind Park OWF incorporates a maximum of up to 75 WTGs, three export cables and up to three OSPs have been identified as the offshore design parameters (Codling Wind Park Limited, 2020), which is of larger magnitude to that assessed for Dublin Array. Dates for construction have been identified as 2027 to 2029/2030, which overlap with the construction of Dublin Array. Mares Connect subsea cable is a HVDC electricity cable laid between Wales and Ireland, with offshore construction scheduled for 2026 to 2029, overlapping with that of Dublin Array. The potential effects from such works would be temporary increases in SSC and associated sedimented deposition and smothering of the benthos and their supporting habitats. As increased SSC rapidly dissipates immediately following the cessation of activities, it is not expected for there to be any additive process for the increased turbidity within the water column. In the event of programme overlap, in an area where export cable cross installation would need to be sequential, although landfall could be attained at the same time.

6.2.7.10 As outlined in the Decommissioning and Restoration Plan for the decommissioning phase, the potential impacts are considered to be similar to those outlined in the construction phase, however given there is no requirement for seabed preparation and cables and scour protection expected to be left in situ, impacts will be at a reduced magnitude.

6.2.7.11 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is considered that there is no potential for AEoI on the sites and features for this impact from any of the projects considered in-combination.

6.3 Migratory fish

6.3.1.1 This section outlines the in-combination assessment for migratory fish features and effect pathways screened in for LSE. To assess potential in-combination impacts from underwater noise, a screening range of 100 km 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}) in fleeing migratory fish during the piling of foundations is 8.5 km for monopiles and 9.3 km for jacket foundations (Underwater noise assessment). Assuming a stationary animal, impact ranges for the onset of TTS may extend up to 19 km during the installation of monopiles and 29 km during the installation of jacket foundations. Underwater noise modelling conducted for the proposed Codling Wind Park predicted maximum impact ranges for the onset of TTS of 34 km for stationary receptors and 24 km for fleeing species (Codling Wind Park Limited, 2024). Modelling for the proposed North Irish Sea Array (NISA) showed maximum TTS onset ranges of up to 69 km for stationary receptors and 51 km for fleeing receptors (NISA, 2024), while the predicted maximum impact range for the onset of TTS during the construction of the Awel y Môr (AyM) OWF (located in Welsh waters) was 36 km for stationary receptors and 17 km for fleeing receptors (RWE, 2023). Therefore, a screening range of 100 km is considered to be highly precautionary and likely to encapsulate the area within which potential significant in-combination effects on migratory fish as a result of piling noise might occur.

6.3.1.2 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 17 km buffering the array area and Offshore ECC has been applied. 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. Based on the project-specific plume modelling, the maximum spring tidal excursion at the proposed development area is approximately 16 km from the point of release (Physical Processes Modelling Report). Therefore, a study area of a 17 km buffer around Dublin Array is considered to be precautionary and to encapsulate the area within which all of the potential significant effects on migratory fish might occur. A screening range of 17 km 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.

6.3.1.3 Plans and projects screened into the assessment together with their allocated tier that reflects their current stage within the planning and development process are presented in Table 166. Survey projects associated with offshore energy projects are not listed in Table 166 because these projects are already screened in under offshore wind where the highest level of noise disturbance during construction is assumed. Non-energy projects that have the potential to generate continuous sounds (e.g. dredging, cable maintenance works) but are located outside the 17 km screening range for sedimentary and EMF effects have been screened out of the in-combination noise assessment owing to low risk of overlapping noise impact ranges between these projects and Dublin Array.

6.3.1.4 For the purposes of the in combination assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (refer to Volume 2, Chapter 6: Project Description).

6.3.1.5 Owing to the nature of the in-combination assessment and the interaction between various projects, some effects are considered in-combination that have not been considered in the alone assessment (i.e., in-combination effects from increases in SSC and associated sediment deposition). This is because while the effects associated with Dublin Array alone are not enough to generate a potential for LSE, due to the proximity and interactions with the other plans and projects, there is a potential for additive effects that may result in significant adverse effects on the qualifying migratory fish interests.

Table 166 Plans and projects screened in for consideration within the in-combination assessment of migratory fish

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to Dublin Array (km)	Distance to ECC (km)	Underwater Noise	Suspended Sediment and Deposition	Accidental Pollution	EMF	Screening conclusion In-Combination
Codling Wind Park	Tier 3 Pre-consent	Construction anticipated to commence in 2027 with offshore construction lasting 2-3 years. Piling anticipated in 2027.	2.5	9.6	The proposed dates of the works may overlap with that of the proposed development. In addition, consideration has been given to the potential for effects from sequential piling over prolonged periods of time.	The proposed dates of the works may overlap with that of the proposed development. Therefore, combined with the proximity to Dublin Array, the project it is included in the in-combination assessment for these impacts.		Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, Accidental Pollution, and EMF.
North Irish Sea Array (NISA) Offshore Wind Farm	Tier 3 Pre-consent	Offshore construction anticipated for 2027-2029 with piling anticipated in 2028.	21.6	28.9		The proposed dates of the works may overlap with that of Dublin Array. While the project is outside the sedimentary ZoI for Dublin Array, it has been screened into the assessment because of its proximity to the River Boyne and River Blackwater SAC.		While the project is outside the EMF ZoI for Dublin Array, it has been screened into the assessment because of its proximity to the River Boyne and River Blackwater SAC.	Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, Accidental Pollution, and EMF.
Arklow Bank Phase 2	Tier 3 Pre-consent	Construction anticipated to take place 2026-2030 with piling anticipated in 2028.	25.8	32.9		The proposed dates of the works may overlap with that of Dublin Array. However, due to the distance of the projects from Dublin Array, there is no potential for in-combination effects with Dublin Array.		Due to the distance of the projects from Dublin Array, there is no potential for in-combination effects with Dublin Array.	Included for assessments relating to Underwater Noise.
Oriel Offshore Wind Farm	Tier 3 Pre-consent	Construction anticipated to take place between 2026-2028 with piling anticipated in 2027.	64.7	70.8					
Dublin Port Company MP2 Project	Tier 1 Consented Licence FS006893	Construction activities including dredging in Dublin Harbour scheduled to take place 2022-2032.	6.4	10.5	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.	Due to the nature of these projects, effects from EMF are not anticipated.	Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, and Accidental Pollution.
Dublin Port Company	Tier 1 Consented Licence FS007132	Ongoing maintenance dredging at various locations in Dublin Port from 2022-2029.	16.8	16.8					
Dublin Port Company	Tier 1 Consented Permit S0004-03 and S0024-02	Release of dredged material from vessels west of Burford Bank in outer Dublin Bay 2022-2035.	5.5	8.1					
Dublin Port Company 3FM Project	Tier 3 Pre-consent	Construction activities and capital dredging in Dublin Harbour. Release of dredged material at dredge disposal site at	17.6	13.2					

Plan or Project	Tier and Stage of Development	Planned Programme	Distance to Dublin Array (km)	Distance to ECC (km)	Underwater Noise	Suspended Sediment and Deposition	Accidental Pollution	EMF	Screening conclusion In-Combination
		Burford Bank in outer Dublin Bay.							
EXA Atlantic	Tier 1 Operational	Active telecommunication cable	1.7	8.7	The dates of O&M activities may overlap with that of the proposed development.	The dates of O&M activities may overlap with that of the proposed development.	The dates of O&M activities may overlap with that of the proposed development.	The installation of power cables at the proposed development will result in additional anthropogenic EMFs, which could affect electro- and magneto-sensitive receptors in-combination with existing cables.	Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, Accidental Pollution, and EMF.
Aqua Comms CeltixConnect - Sea Fibre Networks	Tier 1 Operational	Active telecommunication cable	8.1	11.3					
Hibernia Atlantic HIBERNIA 'C'	Tier 1 Operational	Active telecommunication cable	14.3	16.8					
ZAYO Emerald Bridge One	Tier 1 Operational	Active telecommunication cable	16.5	20.5					
Mares Connect	Tier 3 Pre-consent	Subsea power cable; construction anticipated to take place 2026-2029.	0	0	The proposed dates of the works may overlap with the construction period of the proposed development.	The proposed dates of the works may overlap with the construction period of the proposed development.	The proposed dates of the works may overlap with the construction period of the proposed development.	Due to the nature of this project, effects from EMF are anticipated.	Included for assessments relating to Underwater Noise, Suspended Sediment and Deposition, Accidental Pollution, and EMF.

6.3.2 River Boyne and River Blackwater SAC

6.3.2.1 The screening and assessment for effects on the migratory fish features of the River Boyne and River Blackwater SAC concluded that exposure of individuals of the SAC population to impacts arising during the construction, operation and maintenance and decommissioning of Dublin Array is possible. The likelihood of exposure is expected to be low and pathways are limited to passing migratory fish undertaking large migrations. Based on the alone assessments for Dublin Array and the consideration of plans and projects identified within Table 166, this SAC has been screened in for the following effects:

- In-combination effects from underwater noise and vibration;
- In-combination effects from EMF;
- In-combination effects from increases in SSC and associated sediment deposition;
- In-combination effects from accidental pollution;
- In-combination effects from the introduction and spread of invasive species; and
- In-combination effects from effects on prey.

6.3.2.2 Due to their proximity to Dublin Array for various effects (within 100 km for noise effects as stated within the SISAA 5.2.1), all East Coast Irish Phase 1 projects are included in the in-combination assessment. The East Coast Phase 1 projects include the Codling Offshore Wind Farm, the North Irish Sea Array (NISA) Offshore Wind Farm, the Oriel Wind Farm 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 Dublin Array include maintenance and capital dredging at Dublin port, the construction of the Mares Connect power cable, and activities associated with the maintenance of existing cables.

6.3.2.3 In addition, existing and proposed power and telecommunications cables within the cumulative assessment area are considered for their potential to give rise to in-combination effects from EMF emitted from cables installed at the proposed development. The NISA OWF has been screened in specifically in relation to the River Boyne and River Blackwater SAC. Despite this project being outside of the relevant sedimentary and EMF ZoIs for Dublin Array, it is in close proximity to the River Boyne and River Blackwater SAC (11.4 km at its closest point with the cable corridor) and therefore there is a higher potential for in-combination effects with the SAC.

In-combination Effects from Underwater Noise and Vibration

6.3.2.4 While the conclusion for Dublin Array alone identified no potential for adverse effects from underwater noise, due to proximity with other projects there is still a potential for effects to occur in-combination. As for the project alone, potential in-combination underwater noise effects on migratory fish include mortality and potential mortal injury, recoverable injury, TTS and behavioural changes. Activities that may cause these changes include geophysical surveys, the detonation of UXO and construction and maintenance activities associated with the identified projects such as piling of foundations, dredging, rock placement, cable installation and vessel noise.

6.3.2.5 The greatest risk of in-combination effects of underwater noise on migratory fish species has been identified as being that produced by impact piling during the construction phase of other East Coast Phase 1 OWF projects within 100 km of Dublin Array. As such, likely significant in-combination effects related to impact piling have been the primary focus of the assessment.

Underwater Noise from Piling

6.3.2.6 Each of the five East Coast Phase 1 OWF projects included in the assessment (Table 166) provided indicative piling schedules, which suggest that piling would take place within a period of five years between 2027 and 2031 inclusive. Piling operations at each windfarm site will be intermittent, with each individual piling event likely to be similar in duration to piling events at Dublin Array. The piling schedules further suggest that piling at Codling Wind Park, Oriel, NISA and Arklow Bank Phase 2 would be completed before the piling of foundations at Dublin Array commences, For the purposes of this assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period, with piling at Codling and Oriel expected to take place in 2027 and piling at NISA and Arklow Bank Phase 2 currently scheduled for 2028. However, in-combination effects may also result from the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

6.3.2.7 The effects of underwater noise from piling on Atlantic salmon during the construction of Dublin Array alone are discussed in Section 5.3. Mortal and recoverable injuries to mobile fish from piling noise at Dublin Array are predicted to occur less than 100 m from the noise source for both the piling of monopiles and jacket foundations (Underwater noise assessment). Comparable impact ranges have been predicted for the other East Coast Phase 1 OWF projects. For example, underwater noise modelling for NISA and Codling predicted mortal and recoverable injuries in fleeing receptors within < 100 m from the piling locations (Codling Wind Park, 2024; NISA, 2024), while for Arklow Phase Bank 2, mortal and recoverable injuries were predicted to occur up to 130 m away from the noise source (SSE Renewables, 2024). Based on these predictions and given the distance between the projects the areas over which mortality, potential mortal injury and recoverable injury in fleeing receptors might occur are not expected to overlap between projects.

6.3.2.8 Furthermore, as discussed previously, 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), which suggests a low likelihood of salmon from the River Boyne and River Blackwater SAC to migrate through the array areas of Dublin Array, Arklow Bank Phase 2, and Codling Wind Park. In addition, the potential for mortal and recoverable injuries to fleeing fish during piling activities is likely to be reduced with the implementation of soft-start and ramp-up procedures, which would allow mobile species, like Atlantic salmon, to move away from the piling location before injurious effects can occur. Therefore, while the sequential piling of multiple East Coast Phase 1 wind farms has the potential to result in additive mortality and/or recoverable injury in Atlantic salmon over time, the mobility of the receptor together with its migration routes and the implementation of best practice mitigation measures (i.e., soft-start procedures) will minimise the risk of any effects to Atlantic salmon native to the SAC. Based on this, it is concluded that the risk of in-combination mortality and recoverable injury to Atlantic salmon associated with the River Boyne and River Blackwater SAC.

6.3.2.9 TTS in Atlantic salmon from piling at Dublin Array is predicted to occur up to 8.5 km from the array area during the installation of monopile foundations and up to 9.3 km during the piling of jacket foundations (Underwater noise assessment), 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). Given the distance between Dublin Array and the River Boyne estuary (43 km) combined with the likely northward migration of Atlantic salmon when leaving the SAC, the risk of in-combination TTS and behavioural effects on Atlantic salmon individuals associated with the SAC is considered to be low. Moreover, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (refer to Volume 2, Chapter 6: Project Description). As such, construction of Dublin Array is anticipated to commence in 2029 after piling at NISA and the Oriel Wind Farm has mostly been completed. Piling itself is anticipated to be intermittent, and any TTS and 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.

6.3.2.10 Based on the above considerations, it is concluded that underwater noise generated during piling at Dublin Array in-combination with piling at the other East Coast Phase 1 project sites will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

Underwater Noise from UXO Clearance

6.3.2.11 Mortality in fish as a result of high order UXO clearance at Dublin Array is expected to occur up to 810 m from the detonation site, with similar impact ranges anticipated for high order UXO clearance operations at other East Coast Phase 1 projects. Recoverable injuries, TTS and behavioural changes may occur over larger distances, with the relative risk of these effects occurring considered to be low at far distances (1000s of metres) from the detonation site (Popper *et al*., 2014).

6.3.2.12 TTS and behavioural changes are likely to be temporary and reversible and, owing to the discrete, infrequent and brief nature of UXO detonations, are not expected to cause widespread and prolonged displacement of Atlantic salmon from marine habitats and migration routes. Moreover, Atlantic salmon associated with the River Boyne and River Blackwater SAC are likely to move northward after leaving the SAC (Barry *et al*., 2020) and as such are unlikely to be affected by UXO clearance operations at Dublin Array.

6.3.2.13 The risk of effects in-combination with UXO clearance operations at other East Coast Phase 1 projects is also considered low as offshore operations at Dublin Array are expected to commence after seabed preparation works at the other windfarm sites would mostly be completed. Moreover, UXO clearance operations at each OWF site will likely follow a UXO mitigation hierarchy similar to that adopted for Dublin Array, with high order UXO detonation only used when other clearance options (e.g., avoidance, removal and low order deflagration) are not possible.

6.3.2.14 Therefore, when factoring in the lack of potential adverse effects from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that in-combination effects on Atlantic salmon arising from high order UXO clearance at Dublin Array and other East Coast Phase 1 project sites will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC. The same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated and the associated smaller scale of effects.

Underwater Noise from Other Noise Sources

6.3.2.15 As discussed previously, non-impulsive sounds such as those emitted during dredging, cable installation, the drilling of foundations, geophysical surveys and vessel operations do not represent a risk of mortality and potential mortal injury to migratory fish. However, there is potential for recoverable injuries and changes in hearing (i.e., TTS), particularly in species with enhanced sensitivities to sound pressure, 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 and high order UXO clearance, both alone and in-combination with other plans and projects.

6.3.2.16 It is anticipated that, following standard practices, vessel moving to and from the offshore sites of the identified projects use, for the majority, existing vessel routes for pre-existing vessel traffic, which migratory fish will be accustomed to. Therefore, it is considered that potential in-combination effects may predominantly result at offshore construction sites.

6.3.2.17 Assuming similar construction and maintenance activities at the East Coast Phase 1 sites, any potential recoverable injuries and TTS as a result of non-impulse sounds are anticipated to be highly localised (i.e., within 10s of metres), and therefore the potential for in-combination effects to Atlantic salmon are considered to be low. The remaining Tier 1 and Tier 3 projects screened into the in-combination assessment for underwater noise will generate non-impulse sounds similar to those generated during the construction of the proposed development (e.g., dredging and vessel noise, noise generated during geophysical surveys), and any potential recoverable injuries and/or TTS will be restricted to individuals close to the noise source. Similarly, the risk of in-combination behavioural reactions from overlapping noise contours or as a result of sequential disturbances is considered to be low, given the reversibility of the effects and the intermittent and temporary nature of the activities. In addition, as discussed previously, Atlantic salmon associated with the River Boyne and River Blackwater SAC are likely to migrate in a northward direction when leaving the SAC away from the Dublin Array (Barry *et al.*, 2020), which reduces the likelihood of in-combination underwater noise effects.

6.3.2.18 Based on the above considerations, it is concluded that in-combination effects on Atlantic salmon arising from non-impulsive sounds at Dublin Array and the identified Tier 1 and Tier 3 project sites will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

In-combination effects from EMF

6.3.2.19 As presented in Section 5.3 any potential behavioural responses in Atlantic salmon as a result of EMF at Dublin Array are expected to be highly localised, based on the rapid attenuation of EMF within the marine environment. Based on similar technology and project designs, the extent of EMF emissions from the identified Tier 1 and Tier 3 projects are also expected to be highly localised and restricted to discrete areas within the immediate proximity of the cable lines. Atlantic salmon are not expected to be present in close proximity to subsea cables for extended periods of time given their migratory nature, and any localised behavioural changes are considered small compared to the overall extent of available marine habitat and migration routes. 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, which were mainly recorded near the surface (Plantalech Manel-La *et al.*, 2009). These studies suggest that Atlantic salmon have limited contact with the seabed and areas potentially affected by EMF. Moreover, Atlantic salmon associated with the River Boyne and River Blackwater SAC are likely to move northward after leaving the SAC (Barry *et al.*, 2020) and as such they are unlikely to be affected by EMF at Dublin Array, Codling Wind Park and the proposed Mares Connect power cables.

6.3.2.20 Based on the above considerations, it is concluded that effects arising from EMF at Dublin Array in-combination with effects from EMF emitted by other subsea cables within the in-combination assessment area will not result in an AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC.

In-combination Effects from Increases in SSC and Sediment Deposition

6.3.2.21 Dredging and sediment disposal, seabed preparation works, and foundation and cable installation activities associated with the identified projects will cause temporary increases in SSC and associated sediment deposition, which if temporarily overlapping with works at Dublin Array may give rise to additive effects on migrating Atlantic salmon.

6.3.2.22 Particular regard has been given to the possibility of cumulative effects from works associated with the Dublin Port Company MP2 and 3FM Projects, the Codling Wind Park and Dublin Array because of the close proximity between the projects. Plume modelling undertaken on behalf of the Dublin Port Company showed that maxima of suspended sediments and sediment deposition resulting from dredging activities within Dublin Harbour remain local to the works, with background levels occurring beyond the immediate area of operations (RPS, 2020, 2021). Plumes associated with the disposal of material in the greater Dublin Bay area have been shown to settle rapidly and within 750 m from the location of disposal (Dublin Port Company, 2024). Activities will be intermittent and any increased SSC levels will dissipate quickly following the cessation of activities, thereby reducing the likelihood for additive effects on fish receptors.

6.3.2.23 Construction of Codling Wind Park is anticipated to commence in 2027, with offshore construction anticipated to last between two to three years. This suggests that construction activities at Codling would mostly be completed before works at Dublin Array commence. Further, it is not considered feasible for Dublin Array and Codling Wind Park to install cables or make landfall at the same time. Should the programmes of the two projects change such that they are scheduled for the same period, the greatest likelihood is for the two project's installation periods to be sequenced to allow for the availability of installation equipment. As increased SSC are predicted to rapidly dissipate immediately following the cessation of activities, it is not expected for there to be any measurable plume coalescence.

6.3.2.24 Similarly, the potential for sediment plumes generated at Dublin Array to interact with those at NISA is considered to be low given the distance between the projects (NISA is located > 21 km to the north of the array area), with SSC across overlapping plumes likely to be close to natural background levels. In-combination effects may also arise from the installation of the Mares Connect power cables and the planned and unplanned maintenance of operational cables. It is not known what volumes of sediment would be disturbed and/or released by these projects at any one time; however, it is anticipated that any sediment plumes will disperse in a similar pattern as plumes generated at Dublin Array owing to similar environmental setting and sediment characteristics. As such, 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.

6.3.2.25 Atlantic salmon are highly mobile and would be expected to avoid unfavourable sediment plumes. This may impede migration in the short-term; however, due to the temporary nature of the predicted changes in SSC, individuals are expected to continue their migration following cessations of activities. Site-specific modelling indicate that SSC may rise above natural background concentrations at distances up to 10 km from the point of release (Physical Processes Modelling Report). Therefore, it is considered unlikely that increases in SSC at Dublin Array will present a barrier for migrating Atlantic salmon associated with the River Boyne and River Blackwater SAC. Moreover, as outlined previously, Atlantic salmon native to the River Boyne and River Blackwater SAC are likely to move northward when leaving the SAC and as such are unlikely to be affected by plumes originating at Dublin Array alone and in-combination with the identified Tier 1 and Tier 3 projects. Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC for this impact from any of the projects considered in-combination.

In-combination Effects from Accidental Pollution

6.3.2.26 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 maintenance and decommissioning activities. In addition, there is the risk of accidental spillage from construction equipment or collision incidents, potentially resulting in the release of pollutants such as fuel, oil and lubricants.

6.3.2.27 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP). Adoption of these measures will minimise the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on migratory fish.

6.3.2.28 Site-specific contaminants sampling undertaken in support of the EIA and reported in the MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations. Sediment concentrations were below lower Irish Action Levels, with the exception of arsenic levels at one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

6.3.2.29 Sediment-bound contaminants are likely to be rapidly diluted by tidal currents, and therefore increased bioavailability that could result in adverse eco-toxicological effects to migratory fish and their prey are not expected from the project alone. Likewise, given the intermittent and temporary nature of sediment-disturbing activities associated with the Tier 1 and Tier 3 projects together with the fate of the sediment plumes, in-combination effects are not anticipated.

6.3.2.30 Therefore, based on the considerations above, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC and feature for this impact from any of the projects considered in-combination.

In-combination Effects from Invasive Species

6.3.2.31 There is the potential for the introduction and spread of invasive species by vessel movements and the introduction of hard substrates onto the seafloor, which may affect Atlantic salmon directly through the spread of disease or indirectly by changing food web dynamics.

6.3.2.32 Potential risks of the introduction or spread of IAS will be minimised by the adoption of biosecurity measures detailed in the Marine Biosecurity Plan. Adoption of these measures will minimise the likelihood of potentially harmful IAS to be released into the marine environment, thereby reducing the likelihood of effects on Atlantic salmon. Moreover, it is anticipated that the identified Tier 1 and Tier 3 projects will have similar mitigation measures in place through relevant environment management plans.

6.3.2.33 Therefore, based on the above considerations, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC for this impact from any of the projects considered in-combination.

In-combination Effects from Effects on Prey

6.3.2.34 Sediment plumes generated by the identified Tier 1 and Tier 3 projects 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. Any potential disturbance effects on sensitive fish are expected to be localised, temporary and intermittent as sediment plumes are expected to quickly dissipate following cessation of activities. Any in-combination disturbances to the seabed due to sequential and/or simultaneous activities would be intermittent and reversible, and the long-term loss of habitats of substrate-dependent prey species (i.e., sandeel) is expected to be restricted to discrete areas at the project sites.

6.3.2.35 Underwater noise associated with piling or UXO clearance at the East Coast Phase 1 projects may result in localised mortality of fish, but this is not predicted to result in wider scale effects and changes at the population level. Disturbance associated with underwater noise may result in the temporary re-distribution of individuals between the affected areas; however, any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling and UXO clearance have 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, it is considered that activities at Dublin Array in-combination with the identified Tier 1 and Tier 3 projects will not result in significant adverse effects to fish including key prey species of Atlantic salmon. Moreover, as outlined previously, the risk of Atlantic salmon native to the River Boyne and River Blackwater SAC to be affected by operations at Dublin Array is considered to be low, based on distance of the SAC from the array area and the likely northward migration of Atlantic salmon away from Dublin Array when leaving the Boyne estuary.

6.3.2.36 Therefore, based on the above considerations, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon QI of the River Boyne and River Blackwater SAC for this impact from any of the projects considered in-combination.

6.3.3 Slaney River Valley SAC

6.3.3.1 The screening and assessment for effects on the migratory fish features of Slaney River Valley SAC concluded that exposure of individuals of the SAC population to impacts arising during construction, operation and maintenance and decommissioning of Dublin Array is possible; however, the likelihood of exposure is expected to be low and pathways are limited to passing migratory fish undertaking large migrations. Based on the alone assessments for Dublin Array the consideration of plans and projects identified within Table 166, this SAC has been screened in for the following potential effects:

- In-combination effects from underwater noise and vibration;
- In-combination effects from EMF;
- In-combination effects from increases in SSC and associated sediment deposition;
- In-combination effects from accidental pollution; and
- In-combination effects from the introduction and spread of invasive species.

6.3.3.2 Due to the nature of the in-combination assessment and the interaction between various projects, some effects are considered in-combination that have not been considered in the alone assessment (i.e., in-combination effects from increases in SSC and associated sediment deposition). This is because while the effects associated with Dublin Array alone are not enough to generate a potential for LSE, due to the proximity and interactions with the other plans and projects, there is a potential for additive effects that may result in significant adverse effects on the qualifying migratory fish interests.

6.3.3.3 Due to their proximity to Dublin Array for various effects (within 100 km for noise effects as stated within the SISAA), all East Coast Irish Phase 1 projects are included in the in-combination assessment. Other projects that may contribute to in-combination effects through simultaneous or sequential activities prior to or during the construction phase of Dublin Array include dredging and associated sediment disposal at Dublin ports, the construction of the Mares Connect power cable, and activities associated with the maintenance of existing cables. In addition, existing and proposed power and telecommunications cables within cumulative assessment area are considered for their potential to give rise to in-combination effects from EMF emitted from cables installed at the proposed development.

In-combination effects from Underwater Noise and Vibration

6.3.3.4 While the conclusion for Dublin Array alone identified no potential for adverse effects from underwater noise, due to proximity with other projects there is still a potential for effects to occur in-combination. As for the project alone, potential in-combination underwater noise effects on migratory fish include mortality and potential mortal injury, recoverable injury, TTS, and behavioural changes. Activities that may cause these changes include geophysical surveys, the detonation of UXO and construction and maintenance activities associated with the identified projects such as piling of foundations, dredging, rock placement, cable installation and vessel noise.

6.3.3.5 The greatest risk of in-combination effects of underwater noise on migratory fish species has been identified as being that produced by impact piling during the construction phase of other East Coast Phase 1 OWF projects within 100 km of Dublin Array. As such, likely significant in-combination effects related to impact piling have been the primary focus of the assessment.

Underwater Noise from Piling

6.3.3.6 Each of the five East Coast Phase 1 OWF projects included in the assessment (Table 166) provided indicative piling schedules, which suggest that piling would take place within a period of five years between 2027 and 2031 inclusive. Piling operations at each windfarm site will be intermittent, with each individual piling event likely to be similar in duration to piling events at Dublin Array. The piling schedules further suggest that piling at Codling Wind Park, Oriel, NISA and Arklow Bank Phase 2 would be completed before the piling of foundations at Dublin Array commences. For the purposes of this assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period, with piling at Codling and Oriel expected to take place in 2027 and piling at NISA and Arklow Bank Phase 2 currently scheduled for 2002. However, in-combination effects may also result from the long-term exposure to sounds due to sequential piling operations over prolonged periods of time.

