Annex E Application for Planning Permission for the Proposed Development ACP Case Ref. ABP-319864-24, EIAR Volume II - Chapter 11: Marine Mammals (Revised March 2026)



Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume II, Chapter 11: Marine Mammals (Revised March 2026)

sse Renewables

Revision	Date	Status	Author	Reviewed by	Approved by
1.0	07/05/2024	Final (External)	APEM Ltd	GoBe Consultants	Sure Partners Limited
2.0	19/03/2026	Final (External)	APEM Ltd	GoBe Consultants	Sure Partners Limited

Statement of Authority

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Experts	Qualifications	Relevant Experience
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Glossary

Term	Meaning
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Arklow Bank Wind Park 2 (ABWP2) (The Project)	Arklow Bank Wind Park 2 (ABWP2) (The Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure: This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Cable Protection	External armouring applied to exposed cables or used at cable crossings, typically comprised of rock (berms or bags), ducting (polyurethane, steel, High Density Polyethylene (HDPE), cast iron or plastic) or concrete mattresses.
Cetacean	The order Cetacea includes whales, dolphins and porpoises and is collectively known as cetaceans.
Coefficient of Variation	The ratio of the standard deviation to the mean.
Confidence Interval	The measure of the degree of uncertainty or certainty in a sampling method.
Deflagration	A low order technique to neutralise explosives.
Environmental Impact Assessment (EIA)	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental

Term	Meaning
	information, which fulfils the assessment requirements of the Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive).
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Proposed Development's transmission assets.
Foundation	The load carrying support structure for the wind turbine generator tower or offshore substation platform topside. The foundation is the part of the structure from the interfacing flange with the turbine tower or topside-foundation interface, down to below seabed. This includes any secondary steel items associated with the structure. For the purposes of the EIAR the term 'foundation' includes the structure from the WTG tower or topside interface down to the lower end of the monopile commonly known as the 'substructure' and encompasses monopiles and transition pieces.
High order (UXO) detonation	Neutralisation of the UXO through full detonation of the original explosive content.
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Low order (UXO) detonation	Neutralisation of the UXO without full detonation of the original explosive material.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact.
Permanent Threshold Shift (PTS)	Following a marine mammal's exposure to high noise levels, if a threshold shift occurs and does not return to normal after several weeks then a Permanent Threshold Shift (PTS) has occurred. This results in a permanent auditory injury to the marine mammal.
Permitted Maritime Usage	The construction and operation of an offshore wind farm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore wind farm).
Pinniped	Fin-footed group of marine mammals which are semi-aquatic. Pinnipeds comprise of the following families: Odobenidae (walrus); Otariidae (eared seals, sea lions, and fur seals); and Phocidae (earless seals). Pinnipeds are more broadly known as "seals".
Ramp-up	The term ramp-up is applied to the gradual, or incremental, increase in energy with the aim to mitigate sound exposure to marine mammals. For piling, this means a gradual increase in hammer blow energy from the initiation of piling activity until required blow energy is reached for installation of each pile, usually over a period not less than 20 minutes. Maximum hammer blow energy may not be required to complete pile installation.

Term	Meaning
Scour protection	A solution for preventing scour around subsea structures, typically comprised of rock or concrete mattresses.
Small Cetacean Abundance in the North Sea and Adjacent Waters (SCANS)	Large scale surveys aimed at estimating the abundance of porpoises and other cetaceans in order to assess the impacts of by-catch. SCANS (1994) and SCANS II (2005), SCANS III (2017) and SCANS VI (2022) have been completed.
Soft-start	The term 'soft-start' is applied to the period at the start of the piling ramp-up period where blows are undertaken at a relatively low energy and reduced strike rate.
Temporary Threshold Shift (TTS)	A temporary change in the hearing threshold of marine mammals following noise exposure. Hearing loss in this case is not permanent.
The Application	The full set of documents that will be submitted to An Bord Pleanála in support of the consent.
The Developer	Sure Partners Ltd.

Acronyms

Term	Meaning
AA	Appropriate Assessment
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
ACP	An Comisiún Pleanála
ADD	Acoustic Deterrent Device
BEIS	Department of Business, Energy, and Industrial Strategy
C	Central
CI	Confidence Interval
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CMACS	Centre for Marine and Coastal Studies
CMS	Convention on Migratory Species
Co.	County
CPT	Cone Penetration Test
CSA	Continental Shelf Associates Ocean Sciences Inc.
CSIP	Cetacean Strandings Investigation Programme
CV	Coefficient of Variation
CWC	Coveney Wildlife Consulting Ltd
DAHG	Department of Arts, Heritage and the Gaeltacht
DAS	Digital Aerial Survey
DCCAE	Department of Communications, Climate Action and Environment
DCHG	Department of Culture, Heritage and the Gaeltacht
DC	Direct Current
DCO	Development Consent Order
DECC	Department of the Environment, Climate and Communications
DEPONS	Disturbance Effects of Noise on the Harbour Porpoise Population in the North Sea

Term	Meaning
DHLGH	Department of Housing, Local Government and Heritage
DHPLG	Department of Housing, Planning and Local Government
DMAP	Designated Maritime Area Plan
DTAG	Digital Acoustic Recording Tag
EC	European Commission
EDR	Effective Deterrence Range
EEC	European Economic Community
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
EVMP	Environmental Vessel Management Plan
FHG	Functional Hearing Group
FLA	Foreshore Licence Application
HDPE	High Density Polyethylene
HF	High Frequency
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
HWM	High-Water Mark
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
INSPIRE	Impulse Noise Sound Propagation and Impact Range Estimator

Term	Meaning
iPCoD	Interim Population Consequences of Disturbance
IRCG	Irish Coast Guard
IWDG	Irish Whale and Dolphin Group
IWEA	Irish Wind Energy Association
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
MAC	Maritime Area Consent
MAP Act	Maritime Area Planning Act 2021
MARA	Maritime Area Regulatory Authority
MARPOL	International Convention for the Prevention of Pollution from Ships 1973
MBES	Multibeam Echo Sounder
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Mammal Observer
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
MU	Management Unit
N	North
NAS	Noise Abatement System
NBAP	National Biodiversity Action Plan
NBDC	National Biodiversity Data Centre
NIS	Natura Impact Statement
NISA	North Irish Sea Array
NMPF	National Marine Planning Framework
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPWS	National Parks and Wildlife Service
NRW	Natural Resources Wales
O&M	Operations and Maintenance

Term	Meaning
OMF	Operations and Maintenance Facility
ORE	Offshore Renewable Energy
OSP	Offshore Substations Platforms
OSPAR	Oslo-Paris Conventions
PAM	Passive Acoustic Monitoring
PCW	Phocid (in water)
PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift
RFI	Request for Further Information
RMS	Root Mean Square
RoI	Republic of Ireland
ROV	Remotely Operated Vehicle
S	South
SAC	Special Area of Conservation
SAM	Static Acoustic Monitoring
SBP	Sub-Bottom Profiler
SCANS	Small Cetacean Abundance in the North Sea
SCOS	Special Committee on Seals
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SOLAS	Safety of Life at Sea
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentrations
SSS	Side Scan Sonar
SST	Sea Surface Temperature

Term	Meaning
SW	Southwest
TNT	Trinitrotoluene
TSHD	Trailing Suction Hopper Dredger
TTS	Temporary Threshold Shift
UK	United Kingdom
US	United States
USBL	Ultra-Short Baseline
UXO	Unexploded Ordnance
VHF	Very High Frequency
VMP	Vessel Management Plan
VP	Vantage Point
WFD	Water Framework Directive
WTG	Wind Turbine Generators
ZoI	Zone of Influence

Units

Unit	Description
%	Percentage
<	Less than
>	More than
dB	Decibel (unit used to measure the intensity of sound)
GW	Gigawatt
Hz	Hertz
kg	Kilograms
kHz	Kilohertz
kJ	Kilojoules
km	Kilometres
km^2	Square kilometre
Kn	Knot
kV	Kilovolt (electrical potential)
m	Metre
m^3	Cubed metres
m/s	Metres per second (speed)
mg	Milligrams
mg/l	Milligrams per litre
mG	Milligauss
MW	Megawatt (power; equal to one million watts)
nm	Nautical mile
s	Second
V/m	Volts per metre
µPa	Micropascals
μPa^2s	Micropascals squared per second
µT	Microtesla

Unit	Description
µV m	Microvolts per metre

11 Marine Mammals

Summary of changes

This Chapter has been updated to reflect changes since submission of the planning application to An Bord Pleanála (ABP) (now An Coimisiún Pleanála (ACP)) in June 2024. All references to ABP, should be considered ACP throughout the document.

The changes that have been made are in response to the Request for Information (RFI) that was received and matters that have been raised therein. The Developer confirms that this Chapter has been based on up-to-date survey reports and data and that that the information submitted is relevant and appropriate at the point of submission (i.e. March 2026). In summary, the following sections of this Chapter have been amended (please note that this is non-exhaustive):

- Section 11.1 (Introduction) has been updated to identify any new or revised documentation of relevance to the amended chapter.
- Section 11.2 (Regulatory Context) has considered the latest policy and legislation of relevance to the assessment.
- Section 11.4 (Study Area) has provided clarification on the rationale for choosing the Study Area where this has been raised via the RFI, so as to clearly demonstrate the logic and spatial appropriateness for the assessment boundary.
- Section 11.5 (Methodology) has been updated to reflect appropriate and relevant data that has been published and/or gathered since the original submission was made.
- Section 11.6 (Impact Assessment Methodology) has considered the latest project design (as detailed in Volume II, Chapter 4: Description of Development (Revised March 2026)) as well as provided clarification in response to the RFI on the impacts scoped in/out where requested, so as to clearly demonstrate the logic and appropriateness of the assessment that has been undertaken.
- Section 11.7 (Methodology for Significance of Effects) has been updated where relevant to reflect the latest guidance and criteria as well as clarification on the Factored In Measures where this has been raised via the RFI and/or updated following additional modelling which has been undertaken.
- Sections 11.9 and 11.10 (Assessment subsections) represents the updated assessment which has been amended to reflect the latest information (i.e. as described above) and any updates required in line with matters raised via the RFI;
- Sections 11.11 and 11.12(Cumulative Assessment subsections) have been updated to reflect the latest information and to align with NSIP (2024) guidance as requested via the RFI.
- Section 11.14 (Summary of Effects) has been updated to reflect the updates that have been made throughout the chapter.

In addition to those changes above, all other sections of this chapter have been adjusted to ensure consideration of the latest information as appropriate to ensure consistency and accuracy. Clarification and/or further detail has also been provided where this has been requested via the RFI, relevant figures and tables have been updated as required and it is confirmed that all cross-references have been updated throughout to ensure accuracy.