Atlantic salmon

6.3.3.7 The potential effects of underwater noise from piling on Atlantic salmon during the construction of Dublin Array alone are discussed in Paragraph 5.3.3.43 *et seq*. Lethal and recoverable injuries in fleeing fish receptors as a result of piling noise at Dublin Array are predicted to occur less than 100 m from the noise source for both the piling of monopiles and jacket foundations (Underwater noise assessment). Comparable impact ranges have been predicted for the other East Coast Phase 1 projects. For example, underwater noise modelling for NISA and Codling predicted mortal and recoverable injuries in fleeing receptors within < 100 m from the piling locations (Codling Wind Park, 2024; NISA, 2024), while for Arklow Phase Bank 2, mortal and recoverable injuries were predicted to occur up to 130 m away from the noise source (SSE Renewables, 2024). Based on these predictions and given the distance between the projects (Table 166), the areas over which mortality, potential mortal injury and recoverable injury in Atlantic salmon might occur are not expected to overlap between projects.

6.3.3.8 In addition, the potential for mortal and recoverable injuries to occur in fleeing fish during piling is likely to be reduced with the implementation of soft-start and ramp-up procedures, which would allow mobile species, like Atlantic salmon, to move away from the piling location before injurious effects can occur. Therefore, while the piling at multiple East Coast Phase 1 sites has the potential to result in additive mortality and/or recoverable injury in Atlantic salmon over time, the mobility of the receptor together with the implementation of best practice mitigation measures (e.g. soft-start procedures) will minimise the risk of these effects occurring.

6.3.3.9 TTS in Atlantic salmon from piling at Dublin Array is predicted to occur up to 8.5 km from the array area during the installation of monopile foundations and up to 9.3 km from the array area during the piling of jacket foundations (Underwater noise assessment), 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). Based on the noise propagation ranges predicted for the identified East Coast Phase 1 projects, noise emitted during piling at Codling Wind Park (located approximately 2.5 km to the south-east of the Dublin Array area), NISA (located approximately 22 km to the north of Dublin Array), and Arklow Bank Phase 2 (located approximately 26 km to the south of Dublin Array) may be sufficient to result in TTS and/or behavioural reactions to Atlantic salmon in-combination with effects arising at Dublin Array, which may result in the temporary re-distribution of individuals between the affected areas. However, the piling of foundations for the Codling Wind Park is anticipated to take place in 2027, while piling at NISA and Arklow Bank Phase 2 is scheduled to take place in 2028, suggesting that piling for these projects would be completed before the installation of foundations at Dublin Array. For the purposes of this assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (Volume 2, Chapter 6: Project Description). 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. Moreover, as discussed previously, tracking data indicate that Atlantic salmon smolts within the south-east coast of Ireland (where the river Slaney is located) head in a south-westerly direction upon leaving the estuaries (Rikardsen *et al.*, 2021), moving further away from Dublin Array, inherently decreasing the potential for effects that noise generated at Dublin Array, and the other East Coast Phase 1 projects, may have on their migration.

6.3.3.10 Based on the above considerations, it is concluded that underwater noise generated during piling at Dublin Array in-combination with piling at the other East Coast Phase 1 sites will not result in an AEoI to the Atlantic salmon QI of the Slaney River Valley SAC.

Sea lamprey

6.3.3.11 The potential effects of underwater noise from piling on sea lamprey during the construction of the proposed development alone are assessed in paragraph 5.3.3.10 *et seq*. Mortality and potential mortal injury and recoverable injury from piling noise at the proposed development and the other East Coast Phase 1 projects are likely to occur within a few hundred metres of piling activity. However, the risk of mortal and recoverable physical injuries in sea lamprey during piling is assessed as low, based on the receptor's lack of gas filled chambers (e.g., swim bladder) and the associated low susceptibility to pressure-related injuries. Moreover, as a mobile species, sea lamprey are considered able to move away from piling operations during soft-start procedures before sound energies reach a level that may cause injuries or death.

6.3.3.12 TTS in sea lamprey from piling at Dublin Array is predicted to occur up to 8.5 km from the array area during the installation of monopile foundations and up to 9.3 km from the array area during the piling of jacket foundations (Underwater noise assessment), 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). As outlined previously, owing to the distance between the East Coast Phase 1 projects and the impact ranges for TTS and behavioural changes in migratory fish, there is potential for temporary re-distribution of individuals between areas affected by piling noise. However, the risk of simultaneous changes in the distribution of sea lamprey during piling at Dublin Array in-combination with piling activities at Codling Wind Park, NISA, Oriel and/or Arklow Bank Phase 2 is considered to be low as piling at Dublin Array will commence after piling at the other East Coast Phase 1 projects has been completed. 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.

6.3.3.13 Moreover, as previously discussed, sea lamprey are not thought to specifically migrate back to their natal rivers (Waldman *et al.*, 2008); instead, they are thought to return to rivers within the regional area, navigating primarily by detection of larval pheromones within shallow coastal waters to identify suitable rivers (Hansen *et al.*, 2016). This flexibility in migration behaviour, combined with the impact ranges predicted by the modelling and the distance of the East Coast Phase 1 projects to the SAC suggests that underwater noise from piling will not result in a barrier effect to any upstream or outgoing migration preventing sea lamprey from accessing or leaving the SAC. In addition, as identified above, the risk for lethal effects to sea lamprey from piling is low, and any potential TTS and behavioural changes would be temporary and reversible.

6.3.3.14 Based on the above considerations, it is concluded that underwater noise generated during piling at Dublin Array in-combination with piling at the other East Coast Phase 1 project sites will not result in an AEoI to the sea lamprey QI of the Slaney River Valley SAC.

Twaite shad

6.3.3.15 The potential effects of underwater noise from piling on twaite shad during the construction of the proposed development alone are assessed in paragraph 5.3.3.32 *et seq.* Mortality and potential mortal injury and recoverable injury in mobile migratory fish as a result of piling noise at Dublin Array are predicted to occur less than 100 m from the noise source for both the piling of monopiles and jacket foundations. As discussed previously, the areas over which mortality, potential mortal injury and recoverable injury in fleeing receptors might occur are not expected to overlap given 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 mobile receptors, such as twaite shad, to leave the area before injurious effects can occur. Therefore, while the piling at multiple East Coast Phase 1 projects has the potential to result in additive mortality and recoverable injury over time, 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.

6.3.3.16 TTS in twaite shad from piling at Dublin Array is predicted to occur up to 8.5 km from the array area during the installation of monopile foundations and up to 9.3 km from the array area during the piling of jacket foundations (Underwater noise assessment), with the relative risk of behavioural responses at these distances is assessed as being moderate. A high risk of behavioural responses exists at intermediate (100s of metres) and near (10s of metres) distances from the piling location. Based on the noise propagation ranges predicted for the identified East Coast Phase 1 projects, noise emitted during piling at the Codling Wind Park (located about 2.5 km to the south of Dublin Array), the NISA (located approximately 22 km to the north of Dublin Array), and Arklow Bank Phase 2 (located approximately 26 km to the south of Dublin Array) may be sufficient to result in TTS and/or behavioural reactions in twaite shad in-combination with effects arising at Dublin Array, which may result in some temporary re-distribution of individuals between the affected areas. However, the indicative piling schedules for the East Coast Phase 1 projects suggest that piling at Dublin Array will commence after the installation piling at the other East Coast Phase 1 sites has been completed. Piling itself will be intermittent, and any TTS or behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours and re-colonise areas during piling free days and shortly after piling has been completed. Moreover, given the distance between the East Coast Phase 1 projects to the Slaney estuary, underwater noise from piling will not result in a barrier effect that would twaite shad prevent from accessing or leaving the SAC to breed.

6.3.3.17 Based on the above considerations, it is concluded that underwater noise generated during piling at Dublin Array in-combination with piling at the other East Coast Phase 1 project sites will not result in an AEoI to the twaite shad QI of the Slaney River Valley SAC.

Freshwater pearl mussel

6.3.3.18 Freshwater pearl mussels have been included in the assessment for this SAC as within the first year of their life cycle, they live on the gills of either young Atlantic salmon or Brown trout (Moorkens, 1999). The viability of the pearl mussel population is inherently linked to the viability of the salmon population in the SAC, and as such it is considered that the maximum potential effect from the proposed development on freshwater pearl mussel will be the same as that considered for Atlantic salmon, and the conclusions made to the salmon population will mirror those for freshwater pearl mussel.

6.3.3.19 As assessed in the previous sections, direct in-combination effects arising from piling noise are not predicted for Atlantic salmon when present within the Slaney River Valley SAC, while any in-combination effects on Atlantic salmon arising from piling at sea will not result in an AEoI to the Atlantic salmon QI of the SAC. Therefore, it is concluded that there will be no AEoI to the freshwater pearl mussels QI of the Slaney River Valley SAC.

Underwater Noise from UXO Clearance

6.3.3.20 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 at Dublin Array, mortality to migratory fish during high order detonation of UXO is expected to occur up to 810 m from the detonation site, with similar impact ranges anticipated for high order clearance operations at the other East Coast Phase 1 projects. The relative risk of recoverable injury in sea lamprey 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, while for Atlantic salmon and twaite shad, the relative risk of recoverable injury 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 (Popper *et al.*, 2014). TTS and disturbance reactions in Atlantic salmon and twaite shad will occur over larger areas, potentially reaching 10s of kilometres from the UXO location.

6.3.3.21 UXO clearance operations at the East Coast Phase 1 projects will likely follow a UXO mitigation hierarchy similar to that adopted for Dublin Array, 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 the qualifying migratory fish interests from specific migration routes and marine habitats. The risk of effects at Dublin Array in-combination with effects arising at other East Coast Phase 1 sites is considered low, given the brief duration of UXO clearance events, and considering that offshore operations at Dublin Array are expected to commence after seabed preparation works at the other windfarm sites would mostly be completed.

6.3.3.22 Moreover, Atlantic salmon associated with the Slaney River Valley SAC are likely to migrate in a south-westerly direction (Rikardsen *et al.*, 2021) after leaving the Slaney estuary and as such are unlikely to be affected by UXO clearance operations at Dublin Array.

6.3.3.23 Therefore, when factoring in the lack of potential adverse effects on Atlantic salmon from Dublin Array alone and the above considerations for the remaining receptors and the various projects in-combination, it is concluded that in-combination effects on migratory fish arising from high order UXO clearance at Dublin Array and other East Coast Phase 1 project sites will not result in an AEoI to the Atlantic salmon, sea lamprey and twaite shad QIs of the Slaney River Valley SAC. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is also concluded that there will be no AEoI to the freshwater pearl mussel QI of the SAC. The same conclusion of no AEoI will apply to low order deflagration of UXO given the lower sound levels generated and the associated smaller scale of effects.

Underwater noise from other noise sources

6.3.3.24 As discussed previously, non-impulsive sounds such as those emitted during dredging, cable installation, the drilling of foundations, geophysical surveys and vessel operations do not represent a risk of mortality and potential mortal injury to migratory fish. However, there is potential for recoverable injuries and changes in hearing (i.e., TTS), particularly in species with enhanced sensitivities to sound pressure, 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 and high order UXO clearance, both alone and in-combination with other plans and projects.

6.3.3.25 It is anticipated that, following standard practices, vessel moving to and from the offshore sites of the identified projects use, for the majority, existing vessel routes for pre-existing vessel traffic, which migratory fish will be accustomed to. Therefore, it is considered that potential in-combination effects may predominantly result at offshore construction sites.

6.3.3.26 Assuming similar construction and maintenance activities at the East Coast Phase 1 sites, any potential recoverable injuries and TTS as a result of non-impulse sounds are anticipated to be highly localised (i.e., within 10s of metres, see paragraph 5.3.2.18 *et seq.*), and therefore the potential for in-combination effects to Atlantic salmon are considered to be low. The remaining Tier 1 and Tier 3 projects screened into the in-combination assessment for underwater noise (Table 166) will generate non-impulsive sounds similar to those generated during the construction of Dublin Array (e.g., dredging and vessel noise, noise generated during geophysical surveys), and any potential recoverable injuries and/or TTS will also be restricted to individuals close to the noise source. Similarly, the risk of in-combination behavioural reactions from overlapping noise contours or as a result of sequential disturbances is considered to be low, given the reversibility of the effects and the intermittent and temporary nature of the activities. In addition, as discussed previously, Atlantic salmon associated with the Slaney River Valley SAC are likely to migrate in a south-westerly direction after leaving the Slaney estuary and as such are unlikely to be affected by activities at Dublin Array and the Tier 1 and Tier 3 projects.

6.3.3.27 Based on the above considerations, it is concluded that in-combination effects on migratory fish arising from non-impulsive sounds at Dublin Array and the identified Tier 1 and Tier 3 project sites will not result in an AEoI to the Atlantic salmon, sea lamprey and twaite shad QI of the Slaney River Valley SAC. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is concluded that there also will be no AEoI to the freshwater pearl mussel QI of the SAC.

In-combination Effects from EMF

6.3.3.28 As discussed previously, any potential behavioural responses in the migratory fish QIs as a result of 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 identified Tier 1 and Tier 3 projects are also expected to be highly localised and restricted to discrete areas within the immediate proximity of the cable lines. Atlantic salmon, sea lamprey and twaite shad are not expected to be present in close proximity to subsea cables for extended periods of time given their migratory nature, any localised behavioural changes are considered small compared to the overall extent of available marine habitat and migration routes. Moreover, Atlantic salmon associated with the Slaney River Valley SAC are likely to move in a south-westward direction after leaving the SAC (Rikardsen *et al.*, 2021) and as such they are unlikely to be affected by EMF at Dublin Array and the identified Tier 1 and Tier 3 projects.

6.3.3.29 Based on the above considerations, it is concluded that effects arising from EMF at Dublin Array in-combination with effects from EMF emitted by other subsea cables within the in-combination assessment area will not result in an AEoI to the qualifying Atlantic salmon, sea lamprey and twaite shad QIs of the Slaney River Valley SAC. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is concluded that there also will be no AEoI to the freshwater pearl mussel QI of the SAC.

In-combination Effects from Increases in SSC and Associated Sediment Deposition

6.3.3.30 Dredging and disposal, seabed preparation works, and foundation and cable installation activities associated with the identified Tier 1 and Tier 3 projects will cause temporary increases in SSC and associated sediment deposition, which if temporarily overlapping with works at Dublin Array may give rise to additive effects on migratory fish.

6.3.3.31 Particular regard has been given to the possibility of cumulative effects from works associated with the Dublin Port Company MP2 and 3FM Projects, the Codling Wind Park and Dublin Array because of the close proximity between the projects. Plume modelling undertaken on behalf of the Dublin Port Company showed that maxima of suspended sediments and sediment deposition resulting from construction and dredging activities within Dublin Harbour remain local to the works, with background levels occurring beyond the immediate area of operations (RPS, 2020, 2021). Plumes associated with the disposal of material in the greater Dublin Bay area have been shown to settle rapidly and within 750 m from the location of disposal (Dublin Port Company, 2024). Activities will be intermittent and any increased SSC levels will dissipate quickly following the cessation of activities, thereby reducing the likelihood for additive effects on fish receptors.

6.3.3.32 Construction of Codling Wind Park is anticipated to commence in 2027, with offshore construction anticipated to last between two to three years. This suggests that construction activities at Codling would mostly be completed before works at Dublin Array commence. Further, it is not considered feasible for Dublin Array and Codling Wind Park to install cables or make landfall at the same time. Should the programmes of the two projects change such that they are scheduled for the same period, the greatest likelihood is for the two project's installation periods to be sequenced to allow for the availability of installation equipment. As increased SSC are predicted to rapidly dissipate immediately following the cessation of activities, it is not expected for there to be any measurable plume coalescence.

6.3.3.33 Similarly, the potential for sediment plumes generated at Dublin Array to interact with those at NISA and Arklow Bank Phase 2 is considered to be low given the distance between the projects, with SSC across overlapping plumes likely to be close to natural background levels. In-combination effects may also arise from the installation of the Mares Connect power cables and the planned and unplanned maintenance of operational cables. It is not known what volumes of sediment would be disturbed and/or released by these projects at any one time; however, it is anticipated that any sediment plumes will disperse in a similar pattern as plumes generated at Dublin Array owing to similar environmental setting and sediment characteristics. As such, 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.

6.3.3.34 Atlantic salmon, sea lamprey and twaite shad are highly mobile and would be able to avoid unfavourable sediment plumes. Any changes in the distribution of the species are anticipated to be highly localised and temporary given the fate of the plumes and the temporary and intermittent nature of activities. Site-specific modelling indicated that SSC may rise above natural background concentrations at distances up to 10 km from the point of release (Physical Processes Modelling Report). Therefore, it is considered unlikely that increases in SSC at Dublin Array will present a barrier that would prevent Atlantic salmon, sea lamprey and twaite shad from leaving or entering the Slaney River Valley SAC. Moreover, as outlined previously, Atlantic salmon native to the SAC are likely to migrate in a south-westward direction when leaving the SAC and as such are unlikely to be affected by plumes originating at Dublin Array alone and in-combination with the identified Tier 1 and Tier 3 projects.

6.3.3.35 Therefore, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon, sea lamprey and twaite shad QIs of the Slaney River Valley SAC for this impact from any of the projects considered in-combination. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is also concluded that there will be no AEoI to the freshwater pearl mussel QI of the SAC.

In-combination Effects from Accidental Pollution

6.3.3.36 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 maintenance and decommissioning activities. In addition, there is the risk of accidental spillage from construction equipment or collision incidents, potentially resulting in the release of pollutants such as fuel, oil and lubricants.

6.3.3.37 The Applicant will implement avoidance and preventative measures outlined within the Marine Pollution Contingency Plan (contained within the PEMP), in line with the Sea Pollution Act 1991 and MARPOL convention. The Marine Pollution Contingency Plan will cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG)) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020). Measures include storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.

6.3.3.38 Adoption of these measures will minimise the likelihood of potentially harmful pollutants to be released into the marine environment, thereby reducing the likelihood of pollution impacts on migratory fish. Moreover, it is anticipated that the identified Tier 1 and Tier 3other projects considered on this list will have similar mitigation measures in place through relevant environment management and emergency response plans.

6.3.3.39 Site-specific contaminants sampling undertaken in support of the EIA and reported in the MW&SQ Chapter of the EIAR provided confirmation that the levels of sediment bound contaminants are low in the array area and within the majority of the Offshore ECC when compared to background concentrations. Sediment concentrations were below lower Irish Action Levels, with the exception of arsenic levels at one subtidal and all intertidal sediment samples where concentrations were between the lower and upper Irish Action Level (i.e. concentrations which are considered to represent marginal contamination). However, as these concentrations were only marginally above the lower Action Level, they are not considered to constitute an environmental risk.

6.3.3.40 Sediment-bound contaminants are likely to be rapidly diluted by tidal currents, and therefore increased bioavailability that could result in adverse eco-toxicological effects to migratory fish and their prey are not expected from the project alone. Likewise, given the intermittent and temporary nature of sediment-disturbing activities associated with the Tier 1 and Tier 3 projects together with the fate of the sediment plumes, in-combination effects are not anticipated.

6.3.3.41 Therefore, based on the above considerations, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the Atlantic salmon, sea lamprey and twaite shad QIs of the Slaney River Valley SAC for this impact from any of the projects considered in-combination. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is also concluded that there will be no AEoI to the freshwater pearl mussel QI of the SAC.

In-combination Effects from Invasive Species

6.3.3.42 As outlined in paragraph 5.3.2.32, there is the potential for the introduction and spread of invasive species by vessel movements and the introduction of hard substrates onto the seafloor, which may affect migratory fish directly through the spread of disease or indirectly by changing food web dynamics.

6.3.3.43 Potential risks of the introduction or spread of IAS will be minimised by the adoption of biosecurity measures detailed in the Marine Biosecurity Plan. During the lifetime of the project the Applicant and its contractors will comply with all measures to include all vessels of 400 gross tonnage (gt) and above to be in possession of a current international Anti-fouling System (AFS) certificate; details of all ship hull inspections and biofouling management measures to be documented by the Contractor; and all vessels to be compliant (where applicable) with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention, developed and adopted by the International Maritime Organisation (IMO).

6.3.3.44 Adoption of these measures will minimise the likelihood of potentially harmful IAS to be released into the marine environment, thereby reducing the likelihood of effects on migratory fish. Moreover, it is anticipated that the identified Tier 1 and Tier 3 projects will have similar mitigation measures in place through relevant environment management plans.

6.3.3.45 Therefore, based on the above considerations, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the sea lamprey, twaite shad and Atlantic salmon QIs of the Slaney River Valley SAC for this impact from any of the projects considered in-combination. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is also concluded that there will be no AEoI to the freshwater pearl mussel QI of the SAC.

In-combination Effects from Effects on Prey

6.3.3.46 As outlined in paragraph 5.3.3.69, migratory fish may be affected indirectly through effects on prey species. Sediment plumes generated by the identified Tier 1 and Tier 3 projects 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. Any potential disturbance effects on sensitive fish are expected to be localised, temporary and intermittent as sediment plumes are expected to quickly dissipate following cessation of activities. Any in-combination disturbances to the seabed due to sequential and/or simultaneous activities would be intermittent and reversible, and the long-term loss of habitats of substrate-dependent prey species (i.e., sandeel) is expected to be restricted to discrete areas at the project sites. Underwater noise associated with piling or UXO clearance at the East Coast Phase 1 projects may result in localised mortality of fish, but this is not predicted to result in wider scale effects and changes at the population level. Disturbance associated with underwater noise may result in the temporary re-distribution of individuals between the affected areas; however, any behavioural responses would be temporary, with affected individuals anticipated to resume normal behaviours or recolonise areas shortly after piling and UXO clearance have 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, it is considered that activities at Dublin Array in-combination with the identified Tier 1 and Tier 3 projects will not result in significant adverse effects to fish including key prey species of Atlantic salmon. Moreover, as outlined previously, the risk of Atlantic salmon native to the Slaney River Valley SAC to be affected by operations at Dublin Array is considered to be low, based on distance of the SAC from the array area and the likely south-westward migration of Atlantic salmon away from Dublin Array when leaving the Slaney estuary.

6.3.3.47 Therefore, based on the above considerations, when factoring in the lack of potential adverse effect from Dublin Array alone and the above considerations for the various projects in-combination, it is concluded that there is no potential for AEoI to the sea lamprey, twaite shad and Atlantic salmon QIs of the Slaney River Valley SAC for this impact from any of the projects considered in-combination. As there will be no AEoI to the Atlantic salmon QI of the Slaney River Valley SAC, it is also concluded that there will be no AEoI to the freshwater pearl mussel QI of the SAC.

6.4 Marine mammals

6.4.1.1 The potential for an in-combination effect upon the designated sites grouped under 'marine mammals', as relevant to features and effect pathways screened in for LSE (as summarised in Table 167) is provided below.

Table 167 Plans and Projects screened in for consideration within the marine mammals in-combination assessment

Project	Project Detail	Tier	Distance to array (km)	Distance to ECC (km)	Impacts considered	In-combination conclusion
Dublin Port Maintenance Dredging	Coastal Assets Construction 2024-2029	1	6.0	2.8	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Dublin Port Company MP2 Project	Coastal Construction 2022-2023	1	6.4	10.5	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
West Anglesey Demonstration Zone	Tidal Construction 2024	1	74.7	78.1	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
River Boyne, Drogheda Maintenance Dredging	Coastal Construction 2024-2029	1	81.6	87.4	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Dún Laoghaire Harbour Company	Coastal Assets Construction 2024-2034	2	12.2	0.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment
Greater Dublin Drainage Outfall	Coastal Assets Construction 2024-2026	2	16.7	9.4	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment
South of South Quay Arklow – ABWP2-OMF	Coastal Construction 2029-2032	2	42.2	46.8	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Holyhead Deep	Tidal Construction 2026-2029	2	72.2	75.6	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in-combination assessment.
Awel y Môr	OWF Construction 2026-2030	2	136.6	140.3	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of Dublin Array. Therefore, all identified impacts are considered in-combination assessment.
Erebus	OWF Construction 2026-2027	2	170.4	178.1	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment

Project	Project Detail	Tier	Distance to array (km)	Distance to ECC (km)	Impacts considered	In-combination conclusion
Erebus Floating Wind Demo	OWF Construction 2026-2027	2	185.2	192.5	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Cardiff Bay Tidal Lagoon	Tidal Construction 2024-2026	2	271.6	278.2	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Mares Connect	Cable Construction 2024-2027	3	0.0	0.0	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Codling Wind Park	OWF Construction 2027-2028	3	2.5	9.6	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Bremore Port Project	Costal Assets Construction 2028-2030	3	6.2	3.0	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment
Dublin Port Company 3FM Project Capital Dredging	Coastal Asset Planned Programme 2026-2040	3	17.6	13.2	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
North Sea Irish Sea Array (NISA)	OWF Construction 2025-2028	3	21.6	28.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Arklow Bank	OWF Construction 2025-2029	3	25.8	32.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Oriel	OWF Construction 2025-2026	3	64.7	70.8	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Rosslare	Coastal Assets Construction 2024-2026	3	103.8	109.5	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Greenlink Interconnector	Cable Construction 2021-2024	3	124.4	127.1	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.

Project	Project Detail	Tier	Distance to array (km)	Distance to ECC (km)	Impacts considered	In-combination conclusion
					▪ Accidental pollution	
Mona	OWF Construction 2028-2029	3	127.7	132.8	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Morgan	OWF Construction 2028-2029	3	136.0	143.2	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Isle of Man	OWF Construction 2026-2028	3	147.3	155.1	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Morecambe	OWF Construction 2026-2028	3	153.3	158.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
North Channel Wind 2	OWF Construction 2029-2030	3	161.0	170.0	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
North Channel Wind 1	OWF Construction 2029-2030	3	184.4	192.3	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Mersey Tidal Power	Tidal Construction 2028-2034	3	195.0	198.0	▪ Underwater noise; Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Llyr 1	OWF Construction 2024-2026	3	199.2	206.6	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Llyr 2	OWF Construction 2024-2026	3	202.0	209.5	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
White Cross	OWF Construction 2025-2027	3	225.4	232.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.

Project	Project Detail	Tier	Distance to array (km)	Distance to ECC (km)	Impacts considered	In-combination conclusion
White Cross	OWF Construction 2027-2029	3	225.4	232.9	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment
Sceirde Rocks	OWF Construction 2026-2030	3	260.2	249.4	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the works may overlap with that of the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.
Atlantic Marine Energy Test Site	OWF Construction 2024-2025	3	294.5	287.1	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in-combination assessment.
TwinHub	OWF Construction 2024-2025	3	308.5	315.8	▪ Underwater noise; ▪ Vessel disturbance; ▪ Vessel collision; ▪ Changes to prey; and ▪ Accidental pollution	The proposed dates of the work are after the collection of the baseline data for the proposed development. Therefore, all identified impacts are considered in the in-combination assessment.

6.4.2 Assessment Approach

6.4.2.1 Based on the assessments of the proposed development alone and the consideration of plans and projects listed in Table 13, the SACs screened-in with relevant QI for marine mammals have been assessed for the following in-combination impacts:

- In-combination underwater noise (construction and decommissioning);
- In-combination vessel collision (construction and decommissioning);
- In-combination vessel disturbance (construction and decommissioning);
- In-combination effects on prey (construction and decommissioning); and
- In-combination accidental pollution (construction and decommissioning).

6.4.2.2 The following predicted impacts are excluded from the marine mammal in-combination assessment:

- Operation and maintenance phase impacts: screened out due to their highly localised effects.
- Habitat loss and disturbance: screened out as the impact is negligible within in the context of highly mobile species, such as marine mammals.
- Access to suitable habitat: the project-alone assessment concluded that the proposed development would not restrict access to any of the designated sites' suitable habitat, even where site boundaries overlap with project infrastructure. As there is no pathway for the proposed development to restrict access to a site's suitable habitat, there can be no cumulative effect in-combination with other plans, projects or activities in this regard.

6.4.2.3 Due to the wide-ranging nature of marine mammal populations in the proposed development area, specific SAC populations alone would not fully represent the broader populations that use this region. Marine mammals do not remain confined to the boundaries of individual SACs but instead use a much larger spatial range. As a result, SAC populations form part of larger, interconnected units spanning multiple regions. Therefore, when assessing in-combination impacts from other projects, it is more appropriate to reference the larger MU populations, which better reflect the extent of marine mammal movement and distribution beyond SAC boundaries. This approach ensures a more accurate assessment of the potential impacts, accounting for the mobility and wider ecological context relevant to marine mammals.

6.4.2.4 The inclusion of other plans, projects, and activities in the in-combination assessment is therefore based on their overlap with the relevant MUs for cetaceans:

- Celtic and Irish Seas (CIS) MU - which is the MU of relevance for the harbour porpoise QI of the SACs; and
- The Irish Sea (IS) MU - which is the MU of relevance for the bottlenose dolphin QI of the SACs.

6.4.2.5 These cetacean MUs also encompass the relevant foraging distances for grey seals (average 100 km, maximum 448 km; Carter *et al.,* 2022) and harbour seals (average 50 km, maximum 273 km; Carter *et al.,* 2022). For seals, the inclusion of other plans, projects, and activities in the in-combination assessment is based on their overlap with the average foraging distance for the respective species.

6.4.2.6 The assessment considers all Irish Phase 1 Projects as well as a number of non-Irish OWFs and other types of development as set out within Table 167.

6.4.2.7 Certain impact pathways have been further excluded from the marine mammal in-combination assessment due to several factors:

- The highly localised nature of the impacts;
- Existing management and mitigation measures implemented by the proposed development and other projects that effectively reduce the likelihood of these impacts; and
- The potential significance of the effect from the proposed development in the alone assessment has been evaluated as negligible.

6.4.2.8 The impacts further excluded from the marine mammal in-combination assessment for these reasons are:

- Auditory injury (PTS): Activities such as pile driving and UXO clearance may lead to PTS, but where necessary robust preventative and mitigation measures will be employed by the project through the measures included in the MMMP and employed by (or is expected to be enforced upon) other projects to minimise injury risk to marine mammals to imperceptible levels.
- Effects from vessel collisions: It is anticipated that all offshore energy projects will adopt an environmental VMP or adhere to guidelines to further reduce the already minimal risk of collisions with marine mammals.
- Effects on prey: Changes in fish and shellfish community affecting prey availability are highly localised and Not Significant.
- Accidental pollution: it is anticipated that all offshore energy projects will implement avoidance and preventative measures within a Marine Pollution Contingency Plan (or PEMP), in line with the Sea Pollution Act 1991, the MARPOL Convention, and other binding regulations imposed the by the International Maritime Organisation. These measures ensure that any potential release from pollutants is minimised and strictly controlled.

6.4.2.9 Furthermore, the Decommissioning and Restoration Plan (Volume 7, Appendix 2) is based on the best scientific and technical knowledge available at the time of submission of this Planning Application. In line with the decommissioning process set out in the Decommissioning and Restoration Plan, the assessment for project alone concluded that potential impacts associated with the decommissioning phase would be no greater than that assessed during construction. It is also likely that the types of plans or projects requiring assessment in the future would be similar in nature to those during the construction and operational phases. Therefore, it is reasonable to assume that the impacts associated with decommissioning, from a cumulative perspective, would be no greater than those identified during the construction phase.

6.4.2.10 The assessment is supported by DEB modelling for Dublin Array and NISA in combination, which quantified the impact of disturbance on harbour porpoises from impact pile driving across both projects (Appendix E). Given the close proximity of both the proposed NISA OWF and the Dublin Array OWF to the Rockabill to Dalkey Island SAC, the Lambay Island SAC and the Codling Fault Zone SAC, the DEB model has been designed to support the Appropriate Assessment for each proposed development. It focusses on the potential for disturbance resulting from underwater noise (from pile driving activities) to impact the harbour porpoise feature of these SACs.

6.4.2.11 As for the DEB project alone assessments, the model examines the behavioural, physiological and health changes that can have subsequent effects on an individual's vital rates (i.e. their chances of reproducing or surviving) and therefore the potential individual and population-level effects on harbour porpoises.

6.4.2.12 The marine mammal in-combination assessment focuses on impacts where there is potential for an effect to occur from the project alone over a scale that could impact in-combination with other plans, projects and activities. These primarily include:

- Disturbance from underwater noise during construction activities; and
- Disturbance from vessel activities.

6.4.2.13 For the purposes of a comparative assessment between the Phase 1 projects, and assuming a precautionary construction period between the years 2029 to 2032, the indicative piling schedules of each the five Phase 1 projects was provided to the Applicant by each of the other four Phase 1 projects. It is noted that it is extremely unlikely that four of the five Irish Phase 1 offshore wind farm projects would be piling at the same time.

6.4.2.14 The parameters and programme for the four other Phase 1 offshore wind farm projects are provided below:

- Oriel Wind Farm will comprise of 25 WTGs with monopile foundations. Construction is anticipated to take place between 2026 and 2028. This suggests that construction work would be completed before offshore construction of the proposed development commences.
- Plans for Codling Wind Park indicate that it may comprise up to 75 WTGs, 3 export cables and 3 OSPs. Dates for offshore construction activities at Codling Wind Park have been identified as commencement in 2027 with offshore construction lasting 2-3 years.

- Plans for North Irish Sea Array (NISA) Wind Farm indicate it may comprise of a maximum of 49 WTGs and one OSP. Dates for construction have been identified as 2027-2029 with piling anticipated in 2028.

- Plans for Arklow Bank Phase 2 indicate that it may comprise a maximum of 56 WTGs, two export cables and a maximum of two OSPs. Dates for construction have been identified as 2026 to 2030.

6.4.2.15 The timings for other OWF projects within the CIS and IS MUs are outlined in Table 167. For all other types of planned offshore projects (e.g. coastal assets, cables), the scale of these developments is smaller compared to large, commercial-scale offshore wind farms, and as such, their potential impact on marine mammals is expected to be less significant.

6.4.2.16 A quantitative cumulative effects assessment for marine mammals was provided in the EIAR chapter (Volume 3, Chapter 5: Marine Mammals). The assessment calculated the number of marine mammals disturbed per day, using available data and projections, and used the Integrated Population Consequences of Disturbance (iPCoD) modelling framework to predict the potential effects of disturbance on marine mammal populations over the course of the project. This approach combines direct disturbance estimates with broader ecological considerations, offering a comprehensive understanding of cumulative impacts from the proposed development and other offshore projects.

6.4.2.17 This assessment also uses the same MU reference populations for the relative marine mammal species. For full details of the methodology and the key limitations of the iPCoD model approach, please see the Cumulative iPCoD modelling report (Volume 4, Appendix 4.3.5-6).

6.4.3 Rockabill to Dalkey Island SAC

In-Combination Effects from Underwater Noise

6.4.3.1 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 to the SAC when considered in-combination with other projects there is still a potential for effects to occur. Potential in-combination effects on harbour porpoise receptors include 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 activities including geophysical surveys).

6.4.3.2 The greatest risk for in-combination underwater noise effects on the harbour porpoise QI 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.

6.4.3.3 See paragraph 6.4.2.14 for an overview of the Phase 1 project plans. Within the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited.

Behavioural Disturbance

6.4.3.4 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. 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 NISA (the two closest projects to the SAC), DEB modelling was run to investigate how piling disturbance might alter the vital rates of female harbour porpoises during different life history stages and to consider how piling disturbance might affect individuals. The DEB predicted the impacts across 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 (see Appendix E).

6.4.3.5 The DEB was used to investigate several scenarios, including a worst-case scenario disturbance rate of 0.2, for which very little scientific evidence exists. Considering the realistic upper limits of disturbance effect (6 hours of lost foraging time) and probability of disturbance (0.1, meaning 10% of the simulated individuals were disturbed), the model concluded no significant change in birth rate or in adult mortality, as compared to the undisturbed population. Under this realistic upper limit of disturbance scenario, the model did conclude a 2.2% increase in calf mortality, as compared to the undisturbed population.

6.4.3.6 The DEB modelling results concluded that most simulations had no effect on calf mortality rate where each disturbance resulted in 1-2 hours of lost foraging opportunity. In a more extreme scenario, a disturbance which caused a 6-hour reduction in foraging resulted in an increase in calf mortality rate by 4.2%. However, this scenario was deemed highly unrealistic based on the evidence base of literature on harbour porpoise responses to such disturbance (see Appendix E).

6.4.3.7 The DEB modelling results reported no significant change in birth rate or adult mortality rate as a result of underwater noise from piling. Whilst DEB can quantify the level of disturbance different piling scenarios could have on vital rates, it is important to consider the use of this model as part of a wider assessment on harbour porpoise.

6.4.3.8 As discussed within Appendix E, a number of assumptions used in the model 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 scenarios included in the DEB modelling.

6.4.3.9 In conclusion, for all simulations using realistic, scientifically supported, disturbance rates (discussed within Appendix E), there was no significant effect on individual harbour porpoise vital rates (i.e. birth rate, calf mortality rate or adult mortality rate) from pile driving at NISA and/or Dublin Array.

6.4.3.10 CSA (2020) assessed the potential for disturbance from geophysical surveys, including impulsive SBPs (e.g. sparkers and boomers) and non-impulsive SBPs (e.g. CHIRP sonars), which operate below 180 kHz and fall within the hearing ranges of marine mammals. In the absence of widely accepted behavioural thresholds (Southall *et al.*, 2019), Level B harassment ranges are often used to estimate the distances within which behavioural effects may occur. Based on modelling undertaken to inform the assessment, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source. However, this range is expected to be fully contained within the broader disturbance/displacement effects caused by the vessels associated with the proposed development (e.g. Benhemma-Le Gall *et al.,* 2023).

6.4.3.11 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 such as vessel activities (e.g. Benhemma-Le Gall *et al*., 2023), and thus it is not expected that individual vital rates would be significantly impacted (Booth and Heinis, 2019).

6.4.3.12 JNCC guidance (2020) states 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 only 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.

6.4.3.13 Non-piling Tier 1 projects are located at a sufficient distance from the proposed development, and their non-piling noise sources (e.g. vessel noise, dredging, geophysical surveys) are expected to have no likely significant effect on harbour porpoise. As a result, they are not considered to meaningfully contribute to an in-combination effect with the proposed development.

6.4.3.14 For piling activities from Tier 2 and 3 projects, if all planned activities occur concurrently, particularly with overlapping timescales, a relatively high number of individuals within the MU could be affected, with some individuals experiencing repeated disturbance. The effects from Tier 2 and 3 projects are expected to affect the wider harbour porpoise population rather than specific individuals associated with the SAC (as the SAC community is a subset of the larger population within the MU).

6.4.3.15 Piling noise has been identified as the primary driver of potential disturbance, particularly if multiple projects conduct piling concurrently or sequentially over prolonged periods. However, the DEB modelling indicated that effects on calf survival were only observed under highly conservative assumptions, and the likelihood of the same individual being affected multiple piling events across different projects was extremely low. When considering projects within the local area of the SAC, the additional disturbance from Tier 1, 2 and 3 projects is not expected to result in detrimental effects on individuals or the population associated with the SAC.

6.4.3.16 Therefore, it is concluded that there will be no change to vital rates of the harbour porpoise feature of the SAC due to the proposed development in-combination with all other plans, projects and activities. Additionally, decommissioning noise impacts are expected to be no greater than those for construction (as described in the alone assessment).

Underwater Noise – Behavioural Disturbance Assessment (Harbour Porpoise)

6.4.3.17 As outlined in paragraph 5.4.2.7, the relevant target for the SAC related to in-combination underwater noise effects is by order to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

6.4.3.18 Some individuals within or associated with the site may be disturbed and displaced by underwater noise arising from construction and decommissioning activities, however, 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.

6.4.3.19 Furthermore, considering the specific technical clarifications regarding the disturbance target, previously outlined in paragraph 5.4.2.8 (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.

6.4.3.20 Therefore, it is concluded that disturbance arising from underwater noise associated with construction activities 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.

6.4.3.21 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

In-Combination Effects from Vessel Disturbance (Harbour Porpoise)

6.4.3.22 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. Vessel disturbance may affect individuals associated with the SAC both within and outside the site. However, the greatest impact is likely to arise from vessel routing through the SAC.

6.4.3.23 It is extremely difficult to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis. This is due to the significant temporal and spatial variation in vessel movements across different projects and regions, coupled with the natural variability in marine mammal movements across the region.

6.4.3.24 At this stage, vessel numbers are not available for other plans, projects or activities, regarding vessel routes for construction or operations bases considered in-combination. However, they are likely to be of a similar scale to the proposed development. 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 of the construction phase, in addition to those transiting between the site and the port.

6.4.3.25 While some OWF vessels, such as crew transport and supply vessels, may operate at higher speeds, they generally travel on designated (and therefore repeated and predictable) routes relative to each site. Other vessels, such as jack-up vessels, pilot vessels, and attending vessels, tend to travel at slower speeds or spend long periods of time stationary (jacked-up, at anchor or using dynamic positioning systems), reducing their movement and/or acoustic footprint. These factors minimise the overall disturbance to marine mammals.

6.4.3.26 Most vessel routes to and from OWFs and other offshore projects will follow existing vessel routes, to which marine mammals are likely already accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for OWFs are likely to be limited and slow, resulting in less risk of disturbance to marine mammals. In addition, most projects are likely to adopt EVMPs (or comply with existing Marine Wildlife Watching Codes) to minimise any potential effects on marine mammals.

6.4.3.27 Vessels are not expected to travel through the SAC outside of the project footprints and defined routes. It is therefore not anticipated that the level of vessel activity from Tier 1, 2 and 3 projects in-combination with the proposed development, would increase the risk of vessel disturbance within the SAC boundary. However, the risk of disturbance may increase outside the SAC boundary for individuals associated with the site community, due to the presence of vessels in the wider region.

6.4.3.28 While harbour porpoises may be sensitive to vessel disturbance, evidence suggests that they are able to compensate for any short-term local displacement (Benhemma-Le Gall *et al*., 2021; 2023). Even if additional vessels are introduced, it is not expected that individual vital rates (e.g. survival and reproduction) will be negatively impacted. Vessel presence is not a novel impact for harbour porpoises in this region.

Vessel Disturbance Assessment (Harbour Porpoise)

6.4.3.29 As outlined in paragraph 5.4.2.7, the relevant COs for the SAC is to maintain human activities below levels which would adversely affect the harbour porpoise community at the site (disturbance).

6.4.3.30 Individuals within or associated with the site may be disturbed by the presence of vessels, however, vessel presence (given the temporary and localised nature of the activities) will not result in a significant impact on individuals and/or the community of harbour porpoise.

6.4.3.31 Furthermore, considering the specific technical clarifications of CO attribute disturbance, as outlined in paragraph 5.4.2.8 (NPWS, 2013a), the in-combination 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.

6.4.3.32 Therefore, it is concluded that vessel disturbance arising from 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 QI of the Rockabill to Dalkey Island SAC.

6.4.3.33 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

6.4.4 Lambay Island SAC

6.4.4.1 It should be noted that the in-combination assessment of the harbour porpoise QI of Lambay Island SAC draws upon the information presented for Rockabill to Dalkey Island SAC, and is summarised in a standalone section at the end of this in-combination appropriate assessment of Lambay Island SAC (see paragraph 6.4.4.32). Hence, the following detailed sections consider only grey seal and harbour seal and the relevant impacts to these species.

In-Combination Effects from Underwater Noise (grey and harbour seal)

6.4.4.2 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 plans, projects and activities there is still potential for effects to occur in-combination. Potential in-combination effects on grey seal and harbour seal receptors include 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 activities including geophysical surveys).

6.4.4.3 The greatest risk for in-combination underwater noise effects on the grey seal and harbour seal features of the SAC has been identified as being that produced by piling during the construction phase of the Phase 1 offshore wind farm 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.

6.4.4.4 See paragraph 6.4.2.13 for an overview of the project parameters for other Phase 1 offshore wind farms. As these projects are still at an early stage in the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited.

Behavioural Disturbance

6.4.4.5 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. 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.

6.4.4.6 The iPCoD results within the EIAR show that the level of disturbance predicted when Dublin Array is expected to be piling, is not sufficient to result in any changes at the population level. Temporary changes in behaviour and/or distribution of individuals may be at a scale that could result in potential reductions to lifetime reproductive success to some individuals, although likely not enough to affect the population trajectory over a generational scale.

6.4.4.7 Overall, the number of harbour seals predicted to be disturbed by each offshore project in the cumulative iPCoD modelling is generally low. This is because most projects are located in areas with relatively low expected harbour seal at-sea usage. The exception is the NISA OWF which is located nearer to the high-density areas around the Strangford Lough SAC and Murlough SAC in Northern Ireland and is located in deeper waters which results in higher noise propagation. Therefore, number of individuals predicted to be impacted are notably higher in the three years in which NISA is expecting to be piling (2027 – 2029).

6.4.4.8 The highest level of predicted disturbance for grey seals in the iPCoD modelling occurs in 2029 when piling is expected to occur at Dublin, NISA, North Channel Wind 1, North Channel Wind 2 and Arklow Bank, alongside various other construction activities along the east coast of Ireland. It is noted that it is extremely unlikely that four of the five Irish Phase 1 OWF projects would be piling at the same time.

6.4.4.9 JNCC guidance (2020) states 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 expected to be significantly less than that associated with piling. Therefore, with a shorter duration (in most cases, single pulse events), is not expected that disturbance from a single UXO detonation would result in any significant impacts for a time period extending beyond minutes. Consequently, it is very unlikely that noise from UXO clearance would impact adult, juvenile or pup survival or reproductive rates to the extent to alter the grey or harbour seal population trajectory.

6.4.4.10 CSA (2020) assessed the potential for disturbance from geophysical surveys, including impulsive SBPs (e.g. sparkers and boomers) and non-impulsive SBPs (e.g. CHIRP sonars), which operate below 180 kHz and fall within the hearing ranges of marine mammals. In the absence of widely accepted behavioural thresholds (Southall *et al.,* 2019), Level B harassment ranges are often used to estimate the distances within which behavioural effects may occur. Based on modelling undertaken to inform the assessment, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source. However, this range is expected to be fully contained within the broader disturbance/displacement effects caused by the vessels associated with the proposed development (e.g. Benhemma-Le Gall *et al.,* 2023).

6.4.4.11 Considering Tier 1, 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 1 projects.

6.4.4.12 Considering Tier 2 and 3, were all plans, projects or activities to occur, particularly with overlapping timescales, this could result in relatively high numbers of individual grey and harbour seals being affected, and may lead to repeated disturbance of some individuals. The effects from the Tier 2 and 3 projects will be extended across the wider area (i.e. into areas that are out with average foraging distances of individuals) and will therefore affect multiple colonies.

6.4.4.13 Considering the projects within the local area to the SAC, it is not considered that the additional disturbance from Tier 1, 2 and 3 projects will result in any detrimental in-combination effects to individuals or the population associated with the SAC. Impacts from noise from decommissioning are expected to be no greater than those for construction (as described in the alone assessment).

Underwater Noise – Disturbance Assessment (Grey seal and Harbour seal)

6.4.4.14 Impacts from underwater noise are only considered relevant for the disturbance target of the COs for the SAC, with the access to suitable habitat target being relevant to permanent barrier effects and the behaviour targets 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 is a temporary effect, 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.

6.4.4.15 As outlined in paragraph 5.4.3.14, 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.

6.4.4.16 Some individuals within or associated with the site may be disturbed and displaced by 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 and so is therefore not expected to impact on the populations at the site. Specifically, 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.

6.4.4.17 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 grey or harbour seal QI of the Lambay Island SAC.

6.4.4.18 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

In-Combination Effects from Vessel Disturbance (Grey seal and Harbour seal)

6.4.4.19 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. Vessel disturbance may affect individuals associated with the SAC both within and outside the site. However, the greatest impact is likely to arise from vessel routing through the SAC.

6.4.4.20 It is extremely difficult to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis. This is due to the significant temporal and spatial variation in vessel movements across different projects and regions, coupled with the natural variability in marine mammal movements across the region.

6.4.4.21 At this stage, vessel numbers are not available for other plans, projects or activities, regarding vessel routes for construction or operations bases considered in-combination. However, they are likely to be of a similar scale to the proposed development. 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 of the construction phase, in addition to those transiting between the site and the port.

6.4.4.22 While some OWF vessels, such as crew transport and supply vessels, may operate at higher speeds, they generally travel on designated (and therefore repeated and predictable) routes relative to each site. Other vessels, such as jack-up vessels, pilot vessels, and attending vessels, tend to travel at slower speeds or spend long periods of time stationary (jacked-up, at anchor or using dynamic positioning systems), reducing their movement and/or acoustic footprint. These factors minimise the overall disturbance to marine mammals.

6.4.4.23 Most vessel routes to and from OWFs and other offshore projects will follow existing vessel routes, to which marine mammals are likely already accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for offshore wind farms are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, most projects are likely to adopt environmental VMPs (or comply with existing Marine Wildlife Watching Codes) to minimise any potential effects on marine mammals.

6.4.4.24 Vessels are not expected to travel through the SAC outside of the project footprints and defined routes. It is therefore not anticipated that the level of vessel activity from Tier 1, 2 and 3 projects in-combination with the proposed development, would increase in the risk of vessel disturbance within the SAC boundary. However, the risk of disturbance may increase outside the SAC boundary for individuals associated with the site community, due to the presence of vessels in the wider region.

6.4.4.25 As detailed in the alone assessment, 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 heart-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 100 m for grey seals and harbour seals as concluded by the underwater noise assessment.

Vessel Disturbance Assessment (Grey/Harbour seal)

6.4.4.26 As outlined in paragraph 5.4.3.14, the relevant targets for the assessment are the behaviour and disturbance targets. The behaviour targets 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. The disturbance target relates to maintaining human activities below levels which would adversely affect the grey and harbour seal community at the site.

6.4.4.27 Regarding the behaviour targets, only vessels transiting within 1 km of the haul out sites within the SAC have a potential pathway for effect, therefore, it is unlikely that vessels associated with the proposed development will result in any impact to hauled out individuals. Considering the Tier 1 and 2 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.

6.4.4.28 Regarding the disturbance target, seals are relatively insensitive to disturbance from vessels when at sea and are often recorded around stationary vessels.

6.4.4.29 Individuals within or associated with the site may be disturbed by the presence of vessels, however, this is not predicted to result in any significant change to individual fitness or reproductive success and so is 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.

6.4.4.30 Therefore, it is concluded that vessel disturbance arising from construction and decommissioning activities from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the grey seal or harbour seal QIs of the Lambay Island SAC.

6.4.4.31 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Assessment (Harbour porpoise)

6.4.4.32 A detailed assessment of in-combination impacts to harbour porpoise as a QI of Irish SACs is presented for Rockabill to Dalkey Island SAC.

6.4.4.33 In addition to the assessment of Rockabill to Dalkey Island SAC, project specific in-combination DEB modelling (SMRU, 2024b) has been undertaken and applied to Lambay Island SAC and assessed in line with the assumed COs, attributes and targets. Additional detail on DEB models is detailed in Appendix E of this HDA.

6.4.4.34 For all simulations using realistic, scientifically supported, disturbance rates (discussed within Appendix E), there was no significant effect on individual harbour porpoise vital rates involving birth rate, calf mortality rate or adult mortality rate from pile driving at NISA and/or Dublin Array.

6.4.4.35 Given that the range of suitable habitat available to harbour porpoise is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the in-combination assessment for Rockabill to Dalkey Island SAC, within which Lambay Island lies and which is designated for the same QI (and fully encompasses this SAC). As the assessment of Rockabill to Dalkey Island SAC concluded no AEoI on the harbour porpoise QI for all screened in impacts in-combination with other plans, projects and activities, and given that Lambay Island SAC lies wholly within the Rockabill to Dalkey Island SAC, it is considered that the potential for AEoI is the same or reduced for this site given the lack of overlap with the offshore infrastructure.

6.4.4.36 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.

6.4.5 Hook Head SAC

6.4.5.1 It should be noted that the in-combination assessment of the harbour porpoise QI of Hook Head SAC draws upon the information presented for Rockabill to Dalkey Island SAC, and is summarised in a standalone section at the end of this in-combination appropriate assessment of Hook Head SAC. Hence, the following detailed sections consider only bottlenose dolphin and their respective impacts.

In-Combination Effects from Underwater Noise (Bottlenose dolphin)

6.4.5.2 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. Potential in-combination effects on bottlenose dolphin receptors include 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 activities including geophysical surveys).

6.4.5.3 The greatest risk for in-combination underwater noise effects on the bottlenose dolphin QI 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.

6.4.5.4 See paragraph 6.4.2.13 for an overview of the project parameters for other Phase 1 offshore wind farms. As these projects are still at an early stage in the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited.

Behavioural Disturbance

6.4.5.5 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. To inform the potential for population level impacts to bottlenose dolphin from piling noise generated by all the Phase 1 offshore wind farm projects, iPCoD modelling was undertaken. Whilst this modelling is undertaken at the population level i.e. the MU, and therefore not specific to SAC population, it is useful in informing the wider effects from repeated disturbance events.

6.4.5.6 Based on the outcome of an expert elicitation workshop for iPCoD, bottlenose dolphins are expected to be able to adapt their behaviour, with the impact from an extended period of disturbance most likely to result in potential changes in calf survival (but not expected to affect adult survival or future reproductive rates) (Harwood *et al.,* 2014). 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, it would recover back to the carrying capacity, rather than remaining at a lower population size.

6.4.5.7 The number of bottlenose dolphins predicted to be disturbed by all projects within the iPCoD model is driven largely by the predictions of disturbance at offshore wind farms in the western Irish Sea: Dublin Array, Arklow Bank, Oriel, NISA, North Channel Wind 1 and North Channel Wind 2. This is due to the fact that the bottlenose dolphin density in the western Irish Sea (SCANS IV block CS-D: 0.2352 dolphins/km^2) was predicted to be much higher than that in the eastern Irish Sea (SCANS IV block CS-E: 0.0104 dolphins/km^2).

6.4.5.8 Population modelling across the five Phase 1 projects using the project specific disturbance numbers has already shown no significant impact to the bottlenose dolphin population. It is therefore expected that with the addition of other projects, there is likely to be temporary changes in behaviour and/or distribution of individuals at a scale that could result in potential reductions to lifetime reproductive success to some individuals, although likely not enough to affect the population trajectory over a generational scale.

6.4.5.9 CSA (2020) assessed the potential for disturbance from geophysical surveys, including impulsive SBPs (e.g. sparkers and boomers) and non-impulsive SBPs (e.g. CHIRP sonars), which operate below 180 kHz and fall within the hearing ranges of marine mammals. In the absence of widely accepted behavioural thresholds (Southall et al., 2019), Level B harassment ranges are often used to estimate the distances within which behavioural effects may occur. Based on modelling undertaken to inform the assessment, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source. However, this range is expected to be fully contained within the broader disturbance/displacement effects caused by the vessels associated with the proposed development (e.g. Benhemma-Le Gall et al., 2023).

6.4.5.10 JNCC guidance (2020) states 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 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 only affect foraging behaviour over a period of at most minutes, are very unlikely to alter survival or reproductive rates to the extent to alter the bottlenose dolphin population trajectory.

6.4.5.11 Considering Tier 1, it is expected that any population changes identified at the MU scale would be temporary, and the population would recover to the baseline. Nonetheless, 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 1 projects. This reduces the likelihood of individuals associated with the SAC being affected by sufficient plans, projects or activities to have an effect on vital rates. The small scale of effects likely (relative to the wind farm construction) and distance from the SAC, contributes to the low likelihood of impacts to individuals associated with the SAC.

6.4.5.12 Considering Tiers 2 and 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. These effects from the Tier 2 and 3 projects would occur at the MU level.

6.4.5.13 Considering the few projects within the local area to the SAC, it is considered that the additional disturbance from Tier 1, 2 and 3 projects will not result in any detrimental effects to individuals or the population associated with the SAC. Additionally, decommissioning noise impacts are expected to be no greater than those from construction, as outlined in the alone assessment.

Underwater Noise – Disturbance Assessment (Bottlenose dolphin)

6.4.5.14 As outlined in paragraph 5.4.2.7, the CO for the SAC is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

6.4.5.15 Some individuals associated with the site may be disturbed and displaced by underwater noise arising from construction and decommissioning activities, 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. Therefore, there is not expected to be an impact on the population at the site. Specifically, disturbance from underwater noise from construction or decommissioning activities is not predicted to result in any significant 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.

6.4.5.16 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 bottlenose dolphin QI at the Hook Head SAC.

6.4.5.17 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

In-Combination Effects from Vessel Disturbance (Bottlenose dolphin)

6.4.5.18 Following on from the outlined studies and findings within the alone assessment, this in-combination assessment evaluates the potential combined effects of the proposed development alongside other relevant plans, projects, and activities. Vessel disturbance may affect individuals associated with the SAC both within and outside the site. However, the greatest impact is likely to arise from vessel routing through the SAC.

6.4.5.19 It is extremely difficult to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis. This is due to the significant temporal and spatial variation in vessel movements across different projects and regions, coupled with the natural variability in marine mammal movements across the region.

6.4.5.20 At this stage, vessel numbers are not available for other plans, projects or activities, regarding vessel routes for construction or operations bases considered in-combination. However, they are likely to be of a similar scale to the proposed development. 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 of the construction phase, in addition to those transiting between the site and the port.

6.4.5.21 While some OWF vessels, such as crew transport and supply vessels, may operate at higher speeds, they generally travel on designated (and therefore repeated and predictable) routes relative to each site. Other vessels, such as jack-up vessels, pilot vessels, and attending vessels, tend to travel at slower speeds or spend long periods of time stationary (jacked-up, at anchor or using dynamic positioning systems), reducing their movement and/or acoustic footprint. These factors minimise the overall disturbance to marine mammals.