Additionally, in support of the necessary changes to the chapter, it is noted that the following updates have been made to the appendices supporting this chapter:

- Revised Appendices:
  - Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026) – This is an updated appendix that supersedes the previous version.
  - Volume III, Appendix 11.2: Marine Mammal Technical Report (Revised March 2026) – This is an updated appendix that superseded the previous version.
  - Volume III, Appendix 11.2: Marine Mammal Technical Report (Revised March 2026) – This is an updated appendix that superseded the previous version.
  - Volume III, Appendix 25.5: Marine Mammal Mitigation Plan (Revised March 2026) – This is an updated appendix that superseded the previous version.
- New Appendices:

- Volume III, Appendix 11.4: Seal Survey – 2025 Survey Report (RFI March 2026) – This is a new appendix.
- Volume III, Appendix 11.5: Temporary Threshold Shift (TTS) Position Paper - SMRU Consulting (RFI March 2026) – This is a new appendix.
- Volume III, Annex A in Appendix 25.2: ADD Review– This is a new annex in this appendix.

Additionally, as requested via the RFI, relevant documents have been submitted in Volume IV.

11.1 Introduction

11.1.1.1 This Chapter of the Environmental Impact Assessment Report (EIAR) presents the assessment of the potential impacts of the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (hereafter referred to as 'the Proposed Development') on marine mammals. Specifically, this Chapter considers the potential impact of the Proposed Development below the High-Water Mark (HWM) during the construction, operations and maintenance, and decommissioning phases.

11.1.1.2 This Chapter draws upon information contained within the following Chapters and technical reports:

- Volume II, Chapter 2: Policy and Legislation (Revised March 2026);
- Volume II, Chapter 2: Policy and Legislation (Revised March 2026), Annex 2: Marine Strategy Framework Directive Assessment (RFI March 2026)
- Volume II, Chapter 4: Description of Development (Revised March 2026);
- Volume II, Chapter 5: EIA Methodology (Revised March 2026);
- Volume II, Chapter 6: Coastal Processes (Revised March 2026);
- Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026);
- Volume II, Chapter 15: Shipping and Navigation (Revised March 2026);
- Volume II, Chapter 23: Interactions;
- Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026);
- Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026);
- Volume III, Appendix 11.3: Phase 1 Irish Offshore Windfarms: Cumulative iPCoD Modelling;
- Volume III, Appendix 11.4: Seal Survey – 2025 Survey Report (RFI March 2026);
- Volume III, Appendix 15.1: Navigational Risk Assessment (Revised March 2026);
- Volume III, Appendix 25.1: Environmental Management Plan (Revised March 2026);
- Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026);
- Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026), Annex A: ADD Review (RFI March 2026) and
- Volume III, Appendix 25.10: Environmental Vessel Management Plan.

11.1.1.3 It is intended that this EIAR Chapter will provide stakeholders with sufficient information to determine the potential significant impacts of the Proposed Development on marine mammals.

11.1.1.4 Specifically, this Chapter:

- Presents the existing environmental baseline established from desk-based studies, site-specific surveys, and consultation;
- Identifies any assumptions and limitations encountered in compiling the information for the environmental baseline;
- Presents the potential environmental effects on marine mammals arising from the Proposed Development, based on the information gathered, and the analysis and assessments undertaken; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce, or offset the possible environmental effects of the Proposed Development on marine mammals.

11.2 Regulatory background

11.2.1.1 Legislation, policy, and guidance of relevance to this Chapter is outlined in Table 11.1 and Table 11.2.

11.2.1.2 Further information on relevant planning policy and legislative requirements relating to the Environmental Impact Assessment (EIA) of the Proposed Development is presented in Volume II, Chapter 2: Policy and Legislation (Revised March 2026).

Table 11.1: Summary of regulatory background

Publisher	Name of document incl. reference	Key provisions
Statutory		
Legislation		
European Commission, 2011	European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011); (www.irishstatutebook.ie)	Transposes European Union (EU) Directive 2008/56/EC (Marine Strategy Framework Directive (MSFD)) into Irish law. The MSFD manages the effect of human activity in the marine sector on marine ecosystems; namely in this case, construction, survey and energy production and associated underwater noise.
Department of the Arts, Heritage and the Gaeltacht (DAHG), 2000	The Wildlife Act, 1976 (S.I. No 39 of 1976); (www.irishstatutebook.ie) The Wildlife (Amendment) Act, 2000 (S.I. No. 38 of 2000) (www.irishstatutebook.ie)	The Wildlife Act (1976) provides specific protection to (most relevant) seals, whales, dolphins and porpoise. Under the Act it is an offence to disturb, harm, kill, or otherwise wilfully interfere with or destroy the breeding place of a protected species and if activity is likely to cause any of the above, measures must be taken to prevent.
European Commission, 2011	European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) (www.irishstatutebook.ie)	All cetaceans in Northern European waters are listed under Annex IV of the EU Directive 92/43/European Economic Community (EEC) and in need of strict protection. Of these species, harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) have protection under Annex II as species of Community Interest, whose conservation requires the designation and enforcement of Special Areas of Conservation (SACs).
European Commission, 2003	European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) (www.irishstatutebook.ie)	Transposes Directive 2000/60/EC (Water Framework Directive (WFD)) into Irish law. The WFD encapsulates inland, transitional (estuarine) and coastal surface waters and designates strict protection from water-borne pollution and potential flora / fauna loss as a result.

Publisher	Name of document incl. reference	Key provisions
European Commission, 2023	European Union (Good Agricultural Practice for Protection of Waters) (Amendment) Regulations 2023 (S.I. No. 62 of 2023) (www.irishstatutebook.ie)	Transposes European Communities (Nitrates Directive (91/676/EEC), 2023) into Irish law. This directive links with the WFD specifically managing the potential for eutrophication of water bodies, inland, transitional, and coastal / marine, as a result of agricultural nitrate sources entering waterways. Eutrophication poses particular risk to life as excessive nitrates and phosphates in water bodies can adversely impact trophic chains at all levels.
European Union, 2016	European Union (Framework for Maritime Spatial Planning) Regulations 2016 (S.I. No. 352 of 2016) (www.irishstatutebook.ie)	Transposes EU Directive 2014/89/EU (Marine planning framework) into Irish law. Establishes a framework for maritime spatial planning to promote sustainable development of marine activities and the protection of the marine environment.
Department of Housing, Local Government and Heritage (DHLGH), 2021	Maritime Area Planning Act 2021 (S.I. No. 50 of 2021) (www,irishstatutebook.ie)	Provides a statutory framework for the sustainable management of the maritime area, including the establishment of the Maritime Area Regulatory Authority (MARA), Maritime Area Consents (MACs) and alignment with the National Marine Planning Framework (NMPF).
Planning Policy and Development Control		
Department of the Environment, Climate and Communications (DECC), 2024	South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC DMAP) ttps://assets.gov.ie/static/documents/south-coast-designated-maritime-area-plan-for-offshore-renewable-energy-october-2024.pdf	Contains the AA screening process and Strategic Environmental Assessment (SEA) scoping report of the South Coast Maritime area associated with offshore renewable energy (ORE). This resource has some important information on existing baseline conditions in the maritime area including benthic habitats.
Minister for Communications, Climate Action and Environment, 2020	European Union (Environmental Impact Assessment) (Environmental Protection Agency Act 1992) (Amendment) Regulations 2020 (S.I. No. 191 of 2020) (www.irishstatutebook.ie)	Amends the Environmental Protection Agency Act 1992 in respect of the transposition of the EIA Directive (2014/52/EU) into Irish law. Establishes requirements for the assessment of likely significant effects of projects on the environment, including impacts on biodiversity and marine mammals.
Department of Housing, Local Government and Heritage (DHLGH), 2021	Article 17 update to Ireland's Marine Strategy Part 2: Monitoring Programme (Article 11) (https://assets.gov.ie/)	Provides updated information on Ireland's Marine Strategy Part 2: Monitoring Programme (Article 11), under the MSFD and assessment of environmental status, including monitoring related to underwater noise and marine biodiversity.

Publisher	Name of document incl. reference	Key provisions
DHLGH, 2021	National Marine Planning Framework (NMPF) (www.gov.ie)	The NMPF details how marine activities will interact and coexist with each other in the maritime area. The NMPF directs decision makers and users towards efficient and sustainable use of marine resources via a number of policy objectives. The policy objectives of relevance to this Chapter of the EIAR and how they have been addressed is set out in Table 11.2.
Guidelines and technical standards		
National Parks and Wildlife Service (NPWS), 2024	Ireland's 4th National Biodiversity Action Plan (NBAP) (www.gov.ie)	The 4th NBAP sets the national biodiversity agenda for the period 2023-2030 through five strategic objectives
DAHG, 2014	Guidance to manage the risk to mammals from manmade sound sources in Irish waters (www.npws.ie)	Guidelines on management of underwater noise and effects on marine mammals, including protocols, mitigation and recommendations
Department of Communications, Climate Action, and the Environment (DCCAE), 2018	Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects (Parts 1 and 2); (www.gov.ie)	Guidelines on data collection and analysis requirements for offshore renewable energy developments.
Non-Statutory		
Planning Policy and Development Control		
Irish Whale and Dolphin Group (IWDG), 2020	IWDG Policy on Offshore Windfarm Development (https://iwdg.ie/)	Report describing the best practice in the protection of cetaceans during the development process for offshore windfarms and other marine renewable energy installations.
Irish Wind Energy Association (IWEA), 2012	Best Practice Guidelines for the Irish Wind Energy Industry (windenergyireland.com)	Guidance to development of renewable energy in Ireland.
Guidelines and technical standards		
Environmental Protection Agency (EPA), 2022	Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (www.epa.ie)	These Guidelines apply to the preparation of all EIARs undertaken in the State (Ireland).

Publisher	Name of document incl. reference	Key provisions
EPA, 2012	Assessment and Monitoring of Ocean Noise in Irish Waters (epa.ie)	Guidance on effects of anthropogenic noise in Irish waters.
Chartered Institute of Ecology and Environmental Management (CIEEM), 2018; 2024	Guidelines For Ecological Impact Assessment (EcIA) in The United Kingdom (UK) And Ireland: Terrestrial, Freshwater and Marine (cieem.net)	Guidelines to the preparation of all EIARs undertaken in the UK and Ireland. The 2024 update builds on the established EcIA framework set out in the 2018 guidelines.
Department of Housing, Planning and Local Government (DHPLG), 2019	Draft Revised Wind Energy Development Guidelines (https://assets.gov.ie/) Wind Energy Development Guidelines (2006) (https://assets.gov.ie/)	The draft 2019 Guidelines offer advice to planning authorities on planning for wind energy through the development plan process and in determining applications for planning permission.