6.4.5.22 Most vessel routes to and from OWFs and other offshore projects will follow existing vessel routes, to which marine mammals are likely already accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for offshore wind farms are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, most projects are likely to adopt environmental VMPs (or comply with existing Marine Wildlife Watching Codes) to minimise any potential effects on marine mammals.

6.4.5.23 Vessels are not expected to travel through the SAC outside of the project footprints and defined routes. It is therefore not anticipated that the level of vessel activity from Tier 1, 2 and 3 projects in-combination with the proposed development, would increase in the risk of vessel disturbance within the SAC boundary. However, the risk of disturbance may increase outside the SAC boundary for individuals associated with the site community, due to the presence of vessels in the wider region.

6.4.5.24 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 concluded by the underwater noise assessment.

Vessel Disturbance Assessment (Bottlenose dolphin)

6.4.5.25 As outlined in paragraph 5.4.4.7, the CO for the SAC is to maintain human activities below levels which would adversely affect the bottlenose dolphin population at the site (disturbance).

6.4.5.26 Regarding this target, vessel disturbance may 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 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.

6.4.5.27 Therefore, it is concluded that vessel disturbance arising from construction and decommissioning activities from the proposed development in-combination with other plans, projects and activities will not result in an AEoI to the bottlenose dolphin QI of the Hook Head SAC.

6.4.5.28 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

Assessment (Harbour Porpoise)

6.4.5.29 Given that the range of suitable habitat available to harbour porpoise is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the in-combination assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. As the assessment of Rockabill to Dalkey Island SAC concluded no AEoI on the harbour porpoise QI for all screened in impacts in-combination with other plans, projects and activities, given the greater distance to Hook Head SAC 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 given the lack of overlap with the offshore infrastructure.

6.4.5.30 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.

6.4.5.31 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

6.4.6 Pen Llŷn a'r Sarnau SAC

In-Combination Effects from Underwater Noise (Bottlenose dolphin/grey seal)

6.4.6.1 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. Potential in-combination effects on bottlenose dolphin and grey seal receptors include 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).

6.4.6.2 The greatest risk for in-combination underwater noise effects on the bottlenose dolphin and grey 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.

6.4.6.3 See paragraph 6.4.2.13 for an overview of the project parameters for other Phase 1 offshore wind farms. As these projects are still at an early stage in the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited.

Behavioural Disturbance

6.4.6.4 That assessment applies equally to bottlenose dolphin and grey seal associated with the Pen Llŷn a`r Sarnau SAC, given the localised nature of any effect together with the location of that effect relative to the SAC.

6.4.6.5 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 undertaken at the population level, and therefore not specific to SAC population, it is useful in informing the wider effects from repeated disturbance events.

6.4.6.6 Based on the outcome of an expert elicitation workshop for iPCoD, bottlenose dolphins are expected to be able to adapt their behaviour, with the impact from an extended period of disturbance most likely to result in potential changes in calf survival (but not expected to affect adult survival or future reproductive rates) (Harwood *et al.,* 2014). 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, it would recover back to the carrying capacity, rather than remaining at a lower population size.

6.4.6.7 Another expert elicitation workshop in 2018 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, with the survival of 'weaned of the year' animals and fertility being determined as the most sensitive parameters to disturbance (i.e. due to reduced energy intake) (Booth *et al.*, 2019). 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 negative effect on fecundity rates.

6.4.6.8 CSA (2020) assessed the potential for disturbance from geophysical surveys, including impulsive SBPs (e.g. sparkers and boomers) and non-impulsive SBPs (e.g. CHIRP sonars), which operate below 180 kHz and fall within the hearing ranges of marine mammals. In the absence of widely accepted behavioural thresholds (Southall et al., 2019), Level B harassment ranges are often used to estimate the distances within which behavioural effects may occur. Based on modelling undertaken to inform the assessment, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source. However, this range is expected to be fully contained within the broader disturbance/displacement effects caused by the vessels associated with the proposed development (e.g. Benhemma-Le Gall et al., 2023).

6.4.6.9 JNCC guidance (2020) states 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 only affect foraging behaviour over a period of at most minutes, are very unlikely to alter survival or reproductive rate to the extent to alter bottlenose dolphin and grey seal population trajectory.

6.4.6.10 Considering Tier 1, it is expected that any population changes identified at the MU scale would be temporary, and the population would recover to the baseline. Nonetheless, were any population size changes to occur, it is unlikely that this would affect the population associated with Pen Llŷn a`r Sarnau SAC due to the distance of the site from the majority of the Tier 1 projects. This reduces the likelihood of individuals associated with the SAC being affected by sufficient plans, projects or activities to have an effect on vital rates. The small scale of effects likely (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.

6.4.6.11 Considering Tier 2 and 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 (in the case of cetaceans) and/or across the wider area relative to average foraging ranges (in the case of seals), and may lead to repeated disturbance of some individuals. The effects from the Tier 2 and 3 projects would occur at the MU level / wider area.

6.4.6.12 Considering the few projects within the local area to the SAC, it is considered that the additional disturbance from Tier 1, 2 and 3 projects will not result in any detrimental effects to individuals or the population associated with the SAC. Additionally, decommissioning noise impacts are expected to be no greater than those from construction, as outlined in the alone assessment.

Underwater Noise – Disturbance Assessment (Bottlenose dolphin and Grey seal)

6.4.6.13 As outlined in paragraph 5.4.5.7, the relevant target for the SAC for impacts arising from underwater noise are to maintain the population, the range within the SAC, and maintaining supporting habitats and species.

6.4.6.14 Some individuals associated with the site may be disturbed and displaced by underwater noise arising from construction and decommissioning activities, 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. Therefore, there is not expected to be an impact on the populations at the site. Specifically, disturbance from underwater noise from construction or decommissioning activities is not predicted to result in any significant 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.

6.4.6.15 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 bottlenose dolphin or grey seal features of the Pen Llŷn a`r Sarnau SAC.

6.4.6.16 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

In-Combination Effects from Vessel Disturbance (Bottlenose dolphin and Grey seal)

6.4.6.17 This assessment applies equally to bottlenose dolphin and grey seal associated with the Pen Llŷn a`r Sarnau SAC, given the localised nature of any effect together with the location of that effect relative to the SAC.

6.4.6.18 Vessel disturbance may affect individuals associated with the SAC both within and outside the site. However, the greatest impact is likely to arise from vessel routing through the SAC.

6.4.6.19 It is extremely difficult to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis. This is due to the significant temporal and spatial variation in vessel movements across different projects and regions, coupled with the natural variability in marine mammal movements across the region.

6.4.6.20 At this stage, vessel numbers are not available for other plans, projects or activities, regarding vessel routes for construction or operations bases considered in-combination. However, they are likely to be of a similar scale to the proposed development. 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 of the construction phase, in addition to those transiting between the site and the port.

6.4.6.21 While some OWF vessels, such as crew transport and supply vessels, may operate at higher speeds, they generally travel on designated (and therefore repeated and predictable) routes relative to each site. Other vessels, such as jack-up vessels, pilot vessels, and attending vessels, tend to travel at slower speeds or spend long periods of time stationary (jacked-up, at anchor or using dynamic positioning systems), reducing their movement and/or acoustic footprint. These factors minimise the overall disturbance to marine mammals.

6.4.6.22 Most vessel routes to and from OWFs and other offshore projects will follow existing vessel routes, to which marine mammals are likely already accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for offshore wind farms are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, most projects are likely to adopt environmental VMPs (or comply with existing Marine Wildlife Watching Codes) to minimise any potential effects on marine mammals.

6.4.6.23 Vessels are not expected to travel through the SAC outside of the project footprints and defined routes. It is therefore not anticipated that the level of vessel activity from Tier 1, 2 and 3 projects in-combination with the proposed development, would increase in the risk of vessel disturbance within the SAC boundary. However, the risk of disturbance may increase outside the SAC boundary for individuals associated with the site community, due to the presence of vessels in the wider region.

6.4.6.24 As described in the alone assessment, bottlenose dolphin and grey seal are relatively insensitive to vessel disturbance. The PTS impact ranges of vessel noise from medium- and large-sized vessels are both estimated to be shorter than 100 m for bottlenose dolphin and grey seal as concluded by the underwater noise assessment.

6.4.6.25 While bottlenose dolphin and grey seal 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.

Vessel Disturbance Assessment (Bottlenose dolphin and Grey seal)

6.4.6.26 The first two COs are relevant to the risk disturbance from vessels, in that it may affect the population or range of the features. CO 3 is focused on maintaining the supporting habitats and processes, together with availability of prey, within the Pen Llŷn a'r Sarnau SAC. Disturbance from vessel presence does not have the potential to affect such habitats or processes.

6.4.6.27 Vessel presence will be temporary and localised and will not permanently prevent bottlenose dolphin or grey seal accessing the site. Individuals within, or associated with, the site may be disturbed by the presence of vessels; however, vessel presence (given the temporary and localised nature of the activities) will not result in a significant impact on individuals and/or the community of bottlenose dolphin or grey seal.

6.4.6.28 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.

6.4.6.29 Vessel presence will be temporary and localised within the proposed development and transit corridors, and it is expected that this would be true for Tier 1 to 3 projects. Therefore, vessels associated with the proposed development in-combination with other projects, plans and activities will not permanently prevent bottlenose dolphins or grey seals from maintaining their natural range within the site.

6.4.6.30 Therefore, it is concluded that increased vessel disturbance 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 bottlenose dolphin or grey seal features of the Pen Llŷn a`r Sarnau SAC.

6.4.6.31 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

6.4.7 North Anglesey Marine SAC

In-Combination Effects from Underwater Noise (Harbour porpoise)

6.4.7.1 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 to the SAC when considered in-combination with other projects there is still a potential for effects to occur. Potential in-combination effects on harbour porpoise receptors include 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).

6.4.7.2 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.

6.4.7.3 See paragraph 6.4.2.13 for an overview of the project parameters for other Phase 1 offshore wind farms. As these projects are still at an early stage in the planning process, site specific information relating to the spatial and temporal extent of noise impacts from the Phase 1 projects is limited.

Behavioural Disturbance

6.4.7.4 The DEPONS model has been used to predict the potential population-level effects of cumulative OWF construction in the North Sea. Nabe-Nielsen *et al.* (2018) showed that the North Sea porpoise population was unlikely to be significantly impacted by the construction of 60 wind farms each with 65 turbines resulting in 3,900 disturbance days between 2011-2020, unless impact ranges were assumed to be much larger (exceeding 50 km) than that indicated by existing studies. Even at these extreme disturbance scenarios, the modelled North Sea population showed a quick recovery to baseline size (within 6-7 years) despite up to a 20% decline in population size.

6.4.7.5 Results from previous large-scale cumulative population modelling studies show that persistent (i.e. 10+ years) high levels of disturbance, are unlikely to result in long-term populations declines. Further, previous modelling studies have shown that, even under extreme scenarios, the North Sea population is expected to recover quickly from any short-term decline. While these modelling scenarios were conducted for the North Sea, the results are comparable to potential impacts to other stable harbour porpoise populations such as the Celtic and Irish Sea MU.

6.4.7.6 The level of disturbance predicted to occur within the Celtic and Irish Sea MU between 2024 – 2034 is expected to result in temporary changes in behaviour and/or distribution of individuals at a scale that could result in potential reductions to lifetime reproductive success to some individuals although not enough to affect the population trajectory over a generational scale.

6.4.7.7 CSA (2020) assessed the potential for disturbance from geophysical surveys, including impulsive SBPs (e.g. sparkers and boomers) and non-impulsive SBPs (e.g. CHIRP sonars), which operate below 180 kHz and fall within the hearing ranges of marine mammals. In the absence of widely accepted behavioural thresholds (Southall *et al.*, 2019), Level B harassment ranges are often used to estimate the distances within which behavioural effects may occur. Based on modelling undertaken to inform the assessment, CSA (2020) concluded that Level B harassment ranges could extend up to 141 m from the sound source. However, this range is expected to be fully contained within the broader disturbance/displacement effects caused by the vessels associated with the proposed development (e.g. Benhemma-Le Gall *et al.,* 2023).

6.4.7.8 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 such as vessel activities (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).

6.4.7.9 JNCC guidance (2020) states 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 only 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.

6.4.7.10 Non-piling Tier 1 projects are located at a sufficient distance from the proposed development, and their non-piling noise sources (e.g. vessel noise, dredging, geophysical surveys) are expected to have no likely significant effect on harbour porpoise. As a result, they are not considered to meaningfully contribute to an in-combination effect with the proposed development.

6.4.7.11 For piling activities from Tier 2 and 3 projects, if all planned activities occur concurrently, particularly with overlapping timescales, a relatively high numbers of individuals within the MU could be affected, with some individuals experiencing repeated disturbance. The effects from the Tier 2 and 3 projects will be extended across the entire MU.

6.4.7.12 However, when considering the projects within the local area to the SAC, the additional disturbance from Tier 1, 2 and 3 projects is not expected to result in any detrimental effects on individuals or the population associated with the SAC. Additionally, decommissioning noise impacts are expected to be no greater than those from construction, as outlined in the alone assessment.

Underwater Noise – Disturbance Assessment (Harbour porpoise)

6.4.7.13 As outlined in paragraph 5.4.6.4, the relevant CO for the SAC refers to no significant disturbance of the species (CO 2).

6.4.7.14 As highlighted above that disturbance is assessed here through the application the relevant EDR, which for monopiles is 26 km and for pin-piles is 15 km. The proposed development array area is more than 26 km from the boundary of the North Anglesey Marine SAC at its closest point. As such, any noisy activity within the proposed development array area that takes place would fall outside the need for assessment here. As there is no pathway for significant disturbance in the SAC from the proposed development, it cannot contribute to significant disturbance in-combination with other projects, plans and activities.

6.4.7.15 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 North Anglesey Marine SAC.

6.4.7.16 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

In-Combination Effects from Vessel Disturbance (Harbour porpoise)

6.4.7.17 Vessel disturbance may affect individuals associated with the SAC both within and outside the site. However, the greatest impact is likely to arise from vessel routing through the SAC.

6.4.7.18 It is extremely difficult to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis. This is due to the significant temporal and spatial variation in vessel movements across different projects and regions, coupled with the natural variability in marine mammal movements across the region.

6.4.7.19 At this stage, vessel numbers are not available for other plans, projects or activities, regarding vessel routes for construction or operations bases considered in-combination. However, they are likely to be of a similar scale to the proposed development. 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 of the construction phase, in addition to those transiting between the site and the port.

6.4.7.20 While some OWF vessels, such as crew transport and supply vessels, may operate at higher speeds, they generally travel on designated (and therefore repeated and predictable) routes relative to each site. Other vessels, such as jack-up vessels, pilot vessels, and attending vessels, tend to travel at slower speeds or spend long periods of time stationary (jacked-up, at anchor or using dynamic positioning systems), reducing their movement and/or acoustic footprint. These factors minimise the overall disturbance to marine mammals.

6.4.7.21 Most vessel routes to and from OWFs and other offshore projects will follow existing vessel routes, to which marine mammals are likely already accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for offshore wind farms are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, most projects are likely to adopt environmental VMPs (or comply with existing Marine Wildlife Watching Codes) to minimise any potential effects on marine mammals.

6.4.7.22 Vessels are not expected to travel through the SAC outside of the project footprints and defined routes. It is therefore not anticipated that the level of vessel activity from Tier 1, 2 and 3 projects in-combination with the proposed development, would increase in the risk of vessel disturbance within the SAC boundary. However, the risk of disturbance may increase outside the SAC boundary for individuals associated with the site community, due to the presence of vessels in the wider region.

6.4.7.23 While harbour porpoises may be sensitive to vessel disturbance, evidence suggests that they are able to compensate for any short-term local displacement (Benhemma-Le Gall *et al*., 2021; 2023). Even if additional vessels are introduced, it is not expected that individual vital rates (e.g., survival and reproduction) will be negatively impacted. Vessel presence is not a novel impact for harbour porpoises in this region.

Vessel Disturbance Assessment (Harbour porpoise)

6.4.7.24 As outlined in paragraph 5.4.6.4, the relevant COs for the SAC is to maintain the species as a viable component of the site, and to avoid significant disturbance.

6.4.7.25 Individuals within or associated with the site may be disturbed and displaced by the presence of vessels, however, vessel presence will be temporary and localised therefore any effect on harbour porpoise is also expected to be temporary and localised, and not significant. 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 FCS, the in-combination 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.

6.4.7.26 Therefore, it is concluded that vessel disturbance arising 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 North Anglesey Marine SAC.

6.4.7.27 As this assessment is based on the MDO, any alternative scenario would not give rise to an effect which is more significant than has been assessed herein.

6.4.8 Other Sites with Harbour Porpoise

6.4.8.1 This section highlights all remaining SACs within the Celtic and Irish Sea MU where harbour porpoise is listed as QI or feature. Sites are listed depending on their distance to the proposed development and which jurisdiction they are designated within. Full details for each site-specific CO can be found within Annex A of this HDA.

Irish Sites

6.4.8.2 Eleven Irish sites have been screened in for further assessment:

- Codling Fault SAC lies 14.5 km from the array area and 18.3 km from the Offshore ECC;
- Blackwater Bank SAC lies 75.7 km from the array area and 70.5 km from the Offshore ECC;
- Carnsore Point SAC lies 102.5 km from the array area and 107.8 km from the Offshore ECC;
- Bunduff Lough SAC lies 201.3 km from the array area and 204.6 km from the Offshore ECC;
- Kilkieran Bay and Islands SAC lies 229.7 km from the array area and 239.6 km from the Offshore ECC;
- Inishmore Island SAC lies 232.3 km from the array area and 243.1 km from the Offshore ECC;

- West Connacht Coast SAC lies 250.2 km from the array area and 258.9 km from the Offshore ECC;
- Kenmare River SAC lies 285.4 km from the array area and 280.1 km from the Offshore ECC;
- Roaringwater Bay and Islands SAC lies 291.9 km from the array area and 295.2 km from the Offshore ECC;
- Blasket Islands SAC lies 318.7 km from the array area and 326.5 km from the Offshore ECC; and
- Belgica Mound SAC lies 424.4 km from the array area and 431.2 km from the Offshore ECC.

6.4.8.3 The COs, attributes and targets for the above sites are detailed in paragraph 5.4.7.3.

Appropriate Assessment

6.4.8.4 Given that the range of suitable habitat available to harbour porpoise is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the in-combination assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. The assessment of Rockabill to Dalkey Island SAC concluded no AEoI on harbour porpoise QI for all screened in impacts from the proposed development in-combination with other plans, projects and activities. Given the greater distance of the above sites, 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 no greater for these sites.

6.4.8.5 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development in-combination with other plans, projects and activities.

UK Sites

6.4.8.6 Three additional UK sites have been screened in for further assessment:

- West Wales Marine SAC (Wales) lies 81.9 km from the array area and 75.8 km from the Offshore ECC;
- North Channel SAC (Northern Ireland) lies 110.0 km from the array area and 100.9 km from the Offshore ECC; and
- Bristol Channel Approaches SAC (Wales/England) lies 185.5 km from the array area and 178.5 km from the Offshore ECC.

6.4.8.7 The COs, attributes and targets for the above sites are detailed in paragraph 5.4.7.9.

Appropriate Assessment

6.4.8.8 Given that the range of suitable habitat available to harbour porpoise is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for North Anglesey Marine SAC, which is designated for the same QI and is located nearer to the proposed development. The assessment for North Anglesey Marine SAC concluded no AEoI on harbour porpoise QI for all screened in impacts in-combination with other plans, projects and activities. Given the greater distance of the above sites 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 these sites.

6.4.8.9 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development in-combination with other plans, projects and activities.

French Sites

6.4.8.10 Eighteen French sites have been screened in for further assessment:

- Nord Bretagne DH lies 431.2 km from the array area and 424.4 km from the Offshore ECC;
- Mers Celtiques – Talus du golfe de Gascogne SAC lies 455.5 km from the array area and 449.5 km from the Offshore ECC;
- Récifs et landes de la Hague SAC lies 471.4 km from the array area and 464.6 km from the Offshore ECC;
- Anse de Vauville SAC lies 479.2 km from the array area and 472.3 km from the Offshore ECC;
- Côte de Granit Rose-Sept Iles SAC lies 488.4 km from the array area and 481.6 km from the Offshore ECC;
- Tregor Goëlo SAC lies 496. 3 km from the array area and 489.4 km from the Offshore ECC;
- Banc et récifs de Surtainville SAC lies 496.3 km from the array area and 489.4 km from the Offshore ECC;
- Baie de Morlaix SAC lies 510.3 km from the array area and 503.5 km from the Offshore ECC;
- Abers – Côte des Légendes SAC lies 511.9 km from the array area and 505.3 km from the Offshore ECC;
- Baie du Mont Saint-Michel SAC lies 511.9 km from the array area and 505.3 km from the Offshore ECC;

- Ouessant-Molène SAC lies 524.1 km from the array area and 517.7km from the Offshore ECC;
- Cap d'Erquy-Cap Fréhel SAC lies 539.1 km from the array area and 532.1 km from the Offshore ECC;
- Chausey SAC lies 544.4 km from the array area and 537.5 km from the Offshore ECC;
- Côtes de Crozon SAC lies 555.5 km from the array area and 505.3 km from the Offshore ECC;
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SAC lies 568.7 km from the array area and 561.8 km from the Offshore ECC;
- Baie de Saint-Brieuc – Est SAC lies 573.2 km from the array area and 566.3 km from the Offshore ECC;
- Chaussée de Sein SAC lies 573.8 km from the array area and 567.4 km from the Offshore ECC; and
- Estuaire de la Rance SAC lies 579.5 km from the array area and 572.6 km from the Offshore ECC.

6.4.8.11 The COs for the above sites are detailed in paragraph 5.4.7.13.

Appropriate Assessment

6.4.8.12 Given that the range of suitable habitat available to harbour porpoise is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the in-combination assessment for Rockabill to Dalkey Island SAC, which is designated for the same QI and is located nearer to the proposed development. The assessment of Rockabill to Dalkey Island SAC concluded no AEoI on harbour porpoise QI 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.

6.4.8.13 Therefore, it is concluded that there is no AEoI from any impacts on the harbour porpoise QI of any of these sites from the proposed development in-combination with other plans, projects and activities.

6.4.9 Other Sites with Bottlenose Dolphin

6.4.9.1 This section highlights all remaining SACs within the Irish Sea MU where bottlenose dolphins are listed as QI or feature. Full details of site-specific CO can be found within Appendix A of this HDA.

UK Sites

6.4.9.2 Additional Welsh sites identified within the Irish Sea MU and with bottlenose dolphin listed as a QI or feature have been screened in for further assessment:

- Cardigan Bay SAC lies 124 km from the Offshore ECC and lies 119 km across the Irish Sea from the array.

6.4.9.3 The COs, attributes and targets for the above sites are detailed in paragraph 5.4.8.3.

Appropriate Assessment

6.4.9.4 Given that the range of suitable habitat available to bottlenose dolphin is extensive, the likelihood and or severity of the effect experienced locally is considered to be negligible. Consideration is given to the assessment for Pen Llŷn a`r Sarnau SAC, which is designated for the same QI and is located nearer to the proposed development. The assessment of Pen Llŷn a`r Sarnau SAC concluded no AEoI on bottlenose dolphin QIs for all screened in impacts in-combination with other plans, projects and activities. Given the greater distance of the above 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.

6.4.9.5 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.

6.5 Onshore Ecology

6.5.1.1 For onshore, the cumulative assessment followed the same three stages as offshore. The long list, the initial compilation of all relevant existing, planned, or reasonably foreseeable future projects within a defined area. For biodiversity receptors, all developments within 2 km of the onshore substation (OSS) boundary and 500 m from the OES and 1 km from the O&M Base. All developments within close proximity (i.e. 1 km) of the Shangangah River catchment as well as projects with the potential to pollute the Shanganagh River catchment up to 13.2 km upstream of the project.

6.5.1.2 The long list compiled for the onshore topic chapters predominantly consisted of onshore projects, although some marine projects were also considered where these had the potential to result in cumulative effects on onshore receptors, such as the Ferry Terminal Building Development at Du n Laoghaire Harbour, due to proximity to the O&M Base.

6.5.1.3 Certain types of projects were excluded from the list which, due to their nature and scale, are unlikely to result in cumulative impacts with the Dublin Array. These include one-off housing, farm sheds/buildings, retention permission, house/building extensions/renovations, and similar small-scale developments. Additionally, projects with incomplete, withdrawn and refused application statuses were not included in the stage 1 onshore long list.

6.5.1.4 The long list was screened based on the information available and assessing potential interactions with the Dublin Array onshore infrastructure, whether they be temporal, spatial, or conceptual. This process involved a comprehensive desk study to source publicly available information on these projects using planning databases and internet searches. Relevant project parameters were drawn from EIARs or other similarly detailed planning documents, such as planning applications, licence applications, or EIA Scoping Reports. Additionally, approximate distances to the project were determined for each listed project to better understand their proximity and the potential for spatial overlap. Each EIA specialist evaluated whether projects could lead to significant cumulative effects, considering both spatial overlaps (e.g. habitat loss) and mobile receptor interactions (e.g. biodiversity). Projects without physical or temporal overlaps were screened out, ensuring a focused, evidence-based assessment.

6.5.1.5 The potential for an in-combination likely significant effect(s) that could not be excluded upon the Wicklow Mountains SAC during the stage 1 screening. All developments, including small-scale planning applications across the Shanganagh River and tributaries catchment may cause in-combination effects. Only planning applications with the potential to affect the Shanganagh River and tributaries have been considered. Strategic Infrastructure Developments (SIDs), Strategic Housing Developments (SHDs) (identified using An Bord Pleanála's map viewer and the local development plan) and residential developments >10 units with the potential to impact the Shanganagh River and tributaries catchment have been listed in Table 168.

Table 168 Plans and projects screened in for consideration within the onshore ecology in-combination assessment

ABP Case Number	Project details
313509	BusConnects Belfield/Blackrock to City Centre Core Bus Corridor Scheme
313182	BusConnects Clongriffin to City Centre Core Bus Corridor Scheme
313738	Grand Canal Storm Water Outfall Extension
313892	BusConnects Blanchardstown to City Centre Core Bus Corridor Scheme
314610	BusConnects Ballymun/Finglas to City Centre Core Bus Corridor Scheme
314056	Liffey Valley to City Centre Core Bus Corridor Scheme
314724	Railway (Metrolink - Estuary to Charlemont via Dublin Airport) Order [2022]
309812	Increase the capacity of the Dublin Waste to Energy
315306	543 apartments and a retail unit
PA0049	National Maternity Hospital
PA0043	National Pediatric Hospital, Innovation Centre and Family Accommodation Unit at St James' Hospital Campus
306725	Flood alleviation works
306583	A residential development with ancillary commercial uses
314567	Underground 110kV transmission line connections
309773	The demolition works and the creation of electrical infrastructure
308585	Clutterland Substation and underground circuit transmission lines
312131	Greater Dublin Drainage Project
303945	Glenamuck District Roads Scheme
305785	Cherrywood Strategic Development Zone (SDZ)
315449	32 apartments with all relevant associated site works
300006	42 no. residential units
317742	BusConnects Bray to City Centre Core Bus Corridor Scheme
313341	118 no. apartments and associated site works
301614	136 no. residential units (98 no. apartments and 38 no. houses)
249144	Demolition of existing dwelling and construction of 15 3-storey houses
303978	30 no. houses and 173 no. apartments with all associated site works
301522	927 no. residential units (355 no. houses and 572 no. apartments), a childcare facility and 2 no. retail units
D13A/0190	Development consisting of 46 houses
246601	Residential development of 410 no. residential units and a childcare facility with all associated site works
307415	200 no. apartments, creche and associated site works
315595	A residential development comprising 42 no. apartments, and all associated site works
305142	Construction of 12 detached houses
313321	Demolition of the existing structures on site, construction of 101 no. residential units (32 no. houses, 69 no. apartments
306758	Demolition of residential dwelling and for amendments to approved residential development
301334	Demolition of existing buildings and construction of 102 no. residential units
246572	Construction of 14 no. dwellings with all associated site works
247023	Residential development of 48 no. dwellings with all associated site works
311428	Demolition of buildings and construction of 2 retail units and 20 apartments with car and bicycle parking

ABP Case Number	Project details
301809	New residential development consisting of 50 new apartments and 1 new 2 bedroomed house
303816	Housing Development of 28 Residential Units
246304	35 no. apartments with all associated site works
D08A/1028/E	The construction of a total of 29 residential units
303796	Housing development of 16 houses
248486	Demolition of 2 dwellings and construction of 5 houses and 14 apartments with balconies, access road, parking
304981	Construction of 27 residential units in two apartment blocks
315351	Construction of 24 no. residential units
308612	Residential development consisting of 14 residential units
245603	Demolition of vacant factory building, construction of 14 no. apartments over underground car park
311210	Demolition of existing building on site and the construction of 3-5 storey over basement apartment building
PA0042	Eight-year permission for the construction of a cruise berth facility comprising a new quay, berth, and access causeway, dredging of a navigation channel and associated works
305199	Demolition of existing dwelling and construction of an infill residential scheme of 22 units
316304	Construction of 19 no. apartments
245755	Demolition of furniture store and construction of a mixed-use building over a basement carpark
316955	31 residential units and all associated site development works
301940	Construction of 20 Apartments
309807	Construction of 255 no. residential units

6.5.2 Wicklow Mountains SAC

Disturbance and displacement (construction, decommissioning and O&M)

6.5.2.1 All disturbance related to the Dublin Array project will be caused by the proposed HDD at river crossings and will affect only foraging activity and will be temporary and small in scale. Alone, this impact will not risk undermining the CO of the SAC.

6.5.2.2 The in-combination effects will not cause direct disturbance to the SAC population. However, the in-combination effects do increase the risk of disturbance and displacement of the supporting otter population; and multiple developments across the local area may inhibit dispersal of the supporting population to the SAC population.

6.5.2.3 The SAC population will only be affected if the supporting population provides an important immigration source of otters to the catchments within the SAC. This is unknown and must be assumed to be so. As such, there is potential for an in-combination effect of preventing otters for the supporting population from reaching the SAC population (i.e., inhibiting dispersal).

6.5.2.4 With the identified mitigation measures in place, it can be concluded, beyond all reasonable scientific doubt that the project, either alone or in combination with other plans or projects will not undermine the CO of Wicklow Mountains SAC. It can therefore be concluded that the project would not have an adverse effect on the integrity of the European site."

Accidental pollution (construction, decommissioning and O&M)

6.5.2.5 All identified planning proposals (in Table 168) are located across the Shanganagh River and tributaries. These rivers are not hydrologically connected to the Wicklow Mountains SAC and there is no possibility of pollution arising from the project and flowing downstream into the SAC. Therefore, no direct effects are possible on the otter population within the Wicklow Mountains SAC.

6.5.2.6 There is potential for accidental pollution to occur during construction and decommissioning works similar to the Dublin Array project. In isolation these effects are imperceptible. However, in-combination the pollutants cumulate and could negatively affect both otters directly and indirectly via fish kills and depletion of prey, such as salmonids. This effect is limited to the potential supporting population of otters in the Shanganagh Rivers and tributaries and no direct impact the SAC population is expected.

6.5.2.7 Substances such as grease, oil, fuel, anti-fouling paints and grouting materials may be accidentally released or spilt into the aquatic environment. Dublin Array is committed to the use of best-practice techniques and due diligence throughout all construction, O&M and decommissioning activities. This commitment ensures the use of appropriate preventative measures and serves as mitigation against this type of pollution incident. 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 offshore infrastructure, O&M Base or onshore works. It is anticipated that the other projects considered on this list will have similar mitigation measures.

6.5.2.8 With the identified mitigation measures in place, it can be concluded, beyond all reasonable scientific doubt that the project, either alone or in combination with other plans or projects will not impact a supporting population of otters in the Shanganagh River and tributaries and therefore not undermine the CO of Wicklow Mountains SAC. It can therefore be concluded that the project would not have an adverse effect on the integrity of the European site."

Habitat loss or disturbance

6.5.2.9 Habitat losses across the Dublin Array project when considered alone will not undermine the conservation objectives for otters relating to the Wicklow Mountains SAC. When assessed in-combination with the other planning proposals (listed in Table 168), there will be a larger scale loss and disturbance of habitat However, these relate to terrestrial habitats that are of limited value to otters and this impact will be negligible to the potential supporting population within the Shanganagh River and tributaries.

6.5.2.10 The otters within this catchment are likely highly habituated to the urban environment. However, there is a risk that further habitat losses close to river habitats may lead to an overall reduction in habitat suitable for holt creation across the catchment, which may reduce the breeding success of a supporting otter population to the SAC. Furthermore, developments located between catchments may inhibit otters from traversing across land and may prevent the supporting population in the Shanganagh River and tributaries from supplementing the SAC otter population.

6.5.2.11 With the identified mitigation measures in place, it can be concluded, beyond all reasonable scientific doubt that the project, either alone or in combination with other plans or projects will not undermine the CO of Wicklow Mountains SAC. It can therefore be concluded that the project would not have an adverse effect on the integrity of the European site."

Underwater Noise

6.5.2.12 The Dublin Array project alone would create underwater noise levels that may disturb a supporting population of otters in the Shanganagh River and tributaries. However, the SAC QI population of otters would not be directly affected, and the impacts will be highly localised and will not affect the distribution of the potentially supporting population. This impact is considered to be imperceptible to the conservation objectives of the SAC as a result.

6.5.2.13 When considered in-combination with the other planning proposals (listed in Table 168) there will be additional localised underwater noise effects. However, because this effect is so minor and short-lived for each project, it could not affect the survival of the individual otter or affect its ability to reproduce. Therefore it could not affect the ability of this population to support the otter population within the SAC through the exchange of individuals and is not expected to result in any reduction in supporting otter population or long-term disruption to their distribution to the SAC.

6.5.2.14 Therefore, this impact will not undermine the conservation objectives for QI otters within the Wicklow Mountains SAC and can be scoped out from the NIS.

Effects on prey

6.5.2.15 Any effects on prey will not affect the SAC otter population directly and the only risk is to the Shanganagh River and tributaries (i.e., a potentially supporting population of otters to the SAC). This will only affect the SAC population if the supporting population is vital to maintaining the abundance and distribution of the SAC otter population. This is unknown and must be assumed to be important to the SAC.

6.5.2.16 Effects on prey are likely to be caused via underwater noise or pollution events (both of which are detailed further above). When considered in-combination with other developments, the impact, which may be imperceptible for each development, would become cumulative and may reach a threshold that would reduce prey abundance and therefore would impact a potentially supporting population of otter and potentially the conservation objectives of the SAC as a result. As the other developments could cause a cumulative effect, which in isolation are imperceptible. However, cumulate to cause an impact on the prey through a reduction of prey available for a potentially supporting population of otter.

6.5.2.17 With the identified mitigation measures in place, it can be concluded, beyond all reasonable scientific doubt that the project, either alone or in combination with other plans or projects will not undermine the CO of Wicklow Mountains SAC. It can therefore be concluded that the project would not have an adverse effect on the integrity of the European site."

6.6 Ornithology

6.6.1.1 The potential for an in-combination effect upon the designated sites grouped under 'offshore and intertidal ornithology', as relevant to features and effect pathways screened in for LSE is provided below.

6.6.1.2 Of the sites and species assessed in the project alone assessment (Section 5.6), only sites/species where the predicted impact exceeded a 0.05% increase in baseline mortality are considered in the in-combination assessment (based on the most recent population count). For any impacts below this threshold, the impact is considered to be so low that it will not make any material contribution to in-combination impacts. In addition, impacts where the number of mortalities is <0.2 individuals per annum are not included as they are considered sufficiently small that they would make no material contribution to an in-combination impact.

6.6.1.3 In addition, for sites/species no other projects have submitted project impacts, (e.g., for common tern at Dalkey Island SPA, shag at Lambay Island SPA and red-breasted merganser at Dungarvan Harbour SPA) no assessment is provided as the in-combination impact would be equal to that of the project alone.

6.6.1.4 Based on this, the following sites and species were screened into the in-combination assessment:

- North-West Irish Sea SPA
  - Red-throated diver, great northern diver, common scoter (disturbance and displacement (O&M))
- South Dublin Bay and River Tolka SPA
  - Common tern (collision (O&M))
- Howth Head Coast SPA
  - Kittiwake (collision (O&M))

- Ireland's Eye SPA
  - Guillemot, razorbill (disturbance and displacement (O&M))
  - Kittiwake, herring gull (collision (O&M))
- Lambay Island SPA
  - Guillemot, razorbill (disturbance and displacement (O&M))
  - Kittiwake, herring gull, lesser black-backed gull (collision (O&M))
- Wicklow Head SPA
  - Kittiwake (collision (O&M))
- Morecambe Bay and Duddon Estuary SPA
  - Herring gull (collision (O&M))

6.6.1.5 The in-combination assessment considers impacts from OWF and tidal energy projects only, with all other developments (e.g., oil and gas) unlikely to have any collision or displacement impacts. It is noted that other impacts on birds, such as fisheries bycatch, may also be present within the region. However, these longstanding impacts are considered to be part of the existing baseline and any impacts are generally too inconsistent and unreliably to inform as part of a quantitative assessment. These impacts are therefore not considered further here. A list of projects considered within the in-combination assessment is detailed in Table 169.

Table 169 Plans and projects screened in for consideration within the ornithology in-combination assessment

Project/Plan	Status	No. of turbines	Overlap with Dublin Array
Tier 1			
Burbo Bank Extension	Operational	32	Operational
Walney 1 + 2	Operational	102	Operational
Walney Extension 3 + 4	Operational	87	Operational
West of Duddon Sands	Operational	108	Operational
Ormonde	Operational	30	Operational
Robin Rigg	Operational	60	Operational
Tier 2			
Awel-y-Mor	Consented	Maximum 50	Operational
Erebus	Consented	Seven	Operational
Twinhub	Consented	Four	Operational
White Cross	Consented	Seven	Operational

Project/Plan	Status	No. of turbines	Overlap with Dublin Array
Morlais Tidal Energy	Consented	N/A	Operational
Tier 3			
Morgan	Submitted	Maximum 68	Operational
Morecambe	Submitted	40	Operational
Mona	Submitted	Maximum 68	Operational
Oriel	Submitted	Maximum 25	Potential overlap in Construction; Operation
NISA	Submitted	Maximum 49	Potential overlap in Construction; Operation
Codling	Submitted	Maximum 75	Potential overlap in Construction; Operation
Arklow Bank	Submitted	Maximum 56	Potential overlap in Construction; Operation

6.6.1.6 Where available, a seasonal breakdown of in-combination is presented, however for older projects this is often not provided. Therefore, the main basis of the in-combination considers annual total impacts only.

6.6.1.7 For kittiwake, the project alone impact considered combined collision and displacement impacts, however displacement is not assessed for kittiwake as standard in English and Welsh projects due to their low vulnerability, while other East Coast Phase One Irish projects also did not assess this impact at time of writing. Therefore, the in-combination assessment will consider only collision impacts, though to represent a precautionary approach the combined collision and displacement impacts will be carried through for Dublin Array alone.

6.6.2 North-west Irish Sea SPA

Features and Effects for Assessment

6.6.2.1 Potential for LSE in-combination has been identified for the following features of the North-West Irish Sea SPA:

- Red-throated diver, great northern diver, common scoter
  - Disturbance and displacement (O&M)

Red-throated Diver

Disturbance and Displacement (O&M)

6.6.2.2 For red-throated divers in the non-breeding season, a pragmatic displacement buffer of at least 10 km has recently been recommended for use in impact assessments, where a project is within 10 km of a Special Protection Area (SPA) designated for non-breeding red-throated divers. Three projects (NISA, Dublin Array and Oriel OWF) are within 10km of the North-west Irish Sea SPA.

6.6.2.3 The NISA EIAR provided estimated abundances out to 4 km of the array area, with an estimated peak of five birds in both the spring migration period (February to April) and the breeding season (May to August). However, it should be noted that there are no red-throated diver breeding sites within mean maximum foraging range of the east coast Phase 1 projects, and that birds recorded in April and May are considered likely to be pre-breeding congregations (Hutchinson, 1989). Red-throated diver abundances were not assessed for displacement impacts in the O&M phase for Oriel due to the localised and infrequent nature of potential impacts.

6.6.2.4 Dublin Array is 3.4km from the NWIS SPA. Based on the remaining overlap of the 10km buffer and the NWIS SPA, 24 red-throated divers are estimated to be within the 10km buffer (see Section 5.6.8).

6.6.2.5 The total number of red-throated diver across these three projects is therefore 34 birds (Table 170).

6.6.2.6 As highlighted in the SNCBs guidance, displacement will not be 100% across the distance over which the effect occurs but there will likely be a gradation, with decreasing effects at increased distance from an OWF (SNCBs, 2022b).

6.6.2.7 Evidence from studies at operational OWFs also indicates that displacement effects are likely to decrease with distance from the array area. Studies in the German North Sea have shown that red-throated diver abundance declined within a wind farm and surrounding 1 km buffer by 94%, and within 10 km of the wind farm by 52% (Garthe *et al*., 2023). In the UK North Sea, Webb *et al*. (2017) estimated a decrease in density of 83% within the Lincs, Lynn & Inner Dowsing OWF based on visual and digital aerial surveys, with the displacement effect decreasing to 55% at 4 km and 34% at 8 km from the OWF. Post-construction monitoring at Kentish Flats in the UK southern North Sea using boat-based surveys indicated a 95% displacement rate within the OWF site, decreasing to 63% at 3 km from the OWF site (Percival *et al*. 2010).

6.6.2.8 Modelling has predicted that even in a scenario where there were many OWFs in an area, the increase in population level mortality for red-throated divers would be less than 2% (Topping and Petersen 2011).

6.6.2.9 Applying a worst-case mortality rate of 2% to the estimated 34 red-throated divers potentially displaced from the overlap area within the North West Irish Sea SPA would result an estimated mortality of (0.68) red-throated divers, or 0.34 mortalities when considering a more realistic mortality rate of 1% (Table 171). Therefore, less than one red-throated diver from the North West Irish Sea SPA would suffer mortality as a result of potential cumulative displacement associated with the three OWF projects considered here.

6.6.2.10 Based on a citation population of 538 birds (NPWS, 2023) and a baseline mortality of 121 (120.5) per annum (based on an average mortality of 0.224), the predicted increase in baseline mortality as a result of one mortality is 0.564% based on a 2% mortality rate, and 0.282% based on a 1% mortality rate and as such would be indistinguishable from natural fluctuations in population.

6.6.2.11 There is, therefore, no potential for an AEoI to the population conservation objective of the red-throated diver feature of the North-West Irish Sea SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the red-throated diver feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of red-throated diver at the North-West Irish Sea SPA. Conclusions against all conservation objectives are provided in Table 172.

Table 170 Seasonal and annual abundance of red-throated diver at risk of disturbance and displacement attributed to the North-West Irish Sea SPA for Dublin Array in-combination with other plans and projects.

Project	Tier	Seasonal abundance attributed to SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	-	-	-
Erebus	2	-	-	-
Morgan	3	-	-	-
Mona	3	-	-	-
Morecambe	3	-	-	-
Arklow	3	-	-	-
Codling	3	-	-	-
NISA	3	5	5	10
Oriel	3	-	-	-
Dublin	3	0	24	24
Total	**-**	5	29	34

Table 171 Annual red-throated diver increase in baseline mortality due to disturbance and displacement mortalities at the North-West Irish Sea SPA for all OWFs considered in the in-combination assessment.

Season	Abundance of adults at risk of disturbance and displacement apportioned to the SPA	Predicted increase in mortality (breeding adults per annum)		SPA population size and baseline mortality rates (individuals per annum)		% Increase in baseline mortality (citation count)		% Increase in baseline mortality (most recent count)	
		100% displacement, 1% mortality	90% - 100% displacement, 1%-2% mortality	Citation population (baseline mortality)	Most recent population (baseline mortality)	100% displacement, 1% mortality	90% - 100% displacement, 1%-2% mortality	100% displacement, 1% mortality	90% - 100% displacement, 1%-2% mortality
Annual Total	34	0.34	0.31-0.68	538 (120.5)	-	0.282	0.254-0.564	-	-

Table 172. In-combination displacement assessment conclusions for red-throated diver at North-west Irish Sea SPA.

Conservation Objective	Conclusion
No significant decline in individuals of non-breeding population size;	For citation count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. Additionally, potential displacement may occur within only 4.5% of the total area of the SPA. There is, therefore, no potential for an AEoI to the population or spatial distribution conservation objectives of the red-throated diver feature of North-west Irish Sea SPA in relation to potential displacement effects from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population;	
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;	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the red-throated diver at North-west Irish Sea SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
The number, location, shape and area of barriers to connectivity and site use do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al*., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the red-throated diver at North-west Irish Sea SPA in relation to barrier effects from Dublin Array in-combination with other projects.

Great Northern Diver

Disturbance and Displacement (O&M)

6.6.2.12 For great northern diver, the SNCB guidance recommends that a displacement buffer of 4 km should be used in assessments (SNCBs, 2022b). Assuming that displacement effects on great northern diver extend to 4 km beyond the array area boundary, there is the potential for individuals of this species within the North West Irish Sea SPA to be displaced due to the presence of three projects (NISA, Dublin Array and Oriel OWF) during the operation and maintenance phase.

6.6.2.13 As outlined in the alone assessment (Section 5.6.8), the impact on great northern diver was assessed as not significant owing to the low presence of this species in the Dublin Array survey area (peak of three individuals), and the low potential for disturbance in the North-West Irish Sea SPA (If displacement effects on great northern diver extend out to 4km from the array area, then this could potentially affect an area of 3.48km^2 within the North-west Irish Sea SPA. This equates to approximately 0.15% of the overall SPA area).

6.6.2.14 At the time of this assessment, cumulative numbers of great northern divers are not available for the NISA and Oriel projects. However, based on the low magnitude of impact concluded based on the alone assessment, any effect arising from displacement of birds with the SPA associated with Dublin Area would be negligible, and would not add significantly to any cumulative displacement effects arising from the NISA or Oriel projects.

6.6.2.15 There is, therefore, no potential for an AEoI to the population conservation objective of the great northern diver feature of the North-West Irish Sea SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the great northern diver feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of great northern diver at the North-West Irish Sea SPA.

Common Scoter

Disturbance and Displacement (O&M)

6.6.2.16 For common scoter, the SNCB guidance recommends that a displacement buffer of 4 km should be used in assessments (SNCBs, 2022b). Assuming that displacement effects on common scoter extend to 4 km beyond the array area boundary, there is the potential for individuals of this species within the North West Irish Sea SPA to be displaced due to the presence of three projects (NISA, Dublin Array and Oriel OWF) during the operation and maintenance phase.

6.6.2.17 As outlined in the alone assessment (Section 5.6.8), the impact on common scoter was assessed as not significant owing to the low presence of this species in the Dublin Array survey area (peak of 55 individuals), and the low potential for disturbance in the North-West Irish Sea SPA (If displacement effects on common scoter extend out to 4km from the array area, then this could potentially affect an area of 3.48km^2 within the North-west Irish Sea SPA. This equates to approximately 0.15% of the overall SPA area).

6.6.2.18 At the time of this assessment, cumulative numbers of common scoter are not available for the NISA and Oriel projects. However, based on the low magnitude of impact concluded based on the alone assessment, any effect arising from displacement of birds with the SPA associated with Dublin Area would be negligible, and would not add significantly to any cumulative displacement effects arising from the NISA or Oriel projects.

6.6.2.19 There is, therefore, no potential for an AEoI to the population conservation objective of the common scoter feature of the North-West Irish Sea SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the common scoter feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of common scoter at the North-West Irish Sea SPA.

6.6.3 South Dublin Bay and River Tolka SPA

Features and Effects for Assessment

6.6.3.1 Potential for LSE in-combination has been identified for the following features of South Dublin Bay and River Tolka SPA:

- Common tern
  - Collision Risk (O&M)

Common tern

Collision Risk (O&M)

6.6.3.2 South Dublin Bay and River Tolka Estuary SPA is 12.06km (around land) from Dublin Array, within the MMFR ± 1SD of common tern (18.0±8.9 km; Woodward *et al*., 2019). Common tern have been screened into the assessment for collision risk as they are susceptible to collision due to their distribution (Bradbury *et al*., 2014).

6.6.3.3 Common tern has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Only one other project (Codling) has apportioned impacts to the common tern feature of this SPA, therefore the impact from this project in-combination with Dublin Array is considered for this assessment. Impacts from Codling in-combination with Dublin Array are presented below (Table 173).

Table 173 Seasonal and annual common tern collision mortalities at South Dublin Bay and River Tolka Estuary SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual Total
Codling	3	0.15	0.02	2.11	2.27
Dublin	3	0.00	1.27	0.01	1.28
Total	-	0.15	1.29	2.12	3.55

Annual Total

6.6.3.4 As shown in Table 174, the predicted resultant in-combination mortality across all defined seasons for South Dublin Bay and River Tolka Estuary SPA is four (3.55) individuals. Of the total in-combination predicted collision mortality for common tern attributed to South Dublin Bay and River Tolka Estuary SPA, Dublin Array contributes one (1.28) individual.

6.6.3.5 Based on the 2007 citation colony count of 800 breeding adults and an annual background mortality of 93.6 individuals, the addition of 3.55 predicted breeding adult mortalities per annum would represent a 3.071% increase in baseline mortality. When considering the latest colony count of 988 individuals and an annual background mortality of 115.6 adults, this would represent a 3.071% increase in baseline mortality.

6.6.3.6 For both the citation and latest colony count, the predicted increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through PVA.

Table 174 Annual common tern increase in baseline mortality due to collision mortalities at South Dublin Bay and River Tolka Estuary SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	3.55	3.792	3.071

PVA Analysis

6.6.3.7 The PVA results are shown in Table 175. Assuming a predicted annual mortality of four (3.55) breeding adults, the CGR and CPS values from South Dublin Bay and River Tolka Estuary SPA are 0.996 and 0.859 respectively. This represents a 0.430% reduction in GR and a reduction in final population size of 14.120%. For further details regarding the PVA results presented here see the PVA Appendix 4.3.6-7 of the EIAR.

6.6.3.8 The common tern colony at South Dublin Bay and River Tolka Estuary SPA has displayed a continued increase in population size since 1999. Between the Seabird 2000 and Seabirds count 2015-2021, the colony grew from 216 pairs to 494 pairs, translating to an annual colony growth of 5% (Burnell *et al.*, 2023). The in-combination impact is below 0.5% and as such would be indistinguishable from natural fluctuations in population and would cause no reversal in the observed growth rate.

6.6.3.9 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems because the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.3.10 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e. the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.3.11 There is, therefore, no potential for an AEoI to the population conservation objective of the common tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential collision risk from Dublin Array in-combination. Therefore, subject to natural change, the common tern feature will be maintained in the long term with respect to the potential for collision risk. Conclusions against all conservation objectives are provided in Table 176.

Table 175 PVA outputs for breeding adult common tern at South Dublin Bay and River Tolka Estuary SPA for Dublin Array alone and in-combination with other projects

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone	1.28	0.999 (0.002)	0.949 (0.075)	0.150	5.130
In-combination	3.55	0.996 (0.002)	0.859 (0.070)	0.430	14.120

Table 176. In-combination displacement assessment conclusions for common tern at South Dublin Bay and River Tolka SPA.

Conservation Objective	Conclusion
No significant decline in individuals of passage population or no significant decline in the number of apparently occupied nests;	See results of PVA in the PVA Analysis Section above.
No significant decline in the mean number of fledged young per breeding pair;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the common tern feature of South Dublin Bay and River Tolka Estuary SPA.

Conservation Objective	Conclusion
No significant decline in the number of passage individuals;	Common tern is not vulnerable to displacement from the proposed development. According to Bradbury *et al.* (2014) and Dierschke *et al*. (2016) common tern sensitivity to disturbance and displacement is 'low'. There is, therefore, no potential for an AEoI to the conservation objectives of the common tern feature of South Dublin Bay and River Tolka Estuary SPA in relation to potential displacement effects from Dublin Array in-combination with other projects.
No significant decline in number, location or area of roosting areas or breeding colonies;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the common tern at of South Dublin Bay and River Tolka Estuary SPA in relation to breeding/roost site disturbance from Dublin Array in-combination with other projects.
No significant decline in the prey biomass available; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the common tern at South Dublin Bay and River Tolka Estuary SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
No significant increase in barriers to connectivity.	For most collision risk species 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'. There is, therefore, no potential for an AEoI to the COs of the common tern at South Dublin Bay and River Tolka Estuary SPA in relation to barrier effects from Dublin Array in-combination with other projects .

Howth Head Coast SPA

Features and Effects for Assessment

6.6.3.12 Potential for LSE in-combination has been identified for the following features of Howth Head Coast SPA:

- Kittiwake
  - Collision Risk (O&M)

Kittiwake

Collision Risk (O&M)

6.6.3.13 Howth Head Coast SPA is 8.5km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al.,* 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.3.14 Kittiwake has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for kittiwake (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Howth Head Coast SPA. These projects have also apportioned impacts to kittiwake from Howth Head Coast SPA (Table 177).

6.6.3.15 The main basis of the assessment considers results which incorporate macro-avoidance into the Dublin collision risk impacts, which is deemed most ecologically relevant by not double counting mortalities, and based on a displacement rate of 30% and mortality rate of 1% for Dublin displacement impacts. However, impacts without macro-avoidance applied are also presented in Table 177.

Annual Total

6.6.3.16 As shown in Table 178, the predicted resultant in-combination mortality across all defined seasons for Howth Head Coast SPA is eight (7.66) individuals. Of the total in-combination predicted collision mortality for kittiwake attributed to Howth Head Coast SPA, Dublin Array contributes three (3.02) individuals.

6.6.3.17 Based on the 1999 citation colony count of 4,538 breeding adults and an annual background mortality of 662.5 individuals, the addition of eight predicted breeding adult mortalities per annum would represent a 1.156% increase in baseline mortality. When considering the latest colony count of 3,546 individuals and an annual background mortality of 517.7 adults, this would represent a 1.480% increase in baseline mortality.

6.6.3.18 For both the citation and latest colony count, the predicted increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through PVA.

Table 177 Seasonal and annual kittiwake collision mortalities at Howth Head SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual Total
Awel-y-Mor	2	-	-	-	0.10
Erebus	2	-	-	-	0.01
Morgan	3	-	-	-	0.40
Mona	3	-	-	-	0.16
Morecambe	3	-	-	-	0.38
Arklow	3	-	-	-	2.60
Codling	3	0.05	0.71	0.09	0.84
NISA	3	0.05	0.30	0.02	0.37
Oriel	3	0.10	0.21	0.08	0.39
Dublin (CRM + 30/1 displacement)	3	-	-	-	3.32
Dublin (CRM + 30/3 displacement)	3	-	-	-	3.92
Dublin (CRM + 30/1 displacement) with macro-avoidance	3	-	-	-	2.41
Dublin (CRM + 30/3 displacement) with macro-avoidance	3	-	-	-	3.02
Total (Dublin (CRM + 30/1 displacement))		-	-	-	8.57
Total (Dublin (CRM + 30/3 displacement))		-	-	-	9.17

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual Total
Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance		-	-	-	7.66
Total (Dublin (CRM + 30/3 disp)) with macro-avoidance		-	-	-	8.27

Table 178 Annual kittiwake increase in baseline mortality due to collision mortalities at Howth Head SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total (Dublin (CRM + 30/1 displacement))	8.57	1.294	1.656
Annual Total (Dublin (CRM + 30/3 displacement))	9.17	1.384	1.772
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	7.66	1.156	1.480
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	8.27	1.249	1.598

PVA Analysis

6.6.3.19 The PVA results are shown in Table 179. Assuming a predicted annual mortality of eight (7.66) breeding adults, the CGR and CPS values from Howth Head Coast SPA are 0.998 and 0.913 respectively. This represents a 0.250% reduction in GR and a reduction in final population size of 8.690%. For further details regarding the PVA results presented here see the PVA Appendix 4.3.6-7 of the EIAR.

6.6.3.20 The kittiwake colony at Howth Head Coast SPA has displayed a continued decrease in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 1773 individuals. This translates to an annual colony GR of -1.69% (JNCC, 2023). However, the in-combination impact is below 0.5% (difference in GR = 0.190%) and therefore, despite ongoing declines, the predicted in-combination impacts will be indistinguishable from natural fluctuations and will not cause any material contribution to ongoing trends.

6.6.3.21 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.3.22 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e.,. the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.3.23 There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Howth Head Coast SPA in relation to potential collision risk from Dublin Array in-combination with other projects. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Howth Head Coast SPA. Conclusions against all conservation objectives are provided in Table 180.

Table 179 PVA outputs for breeding adult kittiwake at Howth Head SPA for Dublin Array alone and in-combination with other projects

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Annual Total (Dublin (CRM + 30/1 displacement))	3.32	0.999 (0.002)	0.963 (0.074)	0.100	3.750
Annual Total (Dublin (CRM + 30/3 displacement))	3.92	0.999 (0.002)	0.954 (0.073)	0.130	4.640
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	2.41	0.999 (0.002)	0.971 (0.075)	0.080	2.860
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	3.02	0.999 (0.002)	0.964 (0.076)	0.100	3.580
In-combination					
Annual Total (Dublin (CRM + 30/1 displacement))	8.57	0.997 (0.002)	0.901 (0.070)	0.280	9.860
Annual Total (Dublin (CRM + 30/3 displacement))	9.17	0.997 (0.002)	0.894 (0.070)	0.310	10.640
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	7.66	0.998 (0.002)	0.913 (0.071)	0.250	8.690

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	8.27	0.997 (0.002)	0.906 (0.072)	0.270	9.440

Table 180. In-combination displacement assessment conclusions for kittiwake at Howth Head Coast SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Howth Head SPA.
There is sufficient availability of suitable nesting throughout the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding/roost site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to breeding/roost site disturbance from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of

Conservation Objective	Conclusion
	interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Howth Head SPA in relation to barrier effects from Dublin Array in-combination with other projects.