Table 11.2: National Marine Planning Framework Policy Objectives

NMPF Policy Objective	Description	Section in which it is addressed
Biodiversity Policy 1	Proposals incorporating features that enhance or facilitate species adaptation or migration, or natural native habitat connectivity will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals that may have significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity.	See section 11.7.3.
Biodiversity Policy 4	Proposals must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid; b) minimise; or c) mitigate significant disturbance to, or displacement of, highly mobile species.	See sections 11.7.3, 11.9, 11.9.1, 11.9.2, 11.9.6, 11.9.7, 11.9.8, 11.10, 11.10.1, 11.10.2, 11.10.6, 11.10.7 and 11.10.8.
Protected Marine Sites Policy 1	Proposals must demonstrate that they can be implemented without adverse effects on the integrity of Special Areas of Conservation (SACs) or Special Protection Areas (SPAs). Where adverse effects from proposals remain following mitigation, in line with Habitats Directive Article 6(3), consent for the proposals cannot be granted unless the prerequisites set by Article 6(4) are met.	A Natura Impact Statement – Stage 2 Appraisal to Inform an Appropriate Assessment of Implications on European Sites has been prepared for this planning application.

NMPF Policy Objective	Description	Section in which it is addressed
Underwater Noise Policy 1	Proposals must take account of spatial distribution, temporal extent, and levels of impulsive and / or continuous sound (underwater noise) that may be generated and the potential for significant adverse impacts on marine fauna. Where the potential for significant impact on marine fauna from underwater noise is identified, a Noise Assessment Statement must be prepared by the proposer of development. The findings of the Noise Assessment Statement should demonstrably inform determination(s) related to the activity proposed and the carrying out of the activity itself. The content of the Noise Assessment Statement should be relevant to the particular circumstances and must include: • Demonstration of compliance with applicable legal requirements, such as necessary assessment of proposals likely to have underwater noise implications, including but not limited to: – Appropriate Assessment (AA); – Environmental Impact Assessment (EIA); – Strategic Environmental Assessment (SEA); – Specific response to 'strict protection' requirements of Article 12 of the Habitats Directive in relation to certain species listed in Annex IV of the Directive; and – Species protected under the Wildlife Acts. • An assessment of the potential impact of the development or use on the affected species in terms of environmental sustainability; • Demonstration that significant adverse impacts on marine fauna resulting from underwater noise will, in order of preference and in accordance with legal requirements be: a) avoided,	See sections 11.9, 11.9.1, 11.9.2, 11.9.6, 11.9.7, 11.9.8, 11.10, 11.10.1, 11.10.2, 11.10.6, 11.10.7 and 11.10.8.

NMPF Policy Objective	Description	Section in which it is addressed
	b) minimised, or c) mitigated, or d) if it is not possible to mitigate significant adverse impacts on marine fauna, the reasons for proceeding must be set out. This policy should be included as part of statutory environmental assessments where such assessments require consideration of underwater noise.	

11.3 Consultation

11.3.1.1 Consultation activities have been undertaken with various statutory and non-statutory authorities as part of the EIA for the Proposed Development. A summary of the key issues raised to date that are specific to marine mammals, together with how these issues have been considered in production of this EIAR Chapter is presented in Table 11.3.

Table 11.3: Summary of consultation relating to marine mammals

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
January 2019	Irish Whale and Dolphin Group (IWDG)	Discussion of: • Sources of information including regional monitoring data; • Site-specific survey methods (historical data and aerial surveys); • Mitigation measures to be applied during construction; • Requirement for site-specific noise modelling for piling; and • Return of humpback whales (*Megaptera novaeangliae*) to Irish waters.	The baseline environment section presents the most up-to-date information available, from site-specific surveys and from published sources and includes information provided during consultation (section 11.5.2). Factored In Measures are presented in Table 11.15. The effects of subsea noise were based on project-specific modelling (Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026)).
January 2019	NPWS	Discussion of: • Sources of data for baseline assessment; • Site-specific noise modelling to be undertaken; • Irish guidance on injury/disturbance to marine mammals recommends consideration of onset of temporary threshold shift (TTS); and • Potential for use of Acoustic Deterrent Devices (ADDs).	Sources of data are presented in Table 11.4. The assessment of effects of subsea noise has followed the approach recommended by the Department of Arts, Heritage and the Gaeltacht (DAHG) (2014) and is based on project-specific noise modelling (Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026)) and includes modelling and assessment of TTS for the relevant Functional Hearing Groups (FHGs). ADDs are a potential mitigation device that can be effectively used to deter marine mammals from entering a zone in which they could be injured by noise emissions associated with the Proposed Development or encouraging them to leave such a zone. The use of ADDs for mitigation was discussed with NPWS, who were open to considering this approach as an option.

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
January 2019	Seal Rescue Ireland	Discussion of: • Site-specific surveys and baseline data; and • Characteristics of seals and location of haul out sites.	The baseline environment is informed by site-specific surveys (Table 11.5) and by the most recent information gathered through a desk-based study (Table 11.4). Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026) describes in detail the ecology and distribution of seals within the defined study areas.
August 2020	Department of Culture, Heritage and the Gaeltacht (DCHG)	Comments on the Proposed Development marine mammal risk assessment for the geotechnical surveys (relevant to this EIAR): • Inclusion of the most recent aerial survey data for seals in Ireland; and • Inclusion of TTS in the subsea noise assessment.	The most recent aerial survey data (Morris and Duck, 2019) has been included in the baseline (see Table 11.4). TTS for the relevant FHGs have been included in the assessment of the effects of noise on marine mammals, noting that as a short-term hearing impediment TTS ranges were not used to define the mitigation zone; instead, the range at which a permanent auditory injury (a Permanent Threshold Shift; PTS) occurs was used.
October 2020	IWDG – Scoping response	Comments on the Scoping Report (submitted September 2020): • Inclusion of relevant legislation and guidance including Convention on Migratory Species (CMS) guidance; • Clarification regarding consideration of underwater noise during operation by assessment; • Study area and scope for baseline data to allow assessment of subsea noise impact; • Static Acoustic Monitoring (SAM) to develop a noise profile of the site before, during and after construction; • Concern regarding assigning unidentified 'seal species' as grey seal and 'small cetacean species' as harbour porpoise;	Relevant guidance and legislation are provided in section 11.2. and section 11.7 Operational noise is considered in Table 11.11. Study area and scope of baseline data is presented in Table 11.5 and Table 11.4. (Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)). Confirmatory PAM surveys are planned and will included click detectors (for example C-PODs/F-PODs) and broadband devices (such as soundtraps). Monitoring has been proposed to understand the potential for behavioural disturbance to marine mammals during piling. Such monitoring will include both visual monitoring and the use of PAM. The details of this monitoring are set out in Volume II, Chapter 25: Summary of Factored In Measures, Mitigation and Monitoring (Revised March 2026). Unassigned 'small cetacean species' have not been assigned to harbour porpoise to calculate density estimates within this assessment. Grey seal density estimates from site-specific surveys have not been used in assessment due to insufficient

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
		• Predictive noise modelling for piles should be carried out with and without the use of noise abatement systems (NAS); • The use of Passive Acoustic Monitoring (PAM) as part of mitigation strategy; and • Mitigation measures should include PAM and a minimum of two PAM Operators (PAMOs).	numbers of species recorded to consider the estimate robust. Predictive noise modelling has been carried out for both Project Design Options with Factored In Measures to include a soft start. NAS (such as piling sleeves or bubble curtains to reduce noise at source) have not been included as part of the project design and therefore have not been modelled. Mitigation is outlined in the Marine Mammal Mitigation Plan (MMMP) (Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026); Table 11.15) and follow statutory guidance (DAHG, 2014) and will include the use of both Marine Mammal Observers (MMOs) and PAMOs.
December 2020	IWDG – meeting	Discussion of Scoping Response, including: • Effect of operational noise, including vessel traffic; • Baseline data sources and approach to analysis; • 24-hour mitigation, including use of ADDs; • NAS; and • Monitoring.	As above.
August 2023	IWDG – Scoping response	Comments on the Scoping Report (submitted 2023): • Establishment of baseline underwater noise levels; • DAHG (2014) guidance is currently under review and updated guidance will likely take a significantly different form; and • Underwater noise during operation and potential overlap of TTS ranges from other turbines.	Relevant guidance and legislation are provided in section 11.2. Operational noise has been scoped out for marine mammals, with justification of this provided in Table 11.11.

11.4 Study area

11.4.1.1 Marine mammals are highly mobile and differ in their foraging distances and seasonal distribution based on their ecology and behaviour; therefore, for the purposes of baseline characterisation, four marine mammal study areas were defined:

- Marine Mammal Study Area (Figure 11.1): for all species, this area encompasses the Array Area, and Cable Corridor and Working Area of the Proposed Development, plus a 4-kilometre (km) corridor. The 4 km corridor extends around the Array Area, covering the area west of the Array Area towards the coast. This combined area is covered by the site-specific Digital Aerial Surveys (DAS) conducted 2018-2020 and 2023-2024;
- Extended Marine Mammal Study Area (Figure 11.1): for all marine mammal species, this area encompasses the Array Area, and Cable Corridor and Working Area of the Proposed Development, plus an extended 10 km buffer zone extending around the Array Area and covering west of the Array Area to the coast. This combined area is covered by the site-specific DAS conducted May 2025 – July 2025;
- Seal Survey Study Area (Figure 11.2): This area encompasses the Landfall and a 500 m buffer, with surveys conducted June-November 2025; and
- Marine Mammal Management Unit (MU) Study Area (Figure 11.1): The baseline characterisation considers marine mammal ecology, behaviour, abundance, and distribution within the appropriate species MU for cetaceans (Inter-Agency Marine Mammal Working Group (IAMMWG), 2023). The marine mammal MU Study Area will enable consideration of the scale of movement and population structure for each species. For pinnipeds, this area is defined by survey regions presented in Morris and Duck (2019) whilst giving consideration to the MUs relevant to the neighbouring waters of the United Kingdom (UK).

11.4.1.2 The Proposed Development is located within the following MUs for each species:

- Harbour porpoise (*Phocoena phocoena*) – Celtic and Irish Seas MU;
- Bottlenose dolphin (*Tursiops truncatus*) – Irish Sea MU;
- Risso's dolphin (*Grampus griseus*) – Celtic and Greater North Seas MU;
- Short-beaked common dolphin (*Delphinus delphis*) – Celtic and Greater North Seas MU;
- Minke whale (*Balaenoptera acutorostrata*) – Celtic and Greater North Seas MU;
- Grey seal (*Halichoerus grypus*) – East region of Republic of Ireland (RoI); and
- Harbour seal (*Phoca vitulina*) – East region of RoI.