6.6.4 Ireland's Eye SPA

Features and Effects for Assessment

6.6.4.1 Potential for LSE in-combination has been identified for the following features of Ireland's Eye SPA:

- Razorbill
  - Disturbance and Displacement (O&M)
- Guillemot
  - Disturbance and displacement (O&M)
- Herring gull
  - Collision risk (O&M)
- Kittiwake
  - Collision risk (O&M)

Razorbill

Disturbance and Displacement (O&M)

6.6.4.2 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR +1SD of razorbill (88.7+75.9 km; Woodward *et al.*, 2019). Razorbill have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al.*, 2014).

6.6.4.3 Razorbill has also been screened in for the O&M phases to assess the potential for an AEoI from disturbance and displacement from Dublin Array in-combination with other OWFs and tidal projects. Based on the MMFR +1SD for razorbill (Woodward *et al.*, 2019), there are several other OWF and tidal projects within foraging range from Ireland's SPA. These projects have also apportioned impacts to razorbill from Ireland's Eye SPA (Table 181).

Annual Total

6.6.4.4 The in-combination predicted abundance of razorbill prone to displacement attributed to Ireland's Eye SPA across all defined seasons is 407 (406.56) individuals (Table 182). Of these, Dublin Array contributes a total of 146 (146.25) individuals to this total. When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult razorbill from Ireland's Eye SPA is estimated to be two (1.64) breeding adults per annum. The full range of potential impacts are presented in Table 182.

6.6.4.5 Based on the 2001 citation colony count of 920 breeding adults and annual background mortality of 97 (96.6) individuals, the addition of two (1.64) predicted breeding adult mortalities per annum would represent a 1.702% increase in baseline mortality. However, when considering the more recent (2015) colony count of 1,600 individuals and an annual background mortality of 168 (168.0) adult mortalities per annum, this would represent a 0.979% increase in baseline mortality. Though the predicted impact exceeds a 1% increase in baseline mortality based on the citation population, the impact is <1% based on the more recent count, with this impact considered more realistic due to the population increase that has occurred at this site. Based on this, the impact is considered to be indistinguishable from natural fluctuations in the population. For both the citation colony count and the most recent count, the predicted increase in baseline mortality exceeds 1%, and therefore further consideration is given in the form of PVA.

Table 181 Seasonal and annual razorbill disturbance and displacement mortalities at Ireland's Eye SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Abundances Attributed to the SPA				
		Pre-breeding	Breeding	Post-breeding	Migration-free winter	Annual total
Awel-y-Mor	2	-	4.00	-	-	4.00
Erebus	2	-	-	-	-	NA
Morgan	3	-	-	-	-	NA
Mona	3	-	-	-	-	NA
Morecambe	3	1.00	0.00	1.00	1.00	3.00
Minesto[29]	3	0.03	1.70	0.15	0.12	2.00
Oriel	3	-	-	-	-	28
Codling	3	1.00	50.4	11.0	2.8	65.20
Arklow	3	-	-	-	-	140

[29] A seasonal breakdown of impacts was not available for Minesto. A seasonal breakdown is needed for auk species due to the different mortality rates applied in the breeding versus non-breeding season based on NatureScot guidance. Therefore the annual total was divided into the breeding and non-breeding season based on the proportion of birds in each season from data in other projects.

Project	Tier	Seasonal Abundances Attributed to the SPA				
		Pre-breeding	Breeding	Post-breeding	Migration-free winter	Annual total
NISA	3	0.25	8.55	0.25	9.06	18.11
Dublin	3	1.21	138.57	5.24	1.23	146.25
Total		**3.49**	**199.22**	**17.64**	**14.21**	**406.56**

Table 182 Annual razorbill increase in baseline mortality due to disturbance and displacement mortalities at Ireland's Eye SPA for all OWFs considered in the in-combination assessment.

Season	Abundance of adults at risk of disturbance and displacement apportioned to the SPA (plus 2km buffer)	Predicted increase in mortality (breeding adults per annum)			% Increase in baseline mortality (citation count)			% Increase in baseline mortality (most recent count)		
		50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality
Annual Total	407	2.03	1.22 – 2.85	3.80 – 6.61	2.104	1.263 – 2.946	3.932 – 6.845	1.210	0.726 – 1.694	2.261 – 3.936

PVA Analysis

6.6.4.6 The PVA results are shown in Table 183. Assuming a predicted annual mortality of 2.03 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Ireland's Eye SPA are 0.999 and 0.949 respectively. This represents a 0.140% reduction in GR and a reduction in final population size of 5.110%. For further details regarding the PVA results presented here see the PVA Appendix.

6.6.4.7 The razorbill colony at Ireland's Eye SPA has displayed a continued increase in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 1,600 individuals. This translates to an annual colony GR of 7.3% (JNCC, 2023). The in-combination impact (CGR) is below 0.5% and therefore, the predicted in-combination impacts will be indistinguishable from natural fluctuations and will not cause any material change to this ongoing colony growth.

6.6.4.8 When considering the realistic worst case scenario based on SNCB guidance (70% displacement, 2% mortality) and the worst case scenario based on NatureScot guidance (60% displacement, 3% and 5% mortality) the same conclusion is true with predicted impacts below a 0.5% difference in CGR.

6.6.4.9 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.4.10 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.4.11 There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill feature of Ireland's Eye SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of razorbill at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 184.

Table 183 PVA outputs for breeding adult razorbill at Ireland's Eye SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Project alone (50%, 1%)	0.73	1.000 (0.002)	0.981 (0.065)	0.050	1.930
Project alone (70%, 2%)	2.05	0.999 (0.002)	0.950 (0.064)	0.140	5.000
Project alone (60% displacement, 3 and 1% mortality)	2.54	0.998 (0.002)	0.939 (0.063)	0.180	6.070
Project alone (60% displacement, 5% and 3% mortality)	4.30	0.997 (0.002)	0.897 (0.060)	0.300	10.310
In-combination					
In-combination (50%, 1%)	2.03	0.999 (0.002)	0.949 (0.063)	0.140	5.110
Project alone (70%, 2%)	2.85	0.998 (0.002)	0.931 (0.063)	0.210	6.940
In-combination (60% displacement, 3 and 1% mortality)	3.80	0.997 (0.002)	0.908 (0.061)	0.270	9.190
In-combination (60% displacement, 5% and 3% mortality)	6.61	0.995 (0.002)	0.844 (0.058)	0.470	15.610

Table 184. In-combination displacement assessment conclusions for razorbill at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long term SPA population trend is stable or increasing: Individual (IND)	See results of PVA in the PVA Analysis Section above
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA;	
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them , as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.

Guillemot

Disturbance and Displacement (O&M)

6.6.4.12 Ireland's Eye SPA is 22.5 km (around land) from Dublin Array, within the MMFR +1SD of guillemot (73.2 ± 80.5km; Woodward *et al.*, 2019). Guillemot have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al.*, 2014).

6.6.4.13 Guillemot has also been screened in for the O&M phases to assess the potential for an AEoI from disturbance and displacement from Dublin Array in-combination with other OWFs and tidal projects. Based on the MMFR +1SD for guillemot (Woodward *et al*., 2019), there are several other OWF and tidal projects within foraging range from Ireland's SPA. These projects have also apportioned impacts to guillemot from Ireland's Eye SPA (Table 185).

Annual total

6.6.4.14 The in-combination predicted abundance of guillemot prone to displacement attributed to Ireland's Eye SPA across all defined seasons is 1,983 (1,982.89) individuals (Table 186). Of these, Dublin Array contributes a total of 1,060 (1,059.56) individuals to this total. When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult guillemot from Ireland's Eye SPA is estimated to be ten (9.91) breeding adults per annum. The full range of potential impacts are presented in Table 186.

6.6.4.15 Based on the 2001 citation colony count of 3,950 breeding adults and annual background mortality of 241 (241.0) individuals, the addition of ten (9.91) predicted breeding adult mortalities per annum would represent a 4.115% increase in baseline mortality. However, when considering the more recent (2015) colony count of 4,410 individuals and an annual background mortality of 269 (269.0) adult mortalities per annum, this would represent a 3.686% increase in baseline mortality. For both the citation colony count and the most recent count, the predicted increase in baseline mortality exceeds 1%, and therefore further consideration is given in the form of PVA.

Table 185 Seasonal and annual guillemot disturbance and displacement mortalities at Ireland's Eye SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Abundances Attributed to the SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	8.00	-	8.00
Erebus	2	-	-	NA
Morgan	3	-	-	NA
Mona	3	-	-	NA
Morecambe	3	-	-	NA
Minesto[30]	3	33.42	6.58	40.00
Oriel	3	28	18.57	46.57
Codling	3	131.4	44.2	175.60
Arklow	3	185.01	40.00	225.01
NISA	3	218.19	209.96	428.15
Dublin	3	1,052.73	6.83	1,059.56
Total		**1,656.75**	**326.14**	**1,982.89**

[30] A seasonal breakdown of impacts was not available for Minesto. A seasonal breakdown is needed for auk species due to the different mortality rates applied in the breeding versus non-breeding season based on NatureScot guidance. Therefore the annual total was divided into the breeding and non-breeding season based on the proportion of birds in each season from data in other projects.

Table 186 Annual guillemot increase in baseline mortality due to disturbance and displacement mortalities at Ireland's Eye SPA for all OWFs considered in the in-combination assessment.

Season	Abundance of adults at risk of disturbance and displacement apportioned to the SPA (plus 2km buffer)	Predicted increase in mortality (breeding adults per annum)			% Increase in baseline mortality (citation count)			% Increase in baseline mortality (most recent count)		
		50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality
Annual Total	1,983	9.91	5.95 – 27.76	31.78 – 55.57	4.115	2.469 – 11.521	13.189 – 23.064	3.686	2.211 – 10.320	11.813 – 20.658

PVA Analysis

6.6.4.16 The PVA results are shown in Table 187. Assuming a predicted annual mortality of 9.91 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Ireland's Eye SPA are 0.998 and 0.914 respectively. This represents a 0.250% reduction in GR and a reduction in final population size of 8.620%. For further details regarding the PVA results presented here see the PVA Appendix.

6.6.4.17 The guillemot colony at Ireland's Eye SPA has displayed a continued increase in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 4,410 individuals. This translates to an annual colony GR of 4.47% (JNCC, 2023). The in-combination impact (CGR) is below 0.5% based on 50% displacement and 1% mortality and therefore, the predicted in-combination impacts will be indistinguishable from natural fluctuations and will not cause any material change to this ongoing colony growth.

6.6.4.18 When considering the realistic worst-case scenario based on SNCB guidance (70% displacement, 2% mortality) and the worst case scenario based on NatureScot guidance (60% displacement, 3% and 5% mortality) the impact is above the 0.5% CGR threshold. However, even the worst case scenario (60% displacement, 3% and 5% mortality) would result in a 1.4% reduction in growth rate which would not result in any reversal of ongoing population growth base on the annual growth rate of 4.47%.

6.6.4.19 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would be below 0.5% and closer to zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.4.20 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e.,. the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.4.21 There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot feature of Ireland's Eye SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of guillemot at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 188.

Table 187 PVA outputs for breeding adult guillemot at Ireland's Eye SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Project alone (50%, 1%)	5.26	0.999 (0.001)	0.953 (0.027)	0.130	4.690
Project alone (70%, 2%)	14.74	0.996 (0.001)	0.873 (0.025)	0.380	12.680
Project alone (60% displacement, 3 and 1% mortality)	18.90	0.995 (0.001)	0.841 (0.024)	0.480	15.880
Project alone (60% displacement, 5% and 3% mortality)	31.60	0.992 (0.001)	0.748 (0.022)	0.800	25.160
In-combination					
In-combination (50%, 1%)	9.91	0.998 (0.001)	0.914 (0.026)	0.250	8.620
In-combination (70%, 2%)	27.76	0.993 (0.001)	0.777 (0.022)	0.700	22.350
In-combination (60% displacement, 3 and 1% mortality)	31.78	0.992 (0.001)	0.749 (0.022)	0.800	25.150
In-combination (60% displacement, 5% and 3% mortality)	55.57	0.986 (0.001)	0.601 (0.018)	1.400	39.880

Table 188.In-combination displacement assessment conclusions for guillemot at Ireland’s Eye SPA.

Conservation Objective	Conclusion
The long term SPA population trend is stable or increasing: Individual (IND)	See results of PVA in the PVA Analysis Section above
Barriers do not significantly impact the population’s access to the SPA or other ecologically important sites outside the SPA;	
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the guillemot at Ireland’s Eye SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the guillemot at Ireland’s Eye SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site.	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the guillemot at Ireland’s Eye SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.

Kittiwake

Collision Risk (O&M)

6.6.4.22 Ireland's Eye SPA is 12km (around land) from Dublin Array, within MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al.,* 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.4.23 Kittiwake has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for kittiwake (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Ireland's Eye SPA. These projects have also apportioned impacts to kittiwake from Ireland's Eye SPA (Table 189).

6.6.4.24 The main basis of the assessment considers results which incorporate macro-avoidance into the Dublin collision risk impacts, which is deemed most ecologically relevant by not double counting mortalities, and based on a displacement rate of 30% and mortality rate of 1% for Dublin displacement impacts. However, impacts without macro-avoidance applied are also presented in Table 189.

Annual Total

6.6.4.25 As shown in Table 190, the predicted resultant in-combination mortality across all defined seasons for Ireland's Eye SPA is two (1.98) individuals. However, of the total in-combination predicted collision mortality for kittiwake attributed to Ireland's Eye SPA, Dublin Array contributes less than one individual (total of 0.39 annual mortalities).

6.6.4.26 Based on the 2001 citation colony count of 2,048 breeding adults and annual background mortality of 299.0 individuals, the addition of 1.98 predicted breeding adult mortalities per annum would represent a 0.664% increase in baseline mortality. However, when considering the latest colony count of 802 individuals and an annual background mortality of 117.1 adults, this would represent a 1.695% increase in baseline mortality. For the citation colony count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. However, when using the most recent 2016 count, the increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 189 Seasonal and annual kittiwake collision mortalities at Ireland's Eye SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual total
Awel-y-Mor	2	-	-	-	0.07
Erebus	2	-	-	-	0.01
Morgan	3	-	-	-	0.20
Mona	3	-	-	-	0.14
Morecambe	3	-	-	-	0.17
Arklow	3	-	-	-	0.60
Codling	3	0.01	0.16	0.02	0.19
NISA	3	0.01	0.09	0.01	0.11
Oriel	3	0.03	0.06	0.02	0.11
Dublin (CRM + 30/1 disp)	3	-	-	-	0.53
Dublin (CRM + 30/3 disp)	3	-	-	-	0.63
Dublin (CRM + 30/1 disp) with macro	3	-	-	-	0.39
Dublin (CRM + 30/3 disp) with macro	3	-	-	-	0.48
Total (Dublin (CRM + 30/1 disp))		-	-	-	2.12
Total (Dublin (CRM + 30/3 disp))		-	-	-	2.22
Total (Dublin (CRM + 30/1 disp)) with macro		-	-	-	1.98
Total (Dublin (CRM + 30/3 disp)) with macro		-	-	-	2.07

Table 190 Annual kittiwake increase in baseline mortality due to collision mortalities at Ireland's Eye SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total (Dublin (CRM + 30/1 displacement))	2.12	0.711	1.815
Annual Total (Dublin (CRM + 30/3 displacement))	2.22	0.744	1.900
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	1.98	0.664	1.695
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	2.07	0.694	1.772

PVA Analysis

6.6.4.27 The PVA results are shown in Table 191. Assuming a predicted annual mortality of 1.98 breeding adults the CGR and CPS values from Ireland's Eye SPA are 0.997 and 0.899 respectively. This represents a 0.290% reduction in GR and a reduction in final population size of 10.090%. For further details regarding the PVA results presented here see the PVA Appendix.

6.6.4.28 The kittiwake colony at Ireland's Eye SPA has displayed a continued decrease in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 455 individuals. This translates to an annual colony GR of -4.44% (JNCC, 2023). However, the in-combination impact is below 0.5% (difference in GR = 0.240%) and as such would be indistinguishable from natural fluctuations in population. The predicted impact would therefore cause no material change to the ongoing population trend.

6.6.4.29 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.4.30 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.4.31 There is, therefore, no potential for an AEoI to the population conservation objectives of the kittiwake feature of Ireland's Eye SPA in relation to potential collision risk effects from Dublin Array in-combination with other projects. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Ireland's Eye SPA. Conclusions against all conservation objectives are provided in Table 192.

Table 191 PVA outputs for breeding adult kittiwake at Ireland's Eye SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Annual Total (Dublin (CRM + 30/1 displacement))	0.53	0.999 (0.004)	0.974 (0.165)	0.070	2.650
Annual Total (Dublin (CRM + 30/3 displacement))	0.63	0.999 (0.004)	0.966 (0.171)	0.100	3.380
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	0.39	1.000 (0.004)	0.980 (0.170)	0.050	2.030
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	0.48	0.999 (0.004)	0.976 (0.171)	0.070	2.450
In-combination					
Annual Total (Dublin (CRM + 30/1 displacement))	2.12	0.997 (0.005)	0.894 (0.156)	0.310	10.600
Annual Total (Dublin (CRM + 30/3 displacement))	2.22	0.997 (0.004)	0.900 (0.158)	0.330	11.010
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	1.98	0.997 (0.004)	0.899 (0.159)	0.290	10.090
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	2.07	0.997 (0.004)	0.894 (0.158)	0.310	10.620

Table 192. In-combination displacement assessment conclusions for kittiwake at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Ireland's Eye SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Ireland's Eye SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker et al., 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs

Conservation Objective	Conclusion
	of the kittiwake at Ireland’s Eye SPA in relation to barrier effects from Dublin Array in-combination with other projects.

Herring Gull

Collision Risk (O&M)

6.6.4.32 Ireland's Eye SPA is 12 km (around land) from Dublin Array, within MMFR ± 1SD of herring gull (58.8±26.8 km; Woodward *et al.,* 2019). Herring gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.4.33 Herring gull has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for herring gull (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Ireland's Eye SPA. These projects have also apportioned impacts to herring gull from Ireland's Eye SPA (Table 193).

Annual Total

6.6.4.34 As shown in Table 194, the predicted resultant in-combination mortality across all defined seasons for Ireland’s Eye SPA is three (2.77) individuals. However, of the total in-combination predicted collision mortality for herring gull attributed to Ireland’s Eye SPA, Dublin Array contributes one individual (total of 1.04 annual mortalities).

6.6.4.35 Based on the 1999 citation colony count of 492 breeding adults and annual background mortality of 82 (81.7) individuals, the addition of 2.77 predicted breeding adult mortalities per annum would represent a 3.397% increase in baseline mortality. However, when considering the latest colony count of 796 individuals and an annual background mortality of 132 (132.1) adults, this would represent a 2.099% increase in baseline mortality. For the citation colony count and the most recent 2016 count, the increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 193 Seasonal and annual herring gull collision mortalities at Ireland's Eye SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	-	-	NA
Erebus	2	-	-	NA
Morgan	3	-	-	NA
Mona	3	-	-	NA
Oriel	3	0.49	0.1	0.59
Codling	3	0.806	0.008	0.814
Arklow	3	-	-	NA
NISA	3	0.2	0.13	0.33
Dublin	3	0.96	0.08	1.04
Total	**-**	**2.46**	**0.32**	**2.77**

Table 194 Annual herring gull increase in baseline mortality due to collision mortalities at Ireland's Eye SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	2.77	3.397	2.099

PVA Analysis

6.6.4.36 The PVA results are shown in Table 195. Assuming a predicted annual mortality of 2.77 breeding adults, the CGR and CPS values from Ireland's Eye SPA are 0.996 and 0.856 respectively. This represents a 0.430% reduction in GR and a reduction in final population size of 14.400%. For further details regarding the PVA results presented here see the PVA Appendix.

6.6.4.37 The herring gull colony at Ireland's Eye SPA has displayed a continued increase in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 318 individuals. This translates to an annual colony GR of 1.62% (JNCC, 2023). Furthermore, the in-combination impact is below 0.5% (difference in GR = 0.230%) which would not cause a reversal of current trends and would be indistinguishable from natural fluctuations in population.

6.6.4.38 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.4.39 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.4.40 There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull feature of Ireland's Eye SPA in relation to potential collision risk from Dublin Array in-combination with other projects. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Ireland's Eye SPA.

Table 195 PVA outputs for breeding adult herring gull at Ireland's Eye SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project Alone	1.04	0.998 (0.005)	0.943 (0.200)	0.170	5.670
In-combination	2.77	0.996 (0.006)	0.856 (0.185)	0.430	14.400

Table 196. In-combination displacement assessment conclusions for herring gull at Ireland's Eye SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above
The productivity rate is sufficient to maintain a stable or increasing population;	
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.

Conservation Objective	Conclusion
Disturbance occurs at levels that do not significantly impact on breeding population; and	Herring gull are not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the conservation objectives of the herring gull feature of Ireland's Eye SPA in relation to potential displacement effects from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	For most collision risk species 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) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the herring gull at Ireland's Eye SPA in relation to barrier effects from Dublin Array in-combination with other projects.

6.6.5 Lambay Island SPA

Features and Effects for Assessment

6.6.5.1 Potential for LSE in-combination has been identified for the following features of Lambay Island SPA:

- Guillemot
  - Disturbance and Displacement (O&M)
- Razorbill
  - Disturbance and displacement (O&M)
- Herring gull
  - Collision risk (O&M)
- Kittiwake
  - Collision risk (O&M)
- Lesser black-backed gull
  - Collision risk (O&M)

Razorbill

Disturbance and Displacement (O&M)

6.6.5.2 Lambay Island SPA is 31.5km (around land) from Dublin Array, within the MMFR +1SD of razorbill (88.7+75.9km; Woodward *et al*., 2019). Razorbill have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

6.6.5.3 Razorbill has been screened in for the O&M phases to assess the potential for an AEoI from disturbance and displacement from Dublin Array in-combination with other OWFs and tidal projects. Based on the MMFR +1SD for razorbill (Woodward *et al*., 2019), there are several other OWF and tidal projects within foraging range from Lambay Island SPA. These projects have also apportioned impacts to razorbill from Lambay Island SPA (Table 197).

Annual Total

6.6.5.4 The in-combination predicted abundance of razorbill prone to displacement attributed to Lambay Island SPA across all defined seasons is 1,684 (1,683.92) individuals (Table 198). Of these, Dublin Array contributes 357 (357.33) individuals to this total. When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult razorbill from Lambay Island SPA is estimated to be eight (8.42) breeding adults per annum. The full range of potential impacts are presented in Table 198.

6.6.5.5 Based on the 2001 citation colony count of 7,610 breeding adults and annual background mortality of 799 (799.1) individuals, the addition of 8.42 predicted breeding adult mortalities per annum would represent a 1.054% increase in baseline mortality. Furthermore, when considering the latest (2015) colony count of 7,353 individuals and an annual background mortality of 772 (772.1) adults, this would represent a 1.091% increase in baseline mortality. For both the citation colony count and the most recent count, the predicted increase in baseline mortality exceeds a 1% increase in baseline mortality, therefore further consideration is given in the form of PVA.

Table 197 Seasonal and annual razorbill disturbance and displacement mortalities at Lambay Island SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Abundances Attributed to the SPA				
		Pre-breeding	Breeding	Post-breeding	Winter	Annual total
Awel-y-Mor	2	-	18.00	-	-	18.00
Erebus	2	-	-	-	-	NA
Morgan	3	3.28		2.54	19.89	25.71
Mona	3	-	-	-	-	NA
Morecambe	3	5	62	8	5	80
Minesto[31]	3	1.81	36.21	6.48	29.50	74.00
Oriel	3	15.1	99.4	17.1	6.6	138.3
Codling	3	4.80	168.2	50.6	13.2	236.80
Arklow	3	-	46	-	550	595.576
NISA	3	5.62	71.76	39.19	41.65	158.22
Dublin	3	5.56	322.07	24.07	5.63	357.33
Total		**41.21**	**823.24**	**148.02**	**671.45**	**1,683.92**

[31] A seasonal breakdown of impacts was not available for Minesto. A seasonal breakdown is needed for auk species due to the different mortality rates applied in the breeding versus non-breeding season based on NatureScot guidance. Therefore the annual total was divided into the breeding and non-breeding season based on the proportion of birds in each season from data in other projects.

Table 198 Annual razorbill increase in baseline mortality due to disturbance and displacement mortalities at Lambay Island SPA for all OWFs considered in the in-combination assessment.

Season	Abundance of adults at risk of disturbance and displacement apportioned to the SPA (plus 2km buffer)	Predicted increase in mortality (breeding adults per annum)			% Increase in baseline mortality (citation count)			% Increase in baseline mortality (most recent count)		
		50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality
Annual Total	1,684	8.42	5.05 – 23.57	19.98 – 40.19	1.054	0.632 – 2.950	2.501 – 5.030	1.091	0.654 – 3.053	2.588 – 5.205

PVA Analysis

6.6.5.6 The PVA results are shown in Table 199. Assuming a predicted annual mortality of 8.42 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Lambay Island SPA are 0.999 and 0.955 respectively. This represents a 0.130% reduction in GR and a reduction in final population size of 4.540%. For further details regarding the PVA results presented here see the PVA Appendix .

6.6.5.7 The razorbill colony at Lambay Island SPA has displayed an increase in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 7,353 individuals. This translates to an annual colony GR of 3.4% since the Seabird 2000 Census (Burnell *et al*., 2023). The in-combination impact is below 0.5% reduction in CGR which is considered to be negligible and not distinguishable from natural fluctuations in the population.

6.6.5.8 When considering the realistic worst-case scenario based on SNCB guidance (70% displacement, 2% mortality), the same conclusion is also true. Using the NatureScot worst case scenario (60% displacement, 3% and 5% mortality) the predicted in-combination impact is slightly above the 0.5% CGR threshold, with a 0.620% reduction in CGR predicted. However, when considering the annual population growth rate of 3.4% this predicted impact would still cause no reversal of ongoing population growth rate.

6.6.5.9 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would be under the 0.5% threshold and likely closer to zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.5.10 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.5.11 There is, therefore, no potential for an AEoI to the population conservation objective of the razorbill feature of Lambay Island SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the razorbill feature will be maintained in the long term with respect to the potential for displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of razorbill at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 200.

Table 199 PVA outputs for breeding adult razorbill at Lambay Island SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Project alone (50%, 1%)	1.79	1.000 (0.001)	0.990 (0.031)	0.030	0.980
Project alone (70%, 2%)	5.00	0.999 (0.001)	0.972 (0.030)	0.080	2.780
Project alone (60% displacement, 3 and 1% mortality)	6.01	0.999 (0.001)	0.967 (0.910)	0.090	3.290
Project alone (60% displacement, 5% and 3% mortality)	10.30	0.998 (0.001)	0.944 (0.029)	0.160	5.650
In-combination					
In-combination (50%, 1%)	8.42	0.999 (0.001)	0.955 (0.029)	0.130	4.550
Project alone (70%, 2%)	23.57	0.996 (0.001)	0.876 (0.028)	0.370	12.400
In-combination (60% displacement, 3 and 1% mortality)	19.98	0.997 (0.001)	0.895 (0.028)	0.310	10.540
In-combination (60% displacement, 5% and 3% mortality)	40.19	0.994 (0.001)	0.798 (0.025)	0.620	20.210

Table 200. In-combination displacement assessment conclusions for razorbill at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA;	
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target; and	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the razorbill at Ireland's Eye SPA in relation to prey biomass availability from Dublin Array in-combination with other projects
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the razorbill at Lambay Island SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.

Guillemot

Disturbance and Displacement (O&M)

6.6.5.12 Lambay Island SPA is 31.5 km (around land) from Dublin Array, within the MMFR +1SD of guillemot (73.2±80.5km; Woodward *et al*., 2019). Guillemot have been screened into the assessment for displacement risk as they are susceptible to displacement due to their distribution and behaviours (Bradbury *et al*., 2014).

6.6.5.13 Guillemot has been screened in for the O&M phases to assess the potential for an AEoI from disturbance and displacement from Dublin Array in-combination with other OWFs and tidal projects. Based on the MMFR +1SD for guillemot (Woodward *et al*., 2019), there are several other OWF and tidal projects within foraging range from Lambay Island SPA. These projects have also apportioned impacts to guillemot from Lambay Island SPA (Table 201).

Annual Total

6.6.5.14 The in-combination predicted abundance of guillemot prone to displacement attributed to Lambay Island SPA across all defined seasons is 20,816 (20,816.23) individuals (Table 202). Of these, Dublin Array contributes 7,326 (7,325.57) individuals to this total. When applying a displacement rate of 50% and a mortality rate of 1%, the consequent potential mortality for breeding adult guillemot from Lambay Island SPA is estimated to be 104 (104.08) breeding adults per annum. The full range of potential impacts are presented in Table .

6.6.5.15 Based on the 2004 citation colony count of 77,998 breeding adults and annual background mortality of 4,758 (4,757.88) individuals, the addition of 104.08 predicted breeding adult mortalities per annum would represent a 2.188% increase in baseline mortality. Furthermore, when considering the latest (2015) colony count of 59,983 individuals and an annual background mortality of 3,659 (3,658.96) adults, this would represent a 2.845% increase in baseline mortality. For both the citation colony count and the most recent count, the predicted increase in baseline mortality exceeds 1%, and therefore further consideration in the form of PVA is provided.

Table 201 Seasonal and annual guillemot disturbance and displacement mortalities at Lambay Island SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Abundances Attributed to the SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	120.00	-	120.00
Erebus	2	-	-	NA
Morgan	3	-	225.62	225.62
Mona	3	-	-	NA
Morecambe	3	-	540	540
Minesto[32]	3	98.29	29.71	128.00
Oriel	3	538.57	253.14	791.71
Codling	3	1299.93	600.43	1,900.36
Arklow	3	454.95	234.3	689.24
NISA	3	6,239.96	2,855.77	9,095.73
Dublin	3	7,232.71	92.86	7,325.57
Total		**15,984.41**	**4,831.82**	**20,816.23**

[32] A seasonal breakdown of impacts was not available for Minesto. A seasonal breakdown is needed for auk species due to the different mortality rates applied in the breeding versus non-breeding season based on NatureScot guidance. Therefore the annual total was divided into the breeding and non-breeding season based on the proportion of birds in each season from data in other projects.

Table 202 Annual guillemot increase in baseline mortality due to disturbance and displacement mortalities at Lambay Island SPA for all OWFs considered in the in-combination assessment.

Season	Abundance of adults at risk of disturbance and displacement apportioned to the SPA (plus 2km buffer)	Predicted increase in mortality (breeding adults per annum)	% Increase in baseline mortality (citation count)			% Increase in baseline mortality (most recent count)				
		50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality	50% displacement, 1% mortality	30% - 70% displacement, 1%-2% mortality	60% displacement, 3 – 5% and 1 – 3% mortality
Annual Total	20,816	104.08	62.45 – 291.43	316.71 – 566.50	2.188	1.313 – 6.125	6.657 – 11.907	2.845	1.707 – 7.965	8.656 – 15.483

PVA Analysis

6.6.5.16 The PVA results are shown in Table 203. Assuming a predicted annual mortality of 104.08 breeding adults, using 50% displacement and 1% mortality rates, the CGR and CPS values from Lambay Island SPA are 0.998 and 0.933 respectively. This represents a 0.190% reduction in GR and a reduction in final population size of 6.700%. For further details regarding the PVA results presented here see the PVA Appendix .

6.6.5.17 The guillemot colony at Lambay Island SPA appears to be relatively stable over the last 25 years. The recent count (59,983 individuals) represents only a 1.3% reduction since the original citation count in 1999 of 60,754 individuals. This translates to an annual colony GR of -0.08 % (JNCC, 2023). Notably the population has fluctuated in this period, for example, between 2004 and 2015, the colony population rose from 59,207 individuals to 67,314 individuals in 2009, then back to 59,983 individuals in 2015. The in-combination impact is below 0.5% which is considered to be negligible and indistinguishable from natural fluctuations in the population.

6.6.5.18 When considering the worst case scenario based on SNCB guidance (70% displacement, 2% mortality) and the worst case scenario based on NatureScot guidance (60% displacement, 3% and 5% mortality), the predicted impact is above the 0.5% threshold. However, based on the evidence presented in Section 5.6.3 (Disturbance and Displacement – Auk species), the highest ranges of the SNCB guidance are likely highly over precautionary based on the review of 21 OWFs by APEM (2022), which suggested 50% displacement is the most evidence-based displacement rate, whilst remaining precautionary. Therefore, as discussed in Section 5.6.3 the 50% displacement 1% mortality is the basis of the conclusions based on scientific evidence and expert judgement.

6.6.5.19 Moreover, the reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems. The assessment process includes several compounding levels of precaution, and the models presented here do not incorporate density dependence. If density dependence were factored in, the predicted decrease in population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.5.20 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.5.21 There is, therefore, no potential for an AEoI to the population conservation objective of the guillemot feature of Lambay Island SPA in relation to potential disturbance and displacement from Dublin Array in-combination with other projects. Therefore, subject to natural change, the guillemot feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of guillemot at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 204.

Table 203 PVA outputs for breeding adult guillemot at Lambay Island SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Project alone (50%, 1%)	36.16	0.999 (0.000)	0.976 (0.008)	0.070	2.410
Project alone (70%, 2%)	101.26	0.998 (0.000)	0.934 (0.007)	0.190	6.640
Project alone (60% displacement, 3 and 1% mortality)	130.19	0.998 (0.000)	0.916 (0.007)	0.240	8.630
Project alone (60% displacement, 5% and 3% mortality)	216.98	0.996 (0.000)	0.864 (0.007)	0.410	13.620
In-combination					
In-combination (50%, 1%)	104.08	0.998 (0.000)	0.933 (0.007)	0.190	6.700
Project alone (70%, 2%)	291.43	0.995 (0.000)	0.823 (0.006)	0.540	17.740
In-combination (60% displacement, 3 and 1% mortality)	316.71	0.994 (0.000)	0.810 (0.006)	0.590	19.110

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
In-combination (60% displacement, 5% and 3% mortality)	566.50	0.990 (0.000)	0.684 (0.006)	1.050	31.640

Table 204. In-combination displacement assessment conclusions for guillemot at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
Disturbance occurs at levels that do not significantly impact on breeding population;	
The productivity rate is sufficient to maintain a stable or increasing population;	
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to prey biomass availability from Dublin Array alone.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the qualifying interests disturbance ranges from the development do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to breeding site disturbance from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the guillemot at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Kittiwake

Collision Risk (O&M)

6.6.5.22 Lambay Island SPA is 19.3 km from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al*., 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.5.23 Kittiwake has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for kittiwake (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Lambay Island SPA. These projects have also apportioned impacts to kittiwake from Lambay Island SPA (Table 205).

6.6.5.24 The main basis of the assessment considers results which incorporate macro-avoidance into the Dublin collision risk impacts, which is deemed most ecologically relevant by not double counting mortalities, and based on a displacement rate of 30% and mortality rate of 1% for Dublin displacement impacts. However, impacts without macro-avoidance applied are also presented in Table 205.

Annual Total

6.6.5.25 As shown in Table 206, the predicted resultant in-combination mortality across all defined seasons for Lambay Island SPA is 12 (11.51) individuals. Of the total in-combination predicted collision mortality for kittiwake attributed to Lambay Island SPA, Dublin Array contributes two (1.73) individuals.

6.6.5.26 Based on the 2004 citation colony count of 7,894 breeding adults and an annual background mortality of 1,152.5 individuals, the addition of 11.51 predicted breeding adult mortalities per annum would represent a 0.999% increase in baseline mortality. When considering the latest colony count of 6,640 individuals and an annual background mortality of 969.44 adults, this would represent a 1.188% increase in baseline mortality. For both the latest colony count, the predicted increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 205 Seasonal and annual kittiwake collision mortalities at Lambay Island SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual total
Awel-y-Mor	2	-	-	-	0.15
Erebus	2	-	-	-	0.01
Morgan	3	-	-	-	0.50
Mona	3	-	-	-	0.34
Morecambe	3	-	-	-	0.38
Arklow	3	-	-	-	4.10
Codling	3	0.09	0.97	0.16	1.21
NISA	3	0.09	1.57	0.05	1.71
Oriel	3	0.22	0.99	0.17	1.38
Dublin (CRM + 30/1 displacement)	3	-	-	-	2.38
Dublin (CRM + 30/3 displacement)	3	-	-	-	2.83
Dublin (CRM + 30/1 displacement) with macro-avoidance	3	-	-	-	1.73
Dublin (CRM + 30/3 displacement) with macro-avoidance	3	-	-	-	2.19
Total (CRM + 30/1 displacement)		-	-	-	**12.16**
Total (CRM + 30/3 displacement)		-	-	-	**12.61**
Total (CRM + 30/1 displacement) with macro-avoidance		-	-	-	**11.51**
Total (CRM + 30/3 displacement) with macro-avoidance		-	-	-	**11.97**

Table 206 Annual kittiwake increase in baseline mortality due to collision mortalities at Lambay SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Total (CRM + 30/1 displacement)	12.16	1.055	1.255
Total (CRM + 30/3 displacement)	12.61	1.094	1.301
Total (CRM + 30/1 displacement) with macro-avoidance	11.51	0.999	1.188
Total (CRM + 30/3 displacement) with macro-avoidance	11.97	1.039	1.235

PVA Analysis

6.6.5.27 The PVA results are shown in Table 207. Assuming a predicted annual mortality of 11.51 breeding adults, the CGR and CPS values from Lambay Island SPA are 0.998 and 0.931 respectively. This represents a 0.200% reduction in GR and a reduction in final population size of 6.890%. For further details regarding the PVA results presented here see the PVA Appendix .

6.6.5.28 The kittiwake colony at Lambay Island SPA has displayed a continued decrease in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 3,320 individuals. This translates to an annual colony GR of -1.30% (JNCC, 2023). However, the in-combination impact is below 0.5% (difference in GR = 0.140%) and as such would be indistinguishable from natural fluctuations in population.

6.6.5.29 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.5.30 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.5.31 There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Lambay Island SPA in relation to potential collision risk from Dublin Array in-combination with other projects. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 208.

Table 207 PVA outputs for breeding adult kittiwake at Lambay Island SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in GR (%)	Difference in PS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Annual Total (Dublin (CRM + 30/1 displacement))	2.38	1.000 (0.002)	0.986 (0.058)	0.040	1.450
Annual Total (Dublin (CRM + 30/3 displacement))	2.83	1.000 (0.002)	0.982 (0.059)	0.050	1.760
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	1.73	1.000 (0.002)	0.989 (0.058)	0.030	1.060
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	2.19	1.000 (0.001)	0.985 (0.056)	0.040	1.520
In-combination					
Annual Total (Dublin (CRM + 30/1 displacement))	12.16	0.998 (0.002)	0.924 (0.054)	0.220	7.580
Annual Total (Dublin (CRM + 30/3 displacement))	12.61	0.998 (0.002)	0.922 (0.056)	0.220	7.800
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	11.51	0.998 (0.002)	0.931 (0.055)	0.200	6.890
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	11.97	0.998 (0.002)	0.925 (0.054)	0.210	7.510

Table 208. In-combination displacement assessment conclusions for kittiwake at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing; Disturbance occurs at levels that do not significantly impact on breeding population;	See results of PVA in the PVA Analysis Section above.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Lambay Island SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects). Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in

Conservation Objective	Conclusion
	relation to barrier effects from Dublin Array alone.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Lambay Island SPA in relation to availability of nesting sites from Dublin Array alone.

Herring Gull

Collision Risk (O&M)

6.6.5.32 Lambay Island SPA is 19.3 km from Dublin Array, within the MMFR ± 1SD of herring gull (58.8±26.8 km; Woodward *et al.,* 2019). Herring gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.5.33 Herring gull has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for herring gull (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Lambay Island SPA. These projects have also apportioned impacts to herring gull from Lambay Island SPA (Table 209).

6.6.5.34 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. However, not all OWFs considered within the in-combination assessment provide seasonal breakdowns of attributed mortality. Seasonal assessments have been undertaken with the available data, with the annual assessment providing the overall potential in-combination impacts. Herring gull have been assessed during the breeding season of March to August and the non-breeding season of September to February in relation to Lambay Island SPA. Table 209 provides seasonal and annual mortality estimates of breeding adult herring gull from Lambay Island SPA at OWFs included in the in-combination assessment.

Annual Total

6.6.5.35 As shown in Table 210, the predicted resultant in-combination mortality across all defined seasons for Lambay Island SPA is seven (7.00) individuals. Of the total in-combination predicted collision mortality for herring gull attributed to Lambay Island SPA, Dublin Array contributes one (1.27) annual mortality.

6.6.5.36 Based on the 2004 citation colony count of 622 breeding adults and annual background mortality of 103.3 individuals, the addition of 7.00 predicted breeding adult mortalities per annum would represent a 6.777% increase in baseline mortality. However, when considering the latest colony count of 1,812 individuals and an annual background mortality of 300.8 adults, this would represent a 2.326% increase in baseline mortality. For the citation colony count and the most recent 2015-2018 count, the increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 209 Seasonal and annual herring gull collision mortalities at Lambay Island SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	-	-	NA
Erebus	2	-	-	NA
Morgan	3	-	-	NA
Mona	3	-	-	NA
Oriel	3	1.90	0.50	2.40
Codling	3	1.67	0.02	1.70
Arklow	3	-	-	NA
NISA	3	1.25	0.38	1.63
Dublin	3	1.08	0.19	1.27
Total		5.90	1.09	**7.00**

Table 210 Annual herring gull increase in baseline mortality due to collision mortalities at Lambay SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	7.00	6.777	2.326

PVA Analysis

6.6.5.37 The PVA results are shown in Table 211. Assuming a predicted annual mortality of 7.00 breeding adults, the CGR and CPS values from Lambay Island SPA are 0.995 and 0.842 respectively. This represents a 0.480% reduction in GR and a reduction in final population size of 15.770%. For further details regarding the PVA results presented here see the PVA Appendix .

6.6.5.38 The herring gull colony at Lambay Island SPA has displayed a continued decline in population size since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 906 individuals. This translates to an annual colony GR of -4.22% (JNCC, 2023). The in-combination impact as a result of Dublin Array in combination with other projects is below 0.5% (difference in GR = 0.250%), which would be indistinguishable from ongoing trends and in relation to other pressures driving changes in this colony.

6.6.5.39 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.5.40 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.5.41 There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull feature of Lambay Island SPA in relation to potential collision risk from Dublin Array in-combination with other projects. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for disturbance and displacement in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 212.

Table 211 PVA outputs for breeding adult herring gull at Lambay Island SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone	1.27	0.999 (0.004)	0.968 (0.138)	0.080	3.210
Project in-combination	7.00	0.995 (0.004)	0.842 (0.122)	0.480	15.770

Table 212. In-combination displacement assessment conclusions for herring gull at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the herring gull feature of Lambay Island SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.

Conservation Objective	Conclusion
Disturbance occurs at levels that do not significantly impact on breeding population;	Herring gull is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the conservation objectives of the herring gull feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array in-combination with other projects
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	For most collision risk species 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) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to barrier effects from Dublin Array in-combination with other projects.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the herring gull at Lambay Island SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.

Lesser Black-backed Gull

Collision Risk (O&M)

6.6.5.42 Lambay Island SPA is 19.3 km from Dublin Array, within the MMFR ± 1SD of lesser black-backed gull (127±109 km; Woodward *et al.,* 2019). Lesser black-backed gull have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.5.43 Lesser black-backed gull has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for lesser black-backed gull (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Lambay Island SPA. These projects have also apportioned impacts to lesser black-backed gull from Lambay Island SPA (Table 213).

6.6.5.44 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. However, not all OWFs considered within the in-combination assessment provide seasonal breakdowns of attributed mortality. Seasonal assessments have been undertaken with the available data, with the annual assessment providing the overall potential in-combination impacts. Lesser black-backed gull have been assessed during the breeding season of April to August and the non-breeding season of September to March in relation to Lambay Island SPA. Table 213 provides seasonal and annual mortality estimates of breeding adult lesser black-backed gull from Lambay Island SPA at OWFs included in the in-combination assessment.

Annual Total

6.6.5.45 As shown in Table 214, the predicted resultant in-combination mortality across all defined seasons for Lambay Island SPA is one (0.96) individual. Of the total in-combination predicted collision mortality for lesser black-backed gull attributed to Lambay Island SPA, Dublin Array contributes one (0.71) annual mortality.

6.6.5.46 Based on the 2004 citation colony count of 266 breeding adults and annual background mortality of 30.6 individuals, the addition of 0.91 predicted breeding adult mortalities per annum would represent a 3.138% increase in baseline mortality. When considering the latest colony count of 690 individuals and an annual background mortality of 79.4 adults, this would represent a 1.210% increase in baseline mortality. For the citation colony count and the most recent 2015-2018 count, the increase in baseline mortality is greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 213 Seasonal and annual lesser black-backed gull collision mortalities at Lambay Island SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA				
		Pre-breeding	Breeding	Post-breeding	Winter	Annual total
Awel-y-Mor	2	-	-	-	-	NA
Erebus	2	-	-	-	-	NA
Morgan	3	-	-	-	-	NA
Mona	3	-	-	-	-	NA
Morecambe	3	-	-	-	-	0.01
Oriel	3	-	-	-	-	0
Codling	3	-	-	-	-	NA
Arklow	3	-	-	-	-	0.04
NISA	3	0.00	0.20	0.00	0.00	0.20
Dublin	3	0.00	0.70	0.00	0.01	0.71
Total	**-**	**0.00**	**0.90**	**0.00**	**0.01**	**0.96**

Table 214 Annual lesser black-backed gull increase in baseline mortality due to collision mortalities at Lambay SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.96	3.138	1.210

PVA Analysis

6.6.5.47 The PVA results are in Table 215. Assuming a predicted annual mortality of 0.96 breeding adults, the CGR and CPS values from Lambay Island SPA are 0.998 and 0.943 respectively. This represents a 0.160% reduction in GR and a reduction in final population size of 5.670%. For further details regarding the PVA results presented here see the PVA Appendix.

6.6.5.48 The lesser black-backed gull colony at Lambay Island SPA has remained stable and slightly increased since 1999. Latest estimates (SMP, 2015) now indicate a colony count of 345 pairs. This translates to an annual colony GR of 0.7 the Seabird 2000 Count (Burnell *et al*., 2023). The in-combination impact as a result of Dublin Array in combination with other projects is below 0.5% (difference in GR = 0.250%), which would be indistinguishable from ongoing trends and in relation to other pressures driving changes in this colony.

6.6.5.49 The reported decrease in growth rate is highly precautionary and is likely to over-predict what would realistically occur in natural systems, as the model does not incorporate density dependence. If density dependence were factored in, the predicted decrease population growth rate (CGR) would approach zero because adult survival and productivity rates would increase due to reduced competition for resources, counteracting any reductions in population size.

6.6.5.50 Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e., the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.5.51 Consequently, there is, no potential for an AEoI to the population conservation objective of the lesser black-backed gull feature of Lambay Island SPA in relation to potential collision risk from Dublin Array in-combination. It should also be highlighted that the in-combination impact is <1 bird. Therefore, subject to natural change, the lesser black-backed gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of lesser black-backed gull at Lambay Island SPA. Conclusions against all conservation objectives are provided in Table 216.

Table 215 PVA outputs for breeding adult lesser black-backed gull at Lambay Island SPA for Dublin Array alone and in-combination with other projects

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in PPS (%)
		CGR (SD)	CPS (SD)		
Project alone	0.71	0.999 (0.003)	0.957 (0.126)	0.110	4.270
Project in-combination	0.96	0.998 (0.003)	0.943 (0.125)	0.160	5.670

Table 216. In-combination displacement assessment conclusions for lesser black-backed gull at Lambay Island SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the lesser black-backed gull feature of Lambay Island SPA.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site;	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on breeding population;	Lesser black-backed gull is not vulnerable to displacement from the proposed development. According to Bradbury *et al*. (2014) and Dierschke *et al*. (2016) lesser black-backed sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for

Conservation Objective	Conclusion
	an AEoI to the conservation objectives of the lesser black-backed gull feature of Lambay Island SPA in relation to potential displacement effects from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA; and	For most collision risk species 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) herring gull sensitivity to disturbance and displacement is 'very low'. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to barrier effects from Dublin Array in-combination with other projects.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population.	Given the development or the impact ranges do not overlap with the SPA boundary, there is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the lesser black-backed gull at Lambay Island SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.

6.6.6 Wicklow Head SPA

Features and Effects for Assessment

1.1.1.1 Potential for LSE in-combination has been identified for the following features of Wicklow Head SPA

- Kittiwake
  - Collision risk (O&M only)

Kittiwake

Collision Risk (O&M)

6.6.6.1 Wicklow Head SPA is 19.8 km (around land) from Dublin Array, within the MMFR ± 1SD of kittiwake (156.1±144.5 km; Woodward *et al.,* 2019). Kittiwake have been screened into the assessment for collision risk as they are susceptible to collision due to their flight height distribution/behaviours (e.g. Bradbury *et al*., 2014).

6.6.6.2 Kittiwake has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for kittiwake (Woodward *et al*., 2019), there are several other OWF projects within foraging range from Wicklow Head SPA. These projects have also apportioned impacts to kittiwake from Wicklow Head SPA (Table 217).

6.6.6.3 The main basis of the assessment considers results which incorporate macro-avoidance into the Dublin collision risk impacts, which is deemed most ecologically relevant by not double counting mortalities and based on a displacement rate of 30% and mortality rate of 1% for Dublin displacement impacts. However, impacts without macro-avoidance applied are also presented in Table 217.

Annual Total

6.6.6.4 As shown in Table 218, the predicted resultant in-combination mortality across all defined seasons for Wicklow Head SPA is eight (8.46) individuals. However, of the total in-combination predicted collision mortality for kittiwake attributed to Wicklow Head SPA, Dublin Array contributes less than one individual (total of 0.30 annual mortalities).

6.6.6.5 Based on the 2002 citation colony count of 1,912 breeding adults and an annual background mortality of 279.2 individuals, the addition of 8.46 predicted breeding adult mortalities per annum would represent a 3.032% increase in baseline mortality. When considering the latest colony count of 1,348 individuals and an annual background mortality of 196.8 adults, this would represent a 4.300% increase in baseline mortality. For both the citation and most recent colony counts, the predicted increases in baseline mortality are greater than a 1% increase. Therefore, further consideration is given to these impacts below through a PVA.

Table 217.Seasonal and annual kittiwake collision mortalities at Wicklow Head SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA			
		Pre-breeding	Breeding	Post-breeding	Annual total
Awel-y-Mor	2	-	-	-	0.04
Erebus	2	-	-	-	0.01
Morgan	3	-	-	-	0.1
Mona	3	-	-	-	NA
Morecambe	3	-	-	-	0.07
Arklow	3	-	-	-	6.50
Codling	3	0.02	1.27	0.03	1.31
NISA	3	0.02	0.02	0.01	0.05
Oriel	3	0.03	0.03	0.02	0.08
Dublin (CRM + 30/1 displacement)	3	-	-	-	0.42
Dublin (CRM + 30/3 displacement)	3	-	-	-	0.5
Dublin (CRM + 30/1 displacement) with macro	3	-	-	-	0.3
Dublin (CRM + 30/3 displacement) with macro	3	-	-	-	0.39
Total (Dublin (CRM + 30/1 displacement))		-	-	-	**8.58**
Total (Dublin (CRM + 30/3 displacement))		-	-	-	**8.66**
Total (Dublin (CRM + 30/1 displacement)) with macro		-	-	-	**8.46**
Total (Dublin (CRM + 30/3 displacement)) with macro		-	-	-	**8.55**

Table 218 Annual kittiwake increase in baseline mortality due to collision mortalities at Wicklow Head SPA for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Total (CRM + 30/1 displacement)	8.58	3.075	4.402
Total (CRM + 30/3 displacement)	8.66	3.103	4.402
Total (CRM + 30/1 displacement) with macro-avoidance	8.46	3.032	4.300
Total (CRM + 30/3 displacement) with macro-avoidance	8.55	3.064	4.346

PVA Analysis

6.6.6.6 The PVA results are shown in Table 219. Assuming a predicted annual mortality of 8.46 breeding adults, the CGR and CPS values from Wicklow Head SPA are 0.993 and 0.791 respectively. This represents a 0.750% reduction in GR and a reduction in final population size of 23.910%. For further details regarding the PVA results presented here see the PVA Appendix 4.3.6-7 of the EIAR.

6.6.6.7 The kittiwake colony at Wicklow Head SPA has displayed a continued decrease in population size since 1999. Latest estimates (SMP, 2022) now indicate a colony count of 1,348 individuals, decreasing from 1,912 individuals in 1999. This translates to an annual reduction in colony GR of -1.06% (JNCC, 2023). Considering more recent trends, the colony consisted of 674 pairs in 2018, rising by 8.16% to 729 pairs in 2021, then back to 674 pairs in 2022, implying a more stable trend over this 5-year period (amongst fluctuations). The in-combination estimated reduction in growth is >0.5%. However, when considered in the context of trends at this site, even the worst case scenario (30% displacement, 3% morality and no macro-avoidance applied to CRM), the predicted percentage reduction in population growth rate is lower than the annual rate of change since 1999, and would be indistinguishable when considering the large rate of change (fluctuations) since 2018. In addition, the contribution of Dublin Array to this impact is very small (less than half a bird) and is not considered to be making a material contribution to this in-combination impact.

6.6.6.8 The reported decrease in growth rate is highly precautionary and likely overestimates what would occur in natural systems, as the model does not account for density dependence. Including density dependence would bring the projected decrease in population growth rate (CGR) closer to zero, since adult survival and productivity would likely increase with reduced competition for resources, balancing any population size reductions. The contribution of Dublin Array to this impact is negligible (less than half a bird) and does not materially affect the in-combination impact. Including density dependence would further lessen impacts to this SPA population, which are already minimal. Models that include density dependence have been shown to provide a more biologically accurate indication of population growth and can, therefore, provide more accurate PVA outcomes (Merrall *et al*., 2024). Therefore, population-level impacts from Dublin Array are more likely to be less than those found through PVA which includes density independent outcomes.

6.6.6.9 Arklow Bank Wind Park 2 considered density dependence when assessing in-combination impacts for kittiwake at Wicklow Head. In the worst-case PVA, the density-independent scenario produced a CGR of 0.985 (Arklow Bank Wind Park 2, 2024), whereas a conservative approach incorporating density dependence increased the CGR to 0.995. Therefore, the density-independent CGR value (0.993) presented here represents a highly precautionary assessment, supporting the conclusion that there is no adverse effect on the kittiwake population at Wicklow Head SPA in combination. Although this SPA population has been modelled as a closed system, this assumption does not reflect the reality that individuals from the regional population may migrate in to counteract any reduction in SPA population size (i.e. the closed population model fails to account for the potential influx of non-breeding individuals that could bolster the population). For further details, please refer to the PVA annex.

6.6.6.10 The precautionary nature of CRM is also noted. The literature suggests higher avoidance rates for kittiwake (species specific avoidance rate of 0.997 instead of the recommended 0.993; Ozsanlav-Harris *et al.,* 2023) which would suggest that the potential mortality of kittiwake at Wicklow Head from Dublin Array would be even lower than the predicted 0.42. In addition, a report from Aberdeen Offshore Windfarm Limited (AOWFL, 2023) at the European Offshore Wind Development Centre (EOWDC) recorded zero collisions or narrow escapes in 10,000 videos of bird flight in relation to OWFs. This indicates that bird collision rates are lower in reality than the predicted rates and highlights the precautionary nature of the current methodology. Furthermore, flight speeds from the current methodology have also been shown to be precautionary. Royal Haskoning DHV (2020b) undertook a review of the published literature on kittiwake flight speeds for Norfolk Boreas Offshore windfarm. This study found that a flight speed of 10.8m/s is a more realistic estimation of flight speed for kittiwake compared to the current recommended flight speed for kittiwake (13.1m/s). Other studies have even suggested flight speeds of 8.7m/s for kittiwake (Skov *et al*., 2018). The flight speed parameter used within the CRM assessment directly impacts the predicted potential mortality for seabirds due to collision risk. Therefore, the predicted potential mortalities could be lowered using more appropriate precautionary rates compared to the current advice.

6.6.6.11 There is, therefore, no potential for an AEoI to the population conservation objective of the kittiwake feature of Wicklow Head SPA in relation to potential collision risk from Dublin Array in-combination with other projects. Therefore, subject to natural change, the kittiwake feature will be maintained in the long term with respect to the potential for collision risk in the O&M phase. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of kittiwake at Wicklow Head SPA. Conclusions against all conservation objectives are provided in Table 220.