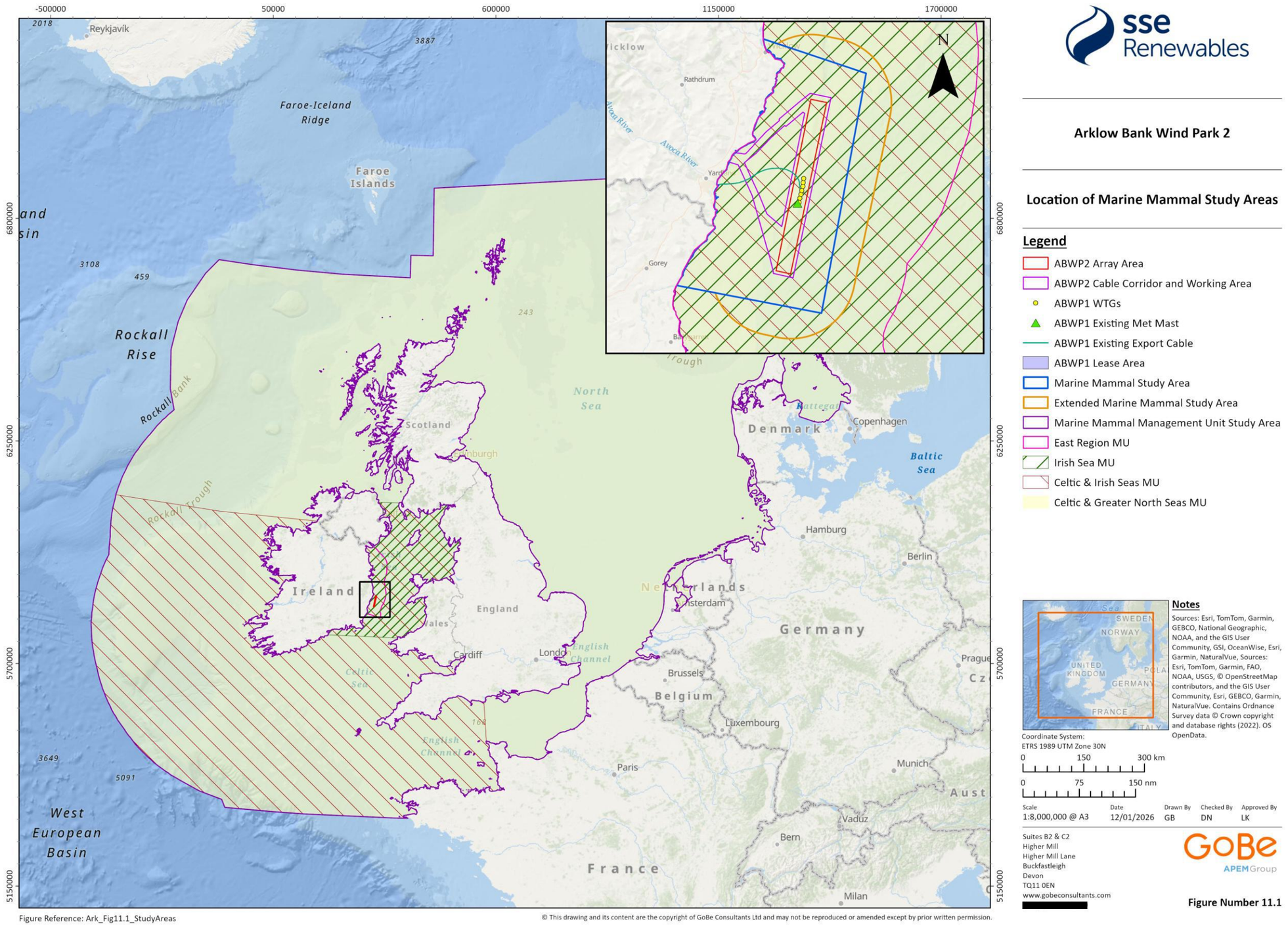

Figure Reference: Ark_Fig11.1_StudyAreas

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sse Renewables

Arklow Bank Wind Park 2

Location of Marine Mammal Study Areas

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Lease Area
- Marine Mammal Study Area
- Extended Marine Mammal Study Area
- Marine Mammal Management Unit Study Area
- East Region MU
- Irish Sea MU
- Celtic & Irish Seas MU
- Celtic & Greater North Seas MU

Notes

Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community, GSI, OceanWise, Esri, Garmin, NaturalVue, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 150 300 km

0 75 150 nm

Scale	Date	Drawn By	Checked By	Approved By
1:8,000,000 @ A3	12/01/2026	GB	DN	LK

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GoBe APEMGroup

Figure Number 11.1

Figure 11.1: Location of Marine Mammal Study Areas

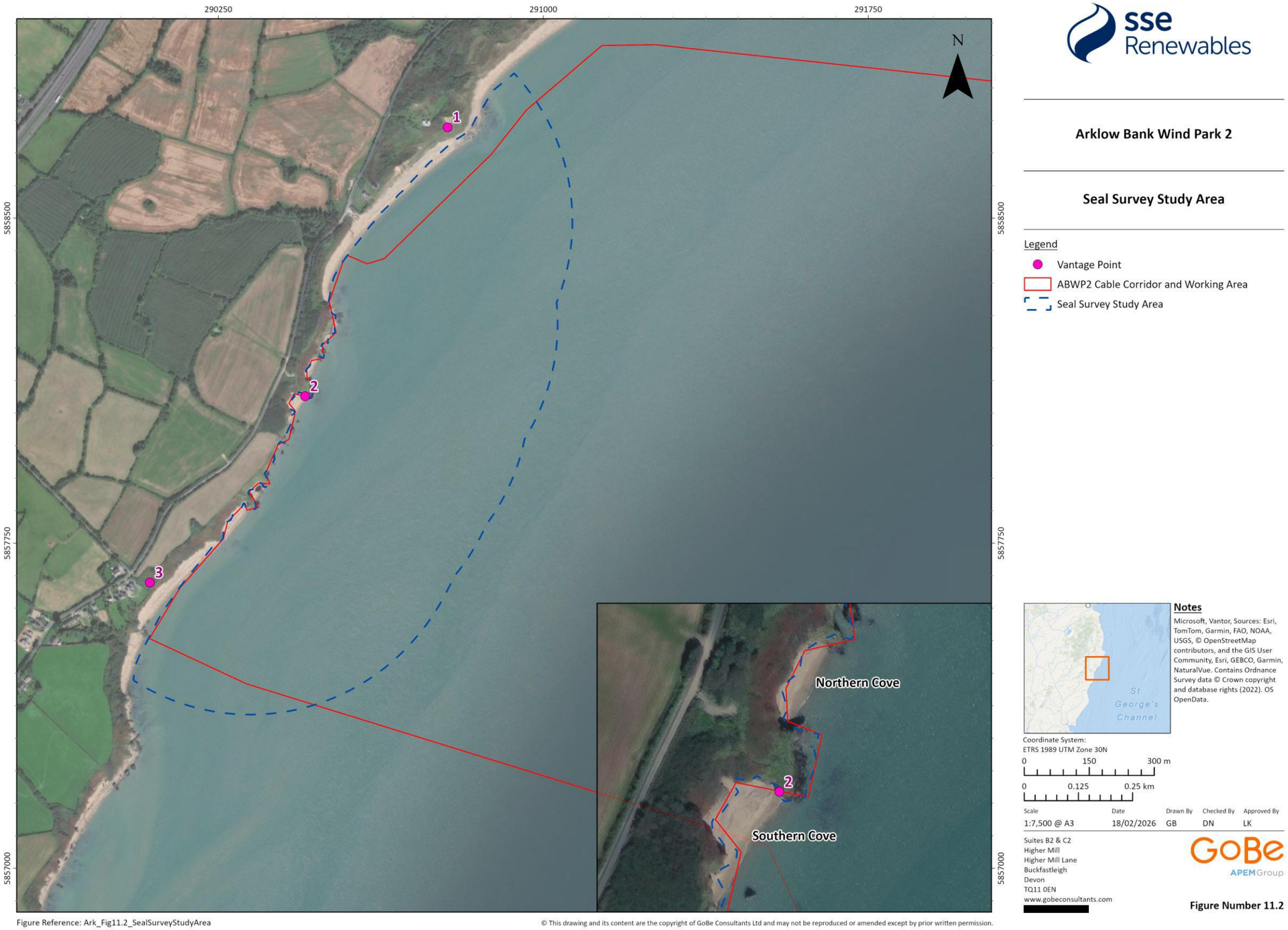


Figure 11.2: Seal Survey Study Area

11.5 Methodology

11.5.1 Methodology to inform the baseline

Desktop studies

11.5.1.1 Information on the marine mammal species within the Marine Mammal Study Area and MU Study Areas was collected through a detailed desktop review of existing studies and datasets. These reports are summarised in Table 11.4.

Table 11.4: Summary of key desktop reports and data resources

Title	Source	Year	Author
Aerial thermal imagery surveys	NPWS	2003	Cronin *et al.* (2004)
Seal counts from aerial imagery surveys	NPWS	2005	O'Cadhla *et al.* (2007)
Irish cetacean review	IWDG	2000 to 2009	Berrow *et al.* (2010)
Atlas of marine mammals in Irish offshore waters	IWDG	2005 to 2011	Wall *et al.* (2013)
Marine mammal surveys	NPWS and IWDG	2008 to 2011	Berrow *et al.* (2008; 2013)
Inshore surveys for cetaceans	IWDG	2011	Berrow *et al.* (2011)
Aerial thermal imagery surveys	NPWS	2011 to 2012	Duck and Morris (2013)
Small Cetacean Abundance in the North Sea (SCANS)-III	Sea Mammal Research Unit (SMRU)	2016	Hammond *et al.* (2017; 2021); Lacey *et al.* (2022)
'ObSERVE' programme aerial data	Department of Communications, Climate Action and Environment (DCCAE) and NPWS	2015 to 2017	Rogan *et al.* (2018a)
Aerial thermal imagery surveys	NPWS	2017 to 2018	Morris and Duck (2019)
Harbour and grey seals at sea usage maps	SMRU	2005 to 2019	Carter *et al.* (2022)
Modelled distributions and abundance of cetaceans of Wales and surrounding waters	Natural Resources Wales (NRW)	1990 to 2020	Evans and Waggitt (2023)

Title	Source	Year	Author
Biodiversity maps for Ireland	National Biodiversity Data Centre (NBDC)	various	NBDC online mapping tool[1]
Special Committee on Seals (SCOS) series	SMRU	1996 to 2022	SCOS (2021; 2022)
SCANS-IV	SMRU	2022	Gilles *et al.* (2023); Gilles *et al.* (2025)
MUs for cetaceans	Joint Nature Conservation Committee (JNCC)	2023	IAMMWG (2023)

Site specific surveys

11.5.1.2 In order to inform the EIAR, site-specific surveys were undertaken. A summary of the surveys used to inform the marine mammals impact assessment is outlined in Table 11.5 below.

11.5.1.3 Site-specific surveys include data collected in support of Arklow Bank Wind Park 1 (ABWP1) and recent surveys commissioned to inform the baseline for the Proposed Development.

11.5.1.4 The site-specific surveys for ABWP1 include historical boat-based visual surveys undertaken between June 2000 and June 2009, and PAM data were also obtained to the northwest of the ABWP1 wind turbines. These acoustic data were collected for a total of 25 days during August and September 2002 (Table 11.5). Historical data has been considered as it is informative to trends in occurrence and distribution, although does not hold substantial weight in informing the baseline characterisation.

11.5.1.5 DAS data (March 2018 to February 2020 and April 2020; August 2023 to June 2024; and February 2025 to July 2025) are available to inform the baseline for this EIAR (Table 11.5). During the 2018 to 2020 surveys an additional survey was conducted in April 2020 to account for a missed survey in April 2019. Across the 2018 to 2020 surveys, all calendar months were surveyed twice to capture seasonal seabird and marine mammal species presence across the Marine Mammal Study Area. Each calendar month was surveyed at least one more time through the further surveys in 2023 to 2025. Most surveys covered the Marine Mammal Study Area, however the surveys from May 2025 onwards include an extension of the existing buffer area to a 10 km buffer, thereby covering the Extended Marine Mammal Survey Area. However, it should be noted that the existing buffer applied in the Marine Mammal Study Area extends landwards to the coast and therefore exceeds the industry standard of a 4 km buffer, which is advised in guidance provided by Statutory Nature Conservation Bodies (SNCBs) in English and Scottish waters (SNCBs, 2022; NatureScot, 2023).

11.5.1.6 Monthly seal surveys were undertaken at suitable Vantage Points (VPs) covering the Landfall plus a 500 m buffer, with three VP locations were selected to provide visual coverage of the Landfall and adjacent coastal habitat (for full details on methodology see Volume III, Appendix 11.4: Seal Survey – 2025 Survey Report (RFI March 2026)). These surveys were carried out from June to November 2025, and the data were included the Marine Mammal Technical Report (Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)) and the

[1] https://maps.biodiversityireland.ie/Map

updates to the EIAR. The seal VP surveys were undertaken to complement the DAS data, providing additional coverage of haul-out sites beyond the high-water mark. The seal VP surveys provided fine-scale, dedicated observations of seal presence, group composition and behaviour, including during the key periods of sensitivity (breeding and moulting). The survey effort has been designed in accordance with the guidance outlined in Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects – Part 2 (DCCAE, 2018).

Table 11.5: Site specific surveys

Data source	Date(s) of survey	Overview of survey	Survey contractor	Reference to further information
PAM	August to September 2002	Static acoustic data logger	Coveney Wildlife Consulting Ltd (CWC)	CWC (2002); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
Historical boat-based visual survey	July 2000 to June 2005	Visual boat-based survey	CWC	CWC (2003; 2004; 2005); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
Historical boat-based visual survey	July 2005 to June 2006	Visual boat-based survey	Fulmar Ecological Services	Fulmar Ecological Services (2006); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
Historical boat-based visual survey	July 2006 to June 2009	Visual boat-based survey	Cork Ecology	Cork Ecology (2007; 2009; 2010); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
Baseline DAS	March 2018 to February 2020 (excluding April 2019) plus April 2020	DAS	HiDef Aerial Surveying Limited	HiDef (2020a; b); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
Baseline DAS	August 2023 to June 2024	DAS	HiDef Aerial Surveying Limited	Volume III, Appendix 11.2: Marine Mammals Technical Report

Data source	Date(s) of survey	Overview of survey	Survey contractor	Reference to further information
				(Revised March 2026).
Baseline DAS	February 2025 to July 2025	DAS	HiDef Aerial Surveying Limited	Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
MMO daily sightings data	July to August 2019	Boat-based sightings during mitigation for geophysical survey campaign	IWDG Consulting	IWDG Consulting (2019); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
MMO daily sightings data	July to August 2020	Boat-based sightings during mitigation for geophysical survey campaign	Gavin & Doherty Geosolutions Ltd	Gavin & Doherty Geosolutions Ltd (2020a); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
MMO daily sightings data	October to November 2020	Boat-based sightings during mitigation for geotechnical survey campaign	Gavin & Doherty Geosolutions Ltd	Gavin & Doherty Geosolutions Ltd (2020b); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
MMO daily sightings data	July to August 2023	Boat-based sightings during mitigation for geotechnical nearshore and offshore survey campaigns	Gavin & Doherty Geosolutions Ltd	Gavin & Doherty Geosolutions Ltd (2023a; b); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).
MMO daily sightings data	June to August 2024	Boat-based sightings during mitigation for survey campaigns	Mizen Archaeology and XOcean	Mizen Archaeology, (2024); XOcean, (2024); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).

Data source	Date(s) of survey	Overview of survey	Survey contractor	Reference to further information
Seal Vantage Point (VP) surveys	June 2025 to November 2025	Land-based surveys from vantage points overlooking the Landfall and the surrounding 500 m buffer zone	APEM Group	Volume III, Appendix 11.4: Seal Survey – 2025 Survey Report (RFI March 2026); Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026).

Identification of designated sites

11.5.1.7 All designated sites within the MU Study Area, and qualifying interests that could be affected by the construction, operations and maintenance, and decommissioning phases of the Proposed Development, were identified using the three-step process described below:

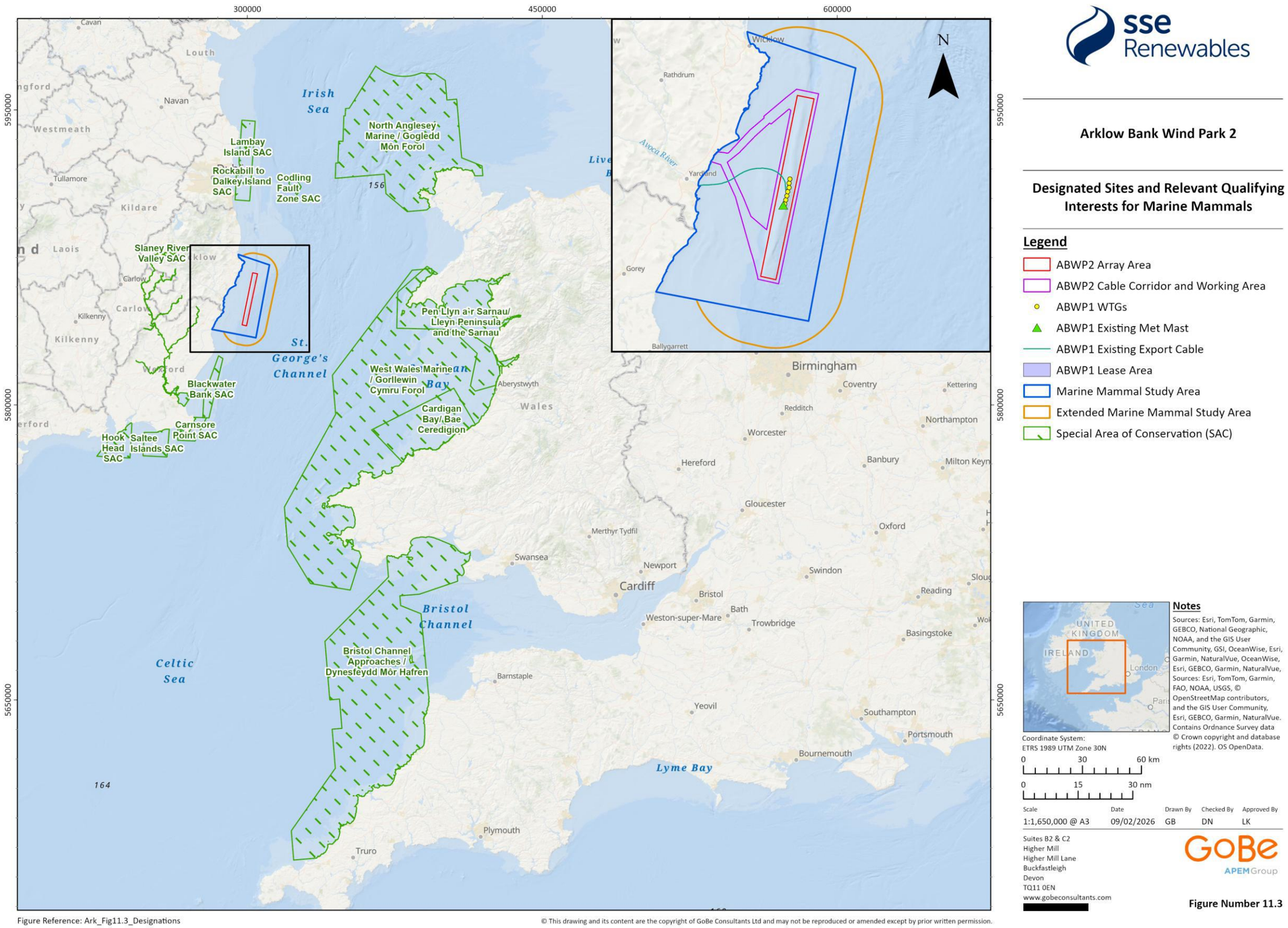
- Step 1: All designated sites of international, national and local importance within the MU Study Area were identified using a number of sources. These included the EPA and NPWS websites;
- Step 2: Information was compiled on the relevant qualifying interest for each of these sites which may make them a sensitive receptor in terms of marine mammals. For example, changes in underwater noise levels may affect animal behaviour; and
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the Proposed Development; or
  - Sites and associated qualifying interests were located within the potential Zone of Influence (ZoI) for impacts associated with the Proposed Development.

11.5.1.8 The designated sites and relevant qualifying interests for marine mammals are presented in Table 11.6 and Figure 11.3.