Table 219 PVA outputs for breeding adult kittiwake at Wicklow Head SPA for Dublin Array alone and in-combination with other projects.

Scenario	Mortalities	Density independent counterfactual metric (after 35 years)		Difference in CGR (%)	Difference in CPS (%)
		CGR (SD)	CPS (SD)		
Project alone					
Annual Total (Dublin (CRM + 30/1 displacement))	0.42	1.000 (0.003)	0.987 (0.116)	0.040	1.350
Annual Total (Dublin (CRM + 30/3 displacement))	0.50	1.000 (0.003)	0.986 (0.116)	0.040	1.450
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	0.30	1.000 (0.003)	0.991 (0.116)	0.030	0.880
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	0.39	1.000 (0.003)	0.988 (0.117)	0.030	1.180
In-combination					
Annual Total (Dublin (CRM + 30/1 displacement))	8.58	0.993 (0.003)	0.791 (0.093)	0.750	23.910
Annual Total (Dublin (CRM + 30/3 displacement))	8.66	0.992 (0.003)	0.760 (0.095)	0.760	24.020
Annual Total (Dublin (CRM + 30/1 displacement)) with macro-avoidance	8.46	0.993 (0.003)	0.770 (0.093)	0.750	23.610
Annual Total (Dublin (CRM + 30/3 displacement)) with macro-avoidance	8.55	0.992 (0.003)	0.766 (0.094)	0.760	23.990

Table 220. In-combination displacement assessment conclusions for kittiwake at Wicklow Head SPA.

Conservation Objective	Conclusion
The long-term SPA population trend is stable or increasing;	See results of PVA in the PVA Analysis Section above.
Disturbance occurs at levels that do not significantly impact on breeding population;	

Conservation Objective	Conclusion
The productivity rate is sufficient to maintain a stable or increasing population;	Collision mortalities impact survival rather than productivity. Impacts from survival and productivity on the population trend are assessed in the preceding conservation objective. Therefore, this conservation objective is not relevant for the kittiwake feature of Wicklow Head SPA.
There is sufficient availability of suitable nesting sites throughout the SPA to maintain a stable or increasing population;	There is no potential pathway from the proposed development to impact the availability of suitable nesting sites. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to availability of nesting sites from Dublin Array in-combination with other projects.
There is a sufficient number of locations, area of suitable habitat and available forage biomass to support the population target;	As discussed in Section 5.6.3 (Indirect impacts on prey), there is no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them, as reflected in the Benthic Ecology Chapter and the Fish and Shellfish Ecology Chapter. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to prey biomass availability from Dublin Array in-combination with other projects.
Disturbance occurs at levels that do not significantly impact on birds at the breeding site; and	Given the development or the impact ranges do not overlap with the SPA boundary there is no functional connectivity for the conservation objective relating to disturbance at the breeding site. There is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to breeding site disturbance from Dublin Array in-combination with other projects.
Barriers do not significantly impact the population's access to the SPA or other ecologically important sites outside the SPA.	The disturbance and displacement assessment for the proposed development considered both flying and sitting birds, including flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest. This approach is supported by NatureScot and Natural England guidance (NatureScot 2023c; Parker *et al.*, 2022c), which states that the displacement assessment is considered to cover all distributional responses (i.e., disturbance and displacement impacts and barrier effects).

Conservation Objective	Conclusion
	Based on the assessment above, there is, therefore, no potential for an AEoI to the COs of the kittiwake at Wicklow Head SPA in relation to barrier effects from Dublin Array in-combination with other projects.

Morecambe Bay and Duddon Estuary SPA

Herring Gull

Collision Risk (O&M)

6.6.6.12 This SPA has no connectivity with Dublin Array during the breeding season for herring gull as Dublin Array is beyond the MMFR+1SD for herring gull (58.8±26.8 km; Woodward *et al.*, 2019). However, this site hosts >1% of the regional non-breeding population for this feature, and therefore herring gull are screened in for the non-breeding season only.

6.6.6.13 Herring gull has also been screened in for the O&M phases to assess the potential for an AEoI from collision risk from Dublin Array in-combination with other OWFs. Based on the MMFR +1SD for herring gull (Woodward *et al.*, 2019), there are several other OWF projects within foraging range from Morecambe Bay and Duddon Estuary SPA. These projects have also apportioned impacts to herring gull from Morecambe Bay and Duddon Estuary SPA (Table 221).

6.6.6.14 As described in Section 5.6.4 (Seasonal variation), the assessment is carried out on a seasonal basis as the potential impacts on the SPA features vary by season. However, not all OWFs considered within the in-combination assessment provide seasonal breakdowns of attributed mortality. Seasonal assessments have been undertaken with the available data, with the annual assessment providing the overall potential in-combination impacts. Herring gull have been assessed during the breeding season of March to August and the non-breeding season of September to February in relation to Morecambe Bay and Duddon Estuary SPA. Table 221 provides seasonal and annual mortality estimates of breeding adult herring gull from Morecambe Bay and Duddon Estuary SPA at OWFs included in the in-combination assessment.

Annual Total

6.6.6.15 As shown in Table 222, the predicted resultant in-combination mortality across all defined seasons for Morecambe Bay and Duddon Estuary SPA is one (0.6) individual. Of the total in-combination predicted collision mortality for herring gull attributed to Morecambe Bay and Duddon Estuary SPA, Dublin Array contributes less than one (0.4) annual mortality.

6.6.6.16 Based on the 1991 citation colony count of 20,000 breeding adults and annual background mortality of 3,320.0 individuals, the addition of 0.6 predicted breeding adult mortalities per annum would represent a 0.019% increase in baseline mortality. However, when considering the latest 2023 colony count of 1,546 individuals and an annual background mortality of 256.6 adults, this would represent a 0.240% increase in baseline mortality.

6.6.6.17 For both citation and most recent count, the predicted increase in baseline mortality would be indistinguishable from natural fluctuations in the population. There is, therefore, no potential for an AEoI to the population conservation objective of the herring gull feature of Morecambe Bay and Duddon Estuary SPA in relation to potential collision risk from Dublin Array in-combination with other OWFs. Therefore, subject to natural change, the herring gull feature will be maintained in the long term with respect to the potential for collision risk. There will be no long-term effect to the conservation objective to maintain or restore the favourable conservation condition of herring gull at Morecambe Bay and Duddon Estuary SPA.

Table 221. Seasonal and annual herring gull collision mortalities at Morecambe Bay and Duddon Estuary SPA for Dublin Array alone and all OWFs considered in the in-combination assessment.

Project	Tier	Seasonal Mortalities Attributed to the SPA		
		Breeding	Non-breeding	Annual total
Awel-y-Mor	2	0.02	0.01	0.04
Erebus	2	-	-	0.00
Morgan	3	0.16	0.02	0.18
Mona	3	0.00	0.00	0.00
Oriel	3	0.00	0.00	0.00
Codling	3	0.00	0.00	0.00
Arklow	3	0.00	0.00	0.00
NISA	3	0.00	0.00	0.00
Dublin	3	0.00	0.40	0.40
Total		**0.18**	**0.43**	**0.62**

Table 222. Annual herring gull increase in baseline mortality due to collision mortalities at Morecambe Bay and Duddon Estuary for all OWFs considered in the in-combination assessment.

Season	Predicted breeding adult collision mortalities attributed to the SPA	Increase in baseline mortality (%)	
		Citation population	Most recent population
Annual Total	0.62	0.019	0.240

7 Summary of Measures - HDA

7.1.1.1 As part of the iterative design of the project, the Applicant has committed to a number of project design features and other avoidance and preventative measures (detailed in Section 3.3.5) that have been referenced throughout the assessments, together with additional commitments made to mitigate the potential for adverse effects identified throughout Section 5 and Section 6. Table 223 provides a summary of all measures relevant to the Habitats Directive Assessment. Please also see Appendix F which provides a standalone summary of all measures relevant to the Habitats Directive Assessment.

Table 223 Project design, avoidance and preventative measure to be implemented during construction, O&M and decommissioning

Measure	Where referenced/secured
Applicant will implement the following, in line with the Sea Pollution Act 1991 and MARPOL convention and other similar binding rules and obligations imposed on ship owners and operators by inter alia the International Maritime Organisation as relevant: Marine Pollution Contingency Plan to cover accidental spills, potential contaminant release and include key emergency contact details (e.g., the Irish Coast Guard (IRCG) and will comply with the National Maritime Oil/ HNS Spill Contingency Plan (IRCG, 2020). Measures include Storage of all chemicals in secure designated areas with impermeable bunding (up to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials to avoid contamination.	The PEMP includes measures outlined within the Marine Pollution Contingency Plan compliant with relevant legal obligations and frameworks
Waste management and disposal arrangements - the developer will dispose of sewage and other waste in a manner which complies with all regulatory requirements, including but not limited to the IMO MARPOL requirements .	The PEMP includes provision for waste management and disposal arrangements compliant with relevant legal obligations.
During the lifetime of the project the Applicant and its contractors will comply with all measures outlined in the Marine Biosecurity Plan to include: ▪ All vessels of 400 gross tonnage (gt) and above to be in possession of a current international Anti-fouling System (AFS) certificate; ▪ Details of all ship hull inspections and biofouling management measures be documented by the Contractor. ▪ All vessels to be compliant (where applicable) with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention,	The PEMP includes details of the Marine Biosecurity plan that details requirements and relevant legislation

Measure	Where referenced/secured
developed and adopted by the International Maritime Organisation (IMO)"	
Installation of cables to an optimum cable burial depth - offshore cables will, where possible, be buried in the seabed to the optimal performance burial depth for the specific ground conditions. Where optimum burial depth cannot be achieved secondary protection measure will be deployed e.g. concrete mattress, rock berm, grout bags or an equivalent in key areas	Volume 2: Chapter 6, Project Description details the requirement for a Cable Installation Plan (CIP) and Cable Burial Risk Assessment (CBRA) which will be developed upon award of consent and in advance of construction. The CIP and CBRA will provide information on the installation plan for subsea cables. The CBRA, will provide a risk assessment and evaluation for cable protection, unburied or shallow buried cables. The CIP will detail pertinent mitigation measures to be used during cable installation and will be applied throughout the construction phase. The CIP and CBRA will be submitted to the consenting authority in advance of construction phase.
A code of conduct will be implemented by all vessel operators when encountering marine species to reduce the risk of injury and disturbance. In addition, vessel movements to and from construction sites and ports will, where feasible, follow existing routes.	The PEMP incorporates all measures within an environmental Vessel Management Plan
Impact piling of a single pile will occur at any one time, i.e. no simultaneous impact piling will occur.	Outlined within the Project Description Chapter.
Procedures for impact piling, will include: ▪ Implementation of a 1000m mitigation zone ▪ pre-piling Marine Mammal Observer (MMO) watches; ▪ pre-piling Passive Acoustic Monitoring (PAM); ▪ Soft start procedure; and Breaks in piling procedure	Outlined within the MMMP. The MMMP has been developed to comply with all relevant guidance, specifically NPWS, (2014); DAHG (2014); IWDG (2020)
The Applicant commits to the implementation of at-source noise mitigation methods (e.g. bubble curtains, casings, resonators) to reduce the source level of the underwater noise from pile driving by at least 10 decibels (dB).	Outlined within the Project Description Chapter with further details relevant to marine mammals within the MMMP
Procedures for geophysical surveys using 3D UHRS (sparker) equipment, will include: ▪ Implementation of a 1000m mitigation zone; ▪ Pre-shooting (in relation to survey start) Marine Mammal Observer (MMO) watches; ▪ Delay of operations if marine mammals detected for at least 30 mins; ▪ Soft start procedure;	Outlined within the MMMP. The MMMP has been developed to comply with all relevant guidance, specifically NPWS, (2014); DAHG (2014[33]); IWDG (2020)

[33] At the time of publication updates to this guidance are still pending.

Measure	Where referenced/secured
▪ Line changes longer than 40 minutes will be stopped with a pre watch of 30 mins, followed by soft start to resume; ▪ Breaks in operation of between 5-10 mins will prompt a MMO watch.	
Procedures for UXO detonation will include: ▪ Implementation of a mitigation zone of 1km; ▪ Pre-detonation MMO and PAM; ▪ Soft start charges; ▪ Use of bubble curtains for high order; and ▪ Post detonation searches"	Outlined within the MMMP. The MMMP has been developed to comply with all relevant guidance, specifically NPWS, (2014); DAHG (2014); IWDG (2020)
HDD will be used to cross watercourses along the OES so there will be no direct loss of foraging habitat for otters within the river itself or creation of any barriers to passage	Appendix F Schedule of Measures – HDA
The pre-construction survey will aim to identify any changes in otter activity, holt locations, etc., since the original surveys. The pre-construction survey should be conducted no more than 10-12 months in advance of construction commencing. This will ensure that there will be sufficient time to comply with all licensing and additional mitigation requirements (e.g., holt exclusion and / or the creation of artificial holts). A 150 m buffer will be implemented around any identified holts, where no works will encroach. Where holts are identified within 150 m of the proposed works areas, and have been verified as inactive, the entrances may be lightly blocked with vegetation and a light application of soil (soft blocking) to prevent their reoccupation. If the entrances remain undisturbed for five days, the holt may then be destroyed (where required) immediately using a mechanical digger. These actions must be conducted under the supervision of the holder of the Section 25 NPWS derogation under the 1997 Habitat Regulations (NRA, 2008).	Appendix F Schedule of Measures – HDA
Avoiding multiple trenchless crossings at any one time will allow otters to naturally migrate away from any source of disturbance. Avoiding the loss of riparian habitat loss through trenchless techniques will ensure that no otter holts will be damaged or lost and therefore, no holt exclusion will be necessary.	Appendix F Schedule of Measures – HDA

Measure	Where referenced/secured
Where holts are found that are likely to be disturbed, their activity level will be assessed to verify whether they are active or inactive. Active breeding otter holts within 150m of proposed works may require a derogation license for disturbance (NRA, 2008). Any necessary removal of otter holts must be conducted under a Section 25 derogation under the 1997 Habitats Regulations (NRA, 2008).	Appendix F Schedule of Measures – HDA
The CEMP details the following measures to minimize pollution risk to aquatic habitats: ▪ refuelling will take place at least 50m from watercourses and where possible it will not occur when there is risk that oil from a spill could directly enter the water environment, for example, periods of heavy rainfall or when standing water is present will be avoided; ▪ a vehicle management plan and speed limit will be strictly enforced onsite to minimise the potential for accidents to occur; ▪ drip trays will be placed under stationary vehicles which could potentially leak fuel/oils; ▪ areas will be designated for washout of vehicles which are a minimum distance of 50 m from a watercourse; ▪ washout water will also be stored in the washout area before being treated and disposed of; ▪ if any water is contaminated with silt or chemicals, runoff will not enter a watercourse directly or indirectly prior to treatment; ▪ water will be prevented as far as possible, from entering excavations such as trenches; ▪ areas of battery storage will be bunded and positively drained so that the quality of runoff can be monitored and contained if required; ▪ procedures will be adhered to for storage of fuels and other potentially contaminative materials to minimise the potential for accidental spillage (e.g. stored in 110% bunded storage facilities); and ▪ a plan for dealing with spillage incidents will be designed prior to construction, and this will be adhered to should any incident occur, reducing the effect as far as practicable. This will be included in the CEMP	Detailed in the Onshore CEMP (Volume 7, Appendix 8).
The pre-construction survey will also check the two holts identified at the O&M Base and Shanganagh-Bray WWTP for breeding activity. ▪ A Pre-construction survey to identify any new holts within riparian habitats near planned river crossings.	Appendix F Schedule of Measures – HDA

Measure	Where referenced/secured
▪ Buffers zones for the two potential holts identified at the O&M Base and Shanganagh-Bray WWTP. ▪ No trenchless crossing activities will encroach within 150 m of any known breeding holts. ▪ Trenchless techniques to be implemented to avoid loss of habitat, activities will be temporary and localized.	
Should Annex I reef be found within the boundary of Rockabill to Dalkey Island SAC, the Applicant commits to avoidance of these features to preclude direct impacts to these reefs from cable installation and protection within the Offshore ECC.	Appendix F Schedule of Measures – HDA

8 Appropriate Assessment Conclusions

8.1 Project alone

8.1.1.1 This NIS has evaluated all relevant information including a description of the methods and approach to construction, O&M and decommissioning of Dublin Array, the receiving environment in which the windfarm would be built and operated and identification of all relevant European sites (and their individual QIs) within the relevant ZoI for the project.

8.1.1.2 The Conservation Objectives of each of the European sites that have been taken forward to Stage 2 (NIS) have been considered in turn (where site specific Conservation Objectives are not available, proxy ones have been used for closest comparable site). This has informed an assessment of the potential for pathways of effect to exist between the European site QIs and the proposed works as identified within HDA Volume 1: Project Description and Volume 2: Flexibility and MDO.

8.1.1.3 Based on the assessment of Dublin Array, including the implementation of mitigation measures, it can be concluded that no adverse effects on the integrity of the European sites will arise, in view of the sites' Conservation Objectives.

8.1.1.4 This report presents a Stage 2 Natura Impact Statement (NIS) for Dublin Array, providing the information required for the competent authority to undertake an appropriate assessment and to determine whether or not the proposed offshore wind farm, either alone or in-combination with other plans and projects, in view of best scientific knowledge, will adversely affect the integrity of European sites.

8.2 In combination

8.2.1.1 Based on the assessment of Dublin Array in-combination with other plans and projects, it can be concluded beyond a reasonable scientific doubt that it will not adversely affect the integrity of any European Site

Table 224 Summary of the potential for adverse effect from Dublin Array alone and in combination

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
SACs screened in for assessment				
Rockabill to Dalkey Island SAC [IE003000]	Harbour porpoise	▪ Underwater noise ▪ Collision risk ▪ Effects on prey ▪ Vessel disturbance ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat disturbance	▪ Collision risk ▪ Vessel disturbance ▪ Effects on prey ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Habitat loss	No adverse effect alone and/or in combination for all impacts.
	Reef	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Physical habitat loss ▪ Habitat disturbance ▪ Invasive species ▪ EMF	No adverse effect alone and/or in combination for all impacts.
South Dublin Bay SAC [IE000210]	Mudflats and sandflats Salicornia and other annuals	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
North Dublin Bay SAC [IE000206]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species	No adverse effect alone and in combination for all impacts.
Baldoyle Bay SAC [IE000199]	Mudflats and sandflats Salicornia and other annuals Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species	No adverse effect alone and in combination for all impacts.
The Murrough Wetlands SAC [IE002249]	Atlantic salt meadows Mediterranean salt meadows	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species	No adverse effect alone and in combination for all impacts.
Codling Fault Zone SAC [IE003015]	Submarine structures made by leaking gases	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Suspended sediment and deposition ▪ Invasive species	▪ Accidental pollution (offshore infrastructure and O&M Base) ▪ Invasive species	No adverse effect alone and in combination for all impacts.
	Harbour porpoise	▪ Underwater noise ▪ Collision risk ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Habitat disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk ▪ Habitat loss	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Hook Head SAC [IE0000764]	Bottlenose dolphin Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Wicklow Mountains SAC [IE002122]	Otters	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey ▪ Habitat loss ▪ Habitat disturbance ▪ Underwater noise-	▪ Disturbance and displacement ▪ Accidental pollution ▪ Effects on prey	No adverse effect alone and in combination for all impacts.
Slaney River Valley SAC [UK000781]	Twaite shad Atlantic salmon Sea lamprey Freshwater pearl mussel	▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	▪ EMF ▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	No adverse effect alone and in combination for all impacts.
River Boyne and River Blackwater SAC [IE004232]	Atlantic Salmon	▪ Underwater noise ▪ Accidental pollution ▪ Effects on prey ▪ Invasives species	▪ EMF ▪ Underwater noise ▪ Accidental pollution ▪ Invasive species ▪ Effects on prey	No adverse effect alone and in combination for all impacts.
Lambay Island SAC [UK004069]	Grey seal Harbour seal Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance ▪ Habitat disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk ▪ Habitat loss	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC [UK0013117]	Bottlenose dolphin Grey seal	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
North Anglesey Marine / Gogledd Môn Forol SAC [UK0030398]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Blackwater Bank SAC [IE002953]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Kilkieran Bay and Islands SAC [IE0002111]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Kenmare River SAC [IE0002158]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
		▪ Collision risk ▪ Vessel disturbance	▪ Collision risk	
West Connacht Coast SAC [IE0002998]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Inishmore Island SAC [IE0000213]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Bunduff, Lough and Machair/ Trawalua/ Mullaghmore SAC [IE0000625]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Carnsore Point SAC [IE0002269]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Belgica Mound Province SAC [IE0002327]	Harbour porpoise	▪ Underwater noise	▪ Accidental pollution (Offshore infrastructure and O&M Base)	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
		▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	
Roaringwater Bay and Islands SAC [IE000101]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Blasket Island [E0002172]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
West Wales Marine / Gorllewin Cymru Forol SAC [UK0030397]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
North Channel SAC [UK0030399]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
		▪ Vessel disturbance		
Bristol Channel Approaches SAC [UK0030396]	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Cardigan Bay SAC [UK0012712]	Bottlenose dolphin	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Transboundary French SAC (18 sites)	Harbour porpoise	▪ Underwater noise ▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Collision risk ▪ Vessel disturbance	▪ Accidental pollution (Offshore infrastructure and O&M Base) ▪ Effects on prey ▪ Vessel disturbance ▪ Collision risk	No adverse effect alone and in combination for all impacts.
SPAs screened in for assessment				
North Bull Island SPA [IE0004006] (10.22km from array, 11.07km from Offshore ECC)	Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Black-tailed godwit Curlew Dún lin Grey plover Knot	▪ -	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
	Light-bellied brent goose Oystercatcher Pintail Redshank Shelduck Shoveler Teal Turnstone			
Dalkey Islands SPA [IE0004172] (2.16km from Offshore ECC, 8.57km from array)	Arctic tern	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Common tern	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Roseate tern	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk	No adverse effect alone and in combination for all impacts.
The Murrough SPA [IE0004186] (2.39km from array and 8.11km from Offshore ECC)	Red-throated diver	▪ Direct disturbance and displacement ▪ Indirect effects on prey	▪ Direct disturbance and displacement ▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Herring gull Black-headed gull Little tern Red-throated diver	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Light-bellied brent goose Wigeon Teal		▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.
North-west Irish Sea SPA [IE004236] (3.36km from	Red-throated diver Great northern diver Common scoter	▪ Indirect effects on prey ▪ Disturbance and displacement	▪ Indirect effects on prey ▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
array, 10.48km from Offshore ECC)	Guillemot Razorbill Fulmar Manx shearwater Cormorant Shag Black-headed gull Common gull Lesser black-backed gull Herring gull Great black-backed gull Kittiwake Roseate tern Common tern Arctic tern Little tern Little gull	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
South Dublin Bay and River Tolka Estuary SPA [IE0004024] (5.88km from ECC, 12.06km from array)	Roseate tern Common tern	▪ Indirect effects on prey	▪ Collision risk ▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Arctic tern Black-headed gull	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Light-bellied brent goose Oystercatcher Ringed plover Grey plover Knot Dunlin Redshank	▪ -	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Howth Head Coast SPA [IE0004113] (8.51km from array, 12.32km from Offshore ECC)	Kittiwake	▪ Indirect effects on prey	▪ Indirect effects on prey ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Ireland's Eye SPA [IE0004117] (12.00km from array, 16.33km from Offshore ECC)	Razorbill Guillemot Kittiwake Cormorant	▪ Indirect effects on prey	▪ Indirect effects on prey	No adverse effect alone and in combination for all impacts.
	Herring gull Kittiwake	▪ -	▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Razorbill Guillemot	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Baldoyle Bay SPA [IE0004016] (14.05km from array, 16.03km from Offshore ECC)	Grey plover Light-bellied brent goose Ringed plover Shelduck	▪	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.
Wicklow Mountains SPA [IE002122] (8.96km from Offshore ECC, 18.39km from array)	Merlin	▪ -	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Lambay Island SPA [IE0004069] (19.27km from array, 25.83km from Offshore ECC)	Guillemot Razorbill Shag	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Herring gull Lesser black-backed gull	▪	▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Cormorant	▪	▪ Collision risk	No adverse effect alone and in combination for all impacts
	Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk	▪ No adverse effect alone and in combination for all impacts
Wicklow Head SPA [IE0004127] (19.84km from array, 25.59km from Offshore ECC)	Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Skerries Island SPA [IE0004122] (30.16km from array, 35.45km from Offshore ECC)	Herring gull	▪	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Saltee Islands SPA [IE0004002] (119.69km from array, 123.61km	Razorbill Guillemot Gannet Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
from Offshore ECC)	Lesser black-backed gull Kittiwake Gannet	▪	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Skomer, Skokholm the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA [UK9014051] (156.5km from array; 163.3km from Offshore ECC)	Kittiwake	▪ Disturbance and displacement	▪ Collision risk ▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Guillemot Razorbill	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Lesser black-backed gull	▪ -	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Grassholm SPA [UK9014041] (157.9km from array; 164.5km from Offshore ECC)	Gannet	▪ Direct disturbance and displacement	▪ Direct disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Dungarvan Harbour SPA [IE004032] (161.02km from array)	Bar-tailed godwit Black-tailed godwit Curlew Dunlin Golden plover Great crested grebe Grey plover Knot	▪	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
	Lapwing Light-bellied brent goose Oystercatcher Red-breasted merganser Redshank Shelduck Turnstone			
Helvick Head and Ballyquin SPA [IE000665] (162.6km from array; 163.7km from Offshore ECC)	Kittiwake	▪ Disturbance and Displacement	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Blackwater Estuary SPA [IE004028] (181.21km from array)	Bar-tailed godwit Black-tailed godwit Curlew Dunlin Golden plover Lapwing Redshank Wigeon	▪	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.
Ballymacoda Bay SPA [IE004023] (189.49km from array)	Bar-tailed godwit Black-tailed godwit Curlew Dunlin Golden plover Grey plover Lapwing Redshank	▪	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
	Ringed plover Teal Turnstone Wigeon			
Ballycotton Bay SPA [IE004022] (200.57km from the array)	Bar-tailed godwit Black-tailed godwit Curlew Golden plover Grey plover Lapwing Ringed plover Teal Turnstone	▪	▪ Migratory collision risk	No adverse effect alone and in combination for all impacts.
Ailsa Craig SPA [UK9003091] (219.2km from array; 228.3km from Offshore ECC)	Gannet	▪ Direct disturbance and displacement	▪ Direct disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Lesser black-backed gull Kittiwake	▪	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Old Head of Kinsale SPA [IE004021] (244.6km form ECC; 246.1km from array)	Kittiwake	▪ Disturbance and displacement	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Aberdaron Coast and Bardsey Island / Glannau Aberdaron ac	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Ynys Enlli [UK9013121]				
Copeland Islands SPA [UK9020291]	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Ribble and Alt Estuaries SPA [UK9005103]	Lesser black-backed gull	▪ -	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Morecambe Bay and Duddon Estuary SPA [UK9020326]	Herring gull Lesser black-backed gull	▪ -	▪ Collision risk	No adverse effect alone and in combination for all impacts.
Rathlin Island SPA [UK9020011]	Kittiwake	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Guillemot Razorbill	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
North Colonsay and Western Cliffs SPA [UK9003171]	Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Kittiwake	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
Isles of Scilly SPA [UK9020288]	Lesser black-backed gull Great black-backed gull	▪ -	▪ Collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Mingulay and Berneray SPA [UK9001121]	Guillemot Razorbill	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Rum SPA [UK9001341]	Manx shearwater	▪ Disturbance and displacement	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Shiant Isles SPA [UK900104]	Razorbill	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
St Kilda SPA [UK9001031]	Gannet	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Flannan Isle SPA [UK9001021]	Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Handa SPA [UK9001241]	Razorbill Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
Cape Wrath SPA [UK9001231]	Razorbill Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
	Kittiwake	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.

European site name	Qualifying feature	Effects screened in for construction and decommissioning	Effects screened in for O&M	Conclusions for the assessment for adverse effect alone and in combination
Sule Skerry and Sule Stack SPA [UK9002181]	Gannet	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.
	Guillemot	▪ -	▪ Disturbance and displacement	No adverse effect alone and in combination for all impacts.
North Rona and Sula Sgeir SPA [UK9001011]	Gannet	▪ -	▪ Disturbance and displacement ▪ Collision risk	No adverse effect alone and in combination for all impacts.

9 Transboundary Statement

9.1.1.1 Based on the assessment of Dublin Array alone and in combination with other projects and plans, including the implementation of mitigation measures, it can be concluded that no adverse effects on the integrity of any European sites will arise, in view of the sites' Conservation Objectives.

9.1.1.2 It can therefore be concluded that there is, therefore, no potential for adverse effect on integrity of any transboundary sites in relation to Dublin Array alone and or in-combination and therefore, subject to natural change, the designated sites will be maintained in the long term.

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