Table 11.6: Designated sites and relevant qualifying interests for marine mammals

Designated site	Distance to Array Area (km)	Distance to Cable Corridor and Working Area (km)	Qualifying Interests
Blackwater Bank Special Area of Conservation (SAC)	19.70	19.13	• Harbour porpoise
Rockabill to Dalkey Island SAC	36.57	35.66	• Harbour porpoise
Codling Fault Zone SAC	44.86	43.90	• Harbour porpoise
Slaney River Valley SAC	48.10	47.55	• Harbour seal
West Wales Marine / Gorllewin Cymru Forol SAC	50.38	49.75	• Harbour porpoise
Carnsore Point SAC	50.62	50.08	• Harbour porpoise
North Anglesey Marine / Gogledd Môn Forol SAC	62.61	61.61	• Harbour porpoise
Lambay Island SAC	62.80	61.89	• Grey seal • Harbour seal

			• Harbour porpoise
Lleyn Peninsula and the Sarnau / Pen Llŷn a'r Sarnau SAC	71.91	71.35	• Bottlenose dolphin • Grey seal
Cardigan Bay/ Bae Ceredigion SAC	82.73	82.05	• Bottlenose dolphin • Grey seal
Pembrokeshire Marine/ Sir Benfro Forol SAC	87.14	86.45	• Grey seal
Saltee Islands SAC	93.39	93.38	• Grey seal
Hook Head SAC	112.62	112.61	• Harbour porpoise • Bottlenose dolphin
North Channel SAC	143.22	142.32	• Harbour porpoise
Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC	214.68	216.09	• Harbour porpoise



sse Renewables

Arklow Bank Wind Park 2

Designated Sites and Relevant Qualifying Interests for Marine Mammals

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Lease Area
- Marine Mammal Study Area
- Extended Marine Mammal Study Area
- Special Area of Conservation (SAC)

Notes

Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community, GSI, OceanWise, Esri, Garmin, NaturalVue, OceanWise, Esri, GEBCO, Garmin, NaturalVue, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 30 60 km

0 15 30 nm

Scale	Date	Drawn By	Checked By	Approved By
1:1,650,000 @ A3	09/02/2026	GB	DN	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com

Figure Number 11.3

Figure Reference: Ark_Fig11.3_Designations

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Figure 11.3: Designated Sites and Relevant Qualifying Interests for Marine Mammals

11.5.2 Baseline environment

11.5.2.1 A technical report has been prepared to provide a detailed characterisation of the receiving baseline (Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)). A review of the key findings from that technical report has been incorporated into the description of the baseline environment.

11.5.2.2 This EIAR Chapter should therefore be read alongside Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026) which describes the range of species, and the abundance and density of marine mammals that could potentially be impacted by the Proposed Development, informed by desktop studies and site-specific data collected covering the Marine Mammal Study Areas and the wider species-specific MU Study Areas relevant to the location of the Proposed Development (see section 11.5.1 for details of sources used).

11.5.2.3 A review of the data available have confirmed the likely presence of the following marine mammal species in the vicinity of the Proposed Development:

- Harbour porpoise;
- Bottlenose dolphin;
- Risso's dolphin;
- Short-beaked common dolphin (hereafter referred to as common dolphin);
- Minke whale;
- Grey seal; and
- Harbour seal.

11.5.2.4 Therefore, these species will be considered within the quantitative impact assessment.

11.5.2.5 The most robust and relevant density estimates within each MU were determined for each receptor with a justification of density estimates used included in the species accounts below. Density estimates and population assessments for the marine mammal species in the Marine Mammal Study Areas are presented in Table 11.7. These values provide a measure to quantify the scale of effect of given impacts within the impact assessment. Where possible, site-specific estimates from the DAS are provided for a species, where this was not possible, the reason for this is outlined in the relevant species-specific sections below.

11.5.2.6 Where appropriate, density estimates derived from site-specific DAS have been used, however it is important to note that the site-specific density estimates are not representative of animal densities across the wider scale for large-scale impacts such as disturbance from piling. For these large-scale impacts, alternative density estimates from regional surveys were also used to determine the number of animals potentially impacted, alongside the density estimates from the DAS. For each impact, the density that resulted in the highest number of animals being potentially impacted was used to inform the assessment conclusion.

11.5.2.7 The reference populations for cetaceans and their relevant MU as identified by the IAMMWG for practical management purposes for cetaceans in Irish and UK waters are presented in IAMMWG (2023). As MUs have not been defined for seals in Irish waters, the reference population is identified based on the latest aerial surveys of seals in Ireland (Morris and Duck, 2019), and extrapolated to a population estimate for grey seal using the conversion factor developed by Lonergan *et al.* (2013), and for harbour seal using the conversion factor presented by SCOS (2022).

Table 11.7: Marine mammal density (animals/km) and population estimates utilised for quantitative impact assessment

Species	Density (animals/km^2)	Density source	Reference population	Reference population estimate	Reference population source
Harbour porpoise	0.38	Site-specific DAS (2018-2020)	Celtic and Irish Seas MU	62,517	IAMMWG (2023)
	0.2803	Gilles *et al.* (2023)			
	Grid-cell specific	Derived from SCANS-IV density surfaces (Gilles *et al.*, 2025)			
Bottlenose dolphin	0.0201	Rogan *et al.* (2018a)	Irish Sea MU	293	IAMMWG (2023)
	0.2352	Gilles *et al.* (2023)			
	Grid-cell specific	Derived from SCANS-IV density surfaces (Gilles *et al.*, 2025)			
Risso's dolphin	0.031	Hammond *et al.* (2021)	Celtic and Greater North Seas MU	12,262	IAMMWG (2023)
Common dolphin	0.0272	Gilles *et al.* (2023)	Celtic and Greater North Sea MU	102,656	IAMMWG (2023)
	Grid-cell specific	Derived from SCANS-IV density surfaces (Gilles *et al.*, 2025)			
Minke whale	0.045	Rogan *et al.* (2018a)	Celtic and Greater North Seas MU	20,118	IAMMWG (2023)
	0.017	Hammond *et al.* (2021)			
	Grid-cell specific	Derived from SCANS-IV density surfaces (Gilles *et al.*, 2025)			
Grey seal	0.08	Grid cell-specific average across the Array Area and Cable Corridor and Working Area extracted from Carter *et al.* (2020)	East region of RoI	1,662	Scaled count data (Morris and Duck, 2019)
Harbour seal	0.0003	Grid cell-specific average across the Array Area and Cable Corridor and Working Area extracted from Carter *et al.* (2020)	East region of RoI	182	Scaled from count data (Morris and Duck, 2019)

Harbour porpoise (*Phocoena phocoena*)

11.5.2.8 Harbour porpoises are listed under Annex IV of the Habitats Directive as a European Protected Species (EPS) and under Annex II of the Habitats Directive as a species of Community Interest. As an Annex II species of the Habitats Directive, the designation of SACs is required as a component of their conservation. There are several SACs where harbour porpoises are listed as a qualifying feature, the closest of which is Blackwater SAC which is 19.70 km from the Array Area (Table 11.6). In Ireland, harbour porpoises have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.9 They are the most abundant cetacean species in Irish waters and have a wide distribution (Berrow *et al.*, 2010; Rogan *et al.*, 2018a; Wall *et al.*, 2013). Within the Celtic and Irish Seas MU, harbour porpoise abundance is estimated as 62,517 individuals (95% confidence interval (CI): 48,324-80,877, coefficient of variation (CV): 0.13) (IAMMWG, 2023).

11.5.2.10 They were recorded during the geotechnical survey campaign of the Proposed Development in 2023, where one sighting of three individuals was recorded (Gavin & Doherty Geosolutions Ltd, 2023b). There was an additional harbour porpoise sighted during the survey campaign in 2024 (Mizen Archaeology, 2024). They were the most frequently recorded marine mammal species during 2018-2020 site-specific DAS, with a total of 263 sightings in 23 of 25 surveys (HiDef, 2020a) and a mean corrected density estimate of 0.38 animals/km^2. The 2018-2020 site-specific DAS confirmed the presence of harbour porpoise within the Marine Mammal Study Area year-round, although abundance and density was higher in summer months (HiDef, 2020a), which has been confirmed by several other studies in this region (Berrow *et al.*, 2008; Rogan *et al.*, 2018a). During the 2023 – 2024 site-specific DAS, densities ranged from 0.02 to 0.39 animals per km^2, with a mean of 0.16 animals per km^2 (95% Confidence Interval (CI): 0.06 - 0.27).

11.5.2.11 During the 2025 site-specific DAS, densities ranged from 0.02 to 0.11 animals per km^2, with a mean of 0.07 animals per km^2 (95% CI: 0.03 - 0.14). Within the Extended Marine Mammal Study Area (survey from May to July 2025), densities ranged from 0.02 to 0.12 animals per km^2, with a mean of 0.07 animals per km^2 (95% CI: 0.03 - 0.12).

11.5.2.12 It is important to note that site-specific density estimates are not representative of animal densities across the wider scale, and therefore should not be used to assess large scale impacts such as disturbance from piling. However, the site-specific density estimates are the best fine-scale data available for assessing the use and importance of the area, therefore the mean corrected density of 0.38 animals/km^2 is taken forward to the quantitative impact assessment (HiDef, 2020b). In addition to this, the SCANS-IV (Gilles *et al.*, 2023) density estimate of 0.2803 animals/km^2 is the most recent large spatial scale estimate available, and is therefore taken forward to the quantitative assessment for impacts that may extend beyond the boundary of the Proposed Development (Table 11.7).

Bottlenose dolphin (*Tursiops truncatus*)

11.5.2.13 Bottlenose dolphins are also listed under Annex IV of the Habitats Directive as an EPS and under Annex II of the Habitats Directive as a species of Community Interest. As an Annex II species of the Habitats Directive, the designation of SACs is required as a component of their conservation. There are three SACs within the MU Study Area where bottlenose dolphin are listed as a qualifying feature: Hook Head SAC in Ireland as well as Cardigan Bay SAC and Lleyn Peninsula and the Sarnau SAC in Wales (Table 11.6) which supports a semi-resident population, where NRW consider connectivity of this population between the two sites (NRW, 2022). In Ireland, bottlenose dolphins have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.14 They are widespread and abundant in Irish waters (Berrow *et al.*, 2010; Wall *et al.*, 2013). Within the Irish Sea MU, bottlenose dolphin abundance is estimated as 293 individuals (95% CI: 108 –

793, CV: 0.54) (IAMMWG, 2023). 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.*, 2018b). 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.

11.5.2.15 One group of bottlenose dolphin was recorded during the 2018-2020 site-specific DAS, confirming their presence within the Marine Mammal Study Area (HiDef, 2020a). However, it was not possible to provide an abundance and/or density estimate for bottlenose dolphin from these site-specific DAS due to the low number of sightings across the survey period. No bottlenose dolphins were sighted in the 2023-2025 site-specific DAS. Similarly, bottlenose dolphins were only observed once in stratum 5 (where the Proposed Development is located) during the ObSERVE surveys, with a greater abundance recorded on the south and west coasts of Ireland (Rogan *et al.*, 2018a). As recent large-scale surveys have provided contrasting density estimates, the quantitative impact assessment will use both a density estimate of 0.0201 animals/km^2 from the ObSERVE surveys (Rogan *et al.*, 2018a) and a density estimate of 0.2352 animals/km^2 from SCANS-IV surveys (Gilles *et al.*, 2023) (Table 11.7).

Risso's dolphin (*Grampus griseus*)

11.5.2.16 Risso's dolphins are listed under Annex IV of the Habitats Directive as an EPS of Community Interest. In Ireland, Risso's dolphin have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.17 Risso's dolphins are frequently recorded in Irish waters and have a wide distribution with sightings in both deep offshore shelf and slopes waters and in coastal areas (Berrow *et al.*, 2010; Rogan *et al.*, 2018a). Within the Celtic and Greater North Seas MU, Risso's dolphin abundance is estimated as 12,262 individuals (95% CI: 5,227 – 28,764, CV: 0.46) (IAMMWG, 2023).

11.5.2.18 They were not recorded during site-specific DAS (HiDef, 2020a; Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)), although six sightings of between one and eight individuals have been previously recorded during historic site-specific boat-based surveys carried out from 2000 to 2008, confirming their presence within the Marine Mammal Study Area. However, it was not possible to provide an abundance and/or density estimate for Risso's dolphin due to the low number of sightings across the survey period. Sightings of Risso's dolphins have also been recorded during the ObSERVE and SCANS surveys of the wider area (Gilles *et al.*, 2023; Hammond *et al.*, 2021; Rogan *et al.*, 2018a). Although only one individual was recorded in stratum 5 (where the Proposed Development is located) during the ObSERVE surveys (Rogan *et al.*, 2018a). Therefore, given the relatively low numbers of this species recorded across the historic and recent site-specific surveys and the broad-scale surveys, the best and most recent density estimate available for the quantitative assessment is 0.031 animals/km^2 from SCANS-III (Hammond *et al.*, 2021) which represents the most conservative estimate available (Table 11.7).

Common dolphin (*Delphinus delphis*)

11.5.2.19 Common dolphins are listed under Annex IV of the Habitats Directive as an EPS of Community Interest. In Ireland, common dolphins have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.20 Common dolphins are the most frequently recorded dolphin species in Irish waters and have a broad distribution, occurring in both offshore and coastal waters (Berrow *et al.*, 2010). A single MU is used for common dolphin: the Celtic and Greater North Seas MU (IAMMWG, 2023). The abundance estimate for this MU is 102,656 individuals (95% CI: 58,932 – 178,822, CV: 0.29).

11.5.2.21 A total of 22 common dolphins were recorded on two occasions, in November 2019 and in January 2020 during site-specific DAS in 2018-2020, confirming their presence within the Marine Mammal Study Area (HiDef, 2020a). During the 2023 – 2024 site-specific DAS, common dolphins were observed on six occasions in the Marine Mammal Study Area, with a total of 32 animals recorded across the survey period. During the 2025 site-specific DAS, common dolphins were observed on only one occasion: a group of 26 animals in the Extended Marine Mammal Study Area in June 2025.

11.5.2.22 It was not possible to provide an abundance and/or density estimate for common dolphin from the site-specific DAS in 2018-2020 due to the low number of sightings across the survey period. Whilst it was possible to generate a density of common dolphin from the 2023-2024 site-specific DAS (0.03 animals/km^2), this density has not been taken forward (see justification in Table 11.8). Therefore, given the relatively low numbers of this species recorded across the historic and recent site-specific surveys and the broad-scale surveys, the best density estimate available is 0.0272 animals/km^2 from the SCANS-IV surveys (Gilles *et al.*, 2023; see Table 11.7).

Minke whale (*Balaenoptera acutorostrata*)

11.5.2.23 Minke whales are listed under Annex IV of the Habitats Directive as an EPS of Community Interest. In Ireland, minke whales have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.24 Minke whale are the most abundant species of baleen whale in Irish waters and have a patchy distribution within the Irish Sea (Reid *et al.*, 2003; Rogan *et al.*, 2018a). Within the Celtic and Greater North Seas MU, minke whale abundance is estimated as 20,118 individuals (95% CI: 14,061 – 178,822, CV: 0.18) (IAMMWG, 2023).

11.5.2.25 There was only one observation of minke whale during the site-specific DAS (HiDef, 2020a; Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)), and one additional sighting of minke whale in 2024 during the survey campaign (Mizen Archaeology, 2024). However, more sightings have been recorded during the ObSERVE and SCANS surveys of the wider area (Gilles *et al.*, 2023; Hammond *et al.*, 2021; Rogan *et al.*, 2018a). Furthermore, the ObSERVE surveys confirmed a higher presence of minke whale during the spring and summer months (Rogan *et al.*, 2018a). The species is expected to be largely absent in autumn and winter due to offshore movement during these months. The highest density estimate for the quantitative assessment is 0.045 animals/km^2 from the ObSERVE surveys (Rogan *et al.*, 2018a), and this represents the most conservative estimate available; this estimate will only be used for impacts within stratum 5 (where the Proposed Development is located). A density estimate of 0.017 animals/km^2 from SCANS-III (Hammond *et al.*, 2021) will be used for to assess the large-scale impacts that may extend beyond the boundary of the Proposed Development (Table 11.7).

Grey seal (*Halichoerus grypus*)

11.5.2.26 Grey seals are listed under Annex II of the Habitats Directive as a species of Community Interest; therefore, the designation of SACs is required as a component of their conservation. There are several SACs where grey seals are listed as a qualifying feature, the closest of which is Lambay Island SAC which is 62.87 km from the Array Area (Table 11.6). In Ireland, grey seals have a 'favourable' conservation status and an 'increasing' population trend (NPWS, 2019).

11.5.2.27 Foraging ranges of up to 448 km from a haul-out have been reported for grey seals, based on the analysis of telemetry data (Carter *et al.*, 2022). However, typical foraging distances tend to be

shorter, for example, McConnell *et al.* (1999) reported that 88% of trips undertaken were local and repeated and were within 65 km of the haul-out site.

11.5.2.28 Grey seals have a wide distribution and occur around the coast of Ireland year-round (Morris and Duck, 2019; O'Cadhla *et al.*, 2007). For the purposes of this impact assessment, grey seals have been assessed within the East region of Ireland (Figure 11.1; Table 11.7). The population size of the East region of Ireland has been scaled by estimating the average proportion of grey seals hauled-out at the time of survey (25.15%, 95% CI: 25.45 – 29.07%) (SCOS, 2022), resulting in an estimate of 1,662 individuals (Table 11.7).

11.5.2.29 During the Proposed Development geotechnical survey campaign in 2023, there were four sightings of individual grey seals and one sighting of a grey seal and an unidentified seal (Gavin & Doherty Geosolutions Ltd, 2023a). During the 2024 survey campaign, there were five additional sightings of grey seal (Mizen Archaeology, 2024).

11.5.2.30 A total of 15 grey seals were sighted across eight of the 25 site-specific DAS in 2018-2020, confirming their presence within the Marine Mammal Study Area year-round (HiDef, 2020a). During the 2023 - 2024 site-specific DAS, grey seals were observed in nine of the 12 survey months in the Marine Mammal Study Area, with a total of 17 animals recorded across the survey period. During the 2025 site-specific DAS, grey seals were observed in all months, albeit in low numbers, across the Marine Mammal Study Area and Extended Marine Mammal Study Area.

11.5.2.31 Grey seal mean density within the Marine Mammal Study Area during the 2018-2020 site-specific DAS was estimated as 0.007 animals/km^2, and this value was greater in the 2023-2025 site-specific DAS at 0.02 animals/km^2(see Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026)). These densities were compared to published at-sea densities for consideration of the most appropriate densities to take forward in the impact assessment. There is a lack of at-sea density estimate due to a lack of telemetry data in Irish waters. However, telemetry data from grey seals tagged in UK waters has shown connectivity between the east and north coasts of Ireland, Wales, Southwest England, and the southwest coast of Scotland (Carter *et al.*, 2020). The average grey seal density across grid cells within the Array Area and Cable Corridor and Working Area is 0.08 animals/km^2 (extracted from Carter *et al.,* 2020). As this value is greater than the site-specific density estimates from the DAS and so more conservative, as well as more appropriate for impacts over a wider scale, it has been taken forward in the impact assessment.

11.5.2.32 Grey seals gather in colonies on land (known as haul-outs) where they breed, rest, moult and engage in social activity (Bonner, 1990). Preferred haul-out locations around the coast of Ireland include uninhabited islands, isolated beaches, rocky skerries and sea caves (O'Cadhla *et al.*, 2007). The closest haul-out to the Proposed Development is on the coast at Arklow, county (Co.) Wicklow. (Duck and Morris, 2013; Morris and Duck, 2019). Grey seals also haul-out at nearby established breeding colonies at Lambay Island, to the north of the Proposed Development, and at Wexford Harbour to the south of the Proposed Development (Duck and Morris, 2013; Morris and Duck, 2019). Grey seals have been observed in-water and hauled out at the Landfall during the 2025 seal VP surveys, including several pups in sheltered coves suggesting that the coves adjacent to the Landfall may serve as a pupping site.

Harbour seal (*Phoca vitulina*)

11.5.2.33 Harbour seals are listed under Annex II of the Habitats Directive as a species of Community Interest, therefore designation of SACs is required as a component of their conservation. Lambay Island SAC is the only SAC for which harbour seals are a designated feature that falls within the East region of the RoI (Table 11.6). In Ireland, harbour seals have a 'favourable' conservation status and a 'stable' population trend (NPWS, 2019).

11.5.2.34 Foraging ranges of up to 273 km from a haul-out have been reported for harbour seals, based on analysis of telemetry data (Carter *et al.*, 2022). However, typically, harbour seals normally forage within 50 km of their haul-out site and show high site fidelity (Carter *et al.*, 2022).

11.5.2.35 Harbour seal occur throughout Irish waters in estuarine, coastal, and marine environments (Cronin *et al.*, 2004; Morris and Duck, 2019). For the purposes of this impact assessment, harbour seals have been assessed within the East region of Ireland (Figure 11.1; Table 11.7). The population size of the East region of the RoI has been scaled by estimating the average proportion of harbour seals hauled-out at the time of survey (72%, 95% CI: 0.54 – 0.88) (Lonergan *et al.*, 2013), resulting in an estimate of 182 individuals (Table 11.7).

11.5.2.36 Two sightings of harbour seals were recorded during 2018-2020 site-specific DAS, confirming their presence within the Marine Mammal Study Area (HiDef, 2020a). Additionally, during the 2023-2024 site-specific DAS, a single confirmed harbour seal sighting was recorded in the Marine Mammal Study Area in April 2024. However, it was not possible to provide an abundance and/or (absolute) density estimate for harbour seal from the site-specific DAS due to the low number of sightings across the survey period. The average harbour seal density across grid cells within the Array Area and Cable Corridor and Working Area is 0.0003 animals/km^2 (extracted from Carter *et al.,* 2020).

11.5.2.37 Harbour seals favour inshore bays and islands, and coves and estuaries to haul-out, and are known to haul-out at Lambay Island to the north of the Proposed Development and at Wexford Harbour to the south of the Proposed Development (Duck and Morris, 2013; Morris and Duck, 2019). The closest haul-out to the Proposed Development is on the coast at North Bull Island to the south of Dublin Bay (Morris and Duck, 2019). No harbour seals have been observed during the seal VP surveys suggesting limited presence of this species surrounding the Proposed Development.

11.5.3 'Do nothing' scenario

11.5.3.1 Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes "a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Proposed Development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge". In the event that the Proposed Development does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

11.5.3.2 The future trajectories of marine mammal populations are challenging to predict because monitoring at the appropriate temporal and/or spatial scales does not exist at present (Martin *et al.,* 2023). Therefore, it is challenging to fully understand the baseline dynamics of some marine mammal populations, including all cetacean species within this assessment.

11.5.3.3 The potential impacts of anthropogenic-induced climate change on marine mammal populations are poorly understood, largely due to difficulties in obtaining sufficient evidence (Martin *et al.,* 2023; Evans and Bjørge, 2013). In UK and Irish waters, the main potential impact is range shifts as species try to remain within preferred thermal habitats and/or in response to changes in prey abundance and distribution because of increasing Sea Surface Temperatures (SSTs) (Albouy *et al.,* 2020; Simmonds and Elliott, 2008; MacLeod, 2009; Lambert *et al.*, 2011; Martin *et al.,* 2023).

11.5.3.4 There is increasing evidence in the UK and Ireland that the northern extent of species is shifting further northwards (Martin *et al.,* 2023). Range shifts have been observed over the past decade in several inshore bottlenose dolphin populations (Martin *et al.,* 2023). For example, evidence suggests that the semi-resident population previously observed on the southern coasts of Devon and Cornwall may now be extending throughout the English Channel, with sightings further north in the Bristol Channel and as far east as Sussex (Corr *et al.,* 2023). However, a study analysing

trends in strandings data found that there was little to no change in the proportion of warmer water species, such as common dolphin, stranding in the Oslo-Paris Conventions (OSPAR) III South region, which is the OSPAR region that the Proposed Development is located in (Williamson *et al.,* 2021). It was concluded that the northward shift was not captured by strandings data in this region because southern regions of the UK and Ireland are already part of the range of warmer water adapted species (Williamson *et al.,* 2021).

11.5.3.5 Observed shifts in marine mammal distribution are considered to represent a functional response of marine mammal species to distribution shifts of their cold-blooded prey which are more sensitive to environmental changes, such as increased SSTs and decreased salinity (Albouy *et al.,* 2020; Vikingsson *et al.,* 2015; Nøttestad *et al.,* 2015; Dye *et al.,* 2020). For example, the observed shift in harbour porpoise distribution in the North Sea over the last 20 years has been linked to changing sandeel (*Ammodytes*) distributions (Hammond *et al.,* 2008; Paxton *et al.,* 2016).

11.5.3.6 There is no clear evidence that climate change has directly affected either grey seal or harbour seal to date, although it is likely to be a key driver of seal population declines in the future (Evans and Bjørge, 2013). UK harbour seal populations have already experienced widespread declines and while the main cause is unknown, the prevalence of domoic acid, a neurotoxin derived from toxic algae, could be a contributing factor, and could be exacerbated by increased SSTs (SCOS, 2022).

11.5.3.7 In addition, sea level rise and increase in storm frequency and associated wave surges could result in changes to physical habitats. This could affect the availability of seal haul-out sites and breeding locations in caves or low-lying coasts, which may be modified or lost as a result, potentially leading to increased pup mortality (Gazo *et al*., 2000; Lea *et al*., 2009).

11.5.3.8 Susceptibility of marine mammal species to disease and contaminants could also be impacted because of climate change as it has the potential to increase pathogen development and survival rates, disease transmission, and host susceptibility (Martin *et al.,* 2023). Higher SSTs could impact disease prevalence by altering the range shifts of both hosts and pathogens which may introduce novel pathogens to new species and regions, and may also increase thermal stress of marine mammal species, increasing their susceptibility to some diseases (Cohen *et al.,* 2018; Tracy *et al.,* 2019; Sanderson and Alexander, 2020). This is supported by an increase in reports of diseases affecting marine organisms, including marine mammals, worldwide (Burek *et al*., 2008; Harvell *et al*., 2002; Lafferty *et al*., 2004; Van Bressem *et al*., 2009).

11.5.3.9 Species responses to climate change are complex and sensitivities are likely exacerbated by anthropogenic pressures such as construction, pollution, and fishing (Poloczanska *et al*., 2016), which also influences the distribution and abundance of marine mammal populations. These potential impacts include: probable mortality due to bycatch from fisheries (particularly for harbour porpoise and common dolphin) (Avila *et al.,* 2018; Leeney *et al.,* 2008; Taylor *et al.,* 2023); removal of prey species by overfishing (DeMaster *et al.,* 2001; Matthiopoulos *et al.,* 2008); direct or indirect effects of contamination (from pollution incidents, sewage discharge, or litter disposal at sea) (Helm *et al.,* 2015; Lane *et al.,* 2015; Mearns *et al.,* 2016); injury or disturbance from noise pollution in the marine environment (for example from shipping, drilling, piling, seismic surveys, military activity, dredging and disposal, aggregate extraction, and unexploded ordnance (UXO) detonations) (Culloch *et al.,* 2016; Pirotta *et al.,* 2012, 2014; Stone *et al.,* 2017; Wisniewska *et al.,* 2018; Graham *et al.,* 2019); and death or injury due to collision with physical objects (including vessels or renewable energy infrastructure) (Wells *et al*., 2008; Luksenburg, 2014).

11.5.3.10 Although anthropogenic activities may be associated with adverse effects on marine mammals, all marine mammal species included in this assessment were assessed as having a 'favourable' conservation status in Irish waters, with grey seal showing an increasing population trend (NPWS, 2019).

11.5.4 Data limitations

Data to inform the baseline

11.5.4.1 The data assumptions and limitations highlighted in Volume III, Appendix 11.2: Marine Mammals Technical Report (Revised March 2026) are typical of difficulties encountered with undertaking field surveys of marine mammals using boat-based and aerial survey methods, and include:

- Historical boat-based survey design issues;
- Poor survey weather conditions;
- Bias in data; and
- Survey timings.

11.5.4.2 An overview of each of these data limitations is provided in Table 11.8 below.

Table 11.8: Identified data limitations associated with data to inform the baseline

Limitation	Description
Historical boat-based survey design issues	The historical site-specific boat-based survey was designed for recording both seabirds and marine mammals. Therefore, the observers were not dedicated MMOs and as a result, there is the possibility that some animals were missed during surveys.
Poor survey weather conditions	Poor weather conditions can limit the ability to carry out surveys by aeroplane or by vessel. Two surveys were conducted in July 2019, where one survey was carried out at the start of July and the next survey at the end of July to compensate for a missed survey (due to weather) in April 2019. An additional survey was undertaken in April 2020 to reflect potential seasonal species distribution in the month of April.
Bias in data	There is the possibility of both availability bias (where an animal is underwater and therefore not available for detection) and detection bias (where an animal is on the surface but the detection is missed). Harbour porpoise are the only species where sufficient sightings were recorded to provide site-specific density estimates from DAS for use within this assessment. The relative density estimate of harbour porpoise was corrected for availability bias using the published correction factor of 0.425 from Teilmann *et al.* (2013) to provide an estimate of absolute density. This correction factor is based on a tagging study in the Baltic/North Sea investigating dive duration of harbour porpoise during different months of the year and times of day (Teilmann *et al.,* 2013). The correction factor from this study that was applied to the DAS data was the lower estimate of availability of 0.425 (i.e. most conservative), based on winter months, specifically February, when surfacing time was found to be lower than in other seasons (Teilman *et al.,* 2013).
Survey timings	Both DAS data and boat-based data represent a snapshot over a short time period each month, during daylight hours and in fair weather. Therefore, it was not possible for HiDef to explore if changes in sighting rates (obtained from the DAS data) were influenced by environmental conditions. Differences in sighting rates between months may be due to seasonal changes, but environmental conditions also have the potential to influence these results. Seal VP surveys have been conducted between June 2025 and November 2025. While this survey window captures the grey seal breeding season (August to November), it does not overlap with their annual moult, which spans December to April (DCCAE, 2018). The survey period fully coincides with the breeding, nursing, and moulting seasons of harbour seals, which occur from Junel through to September (DCCAE, 2018).
Additional DAS	Additional site-specific DAS were undertaken between August 2023 and June 2024, and again from February 2025 to July 2025. The results from these surveys have been described within the baseline environment to support understanding of site use by cetaceans. The results are considered to

Limitation	Description
	complement the existing two-year DAS surveys, and have been used in a qualitative way. The limitations described with regards to bias in data and survey timings also apply to the additional DAS.
Population modelling	It was not considered necessary to update the iPCoD modelling because the revised piling parameters remain within the overall range assessed in the iPCoD modelling. The original iPCoD outputs remain valid for the purposes of assessment and are considered precautionary, as they are based on a scenario that reflects equal or greater impact potential than the revised design.

11.5.4.3 Despite the limitations described in Table 11.8, the baseline assessment provides an informative account of the marine mammals within the Marine Mammal Study Area and MU Study Areas. The site-specific data has also been supported by information collated via the detailed desktop review, and therefore these data limitations are not expected to constrain the ability to draw conclusions within this assessment.

Population modelling

11.5.4.4 Population modelling was completed using the interim Population Consequences of Disturbance (iPCoD) framework for the Proposed Development in isolation to assess whether disturbance resulting from pile driving is predicted to result in population level impacts to five marine mammal species that were identified in the baseline of the EIAR as key receptors. The species assessed are harbour porpoise, bottlenose dolphin, minke whale, grey seal, and harbour seal, noting that iPCoD is not available for Risso's dolphin and common dolphin. The assessment was based on the maximum number of animals predicted to be disturbed per piling day, as presented in sections 11.9 and 11.10.1.

11.5.4.5 iPCoD uses a stage structured model of population dynamics with nine age classes and one stage class (adults 10 years and older). The model is used to run a number of simulations of future population trajectory with and without the predicted level of impact, to allow an understanding of the potential future population level consequences of predicted behavioural responses. For further information see Volume III, Appendix 11.3: Phase 1 Irish Offshore Windfarms: Cumulative iPCoD Modelling.

11.6 Impact assessment methodology

11.6.1 Key parameters for assessment

11.6.1.1 The assessment of significance of effects has been carried out on both of the two discrete Project Design Options detailed in Volume II, Chapter 4: Description of Development (Revised March 2026). This approach has allowed for a robust and full assessment of the Proposed Development.

11.6.1.2 The two Project Design Options and parameters relevant to each potential impact are detailed in Table 11.9 and Table 11.10.

Table 11.9: Project design parameters and impacts assessed – Project Design Option 1

Potential impact	Phase			Project Design Option 1
	C	O	D	
Injury and/or disturbance to marine mammals from underwater noise during piling	✓	×	×	**Construction phase** <u>Foundation installation:</u> Wind Turbine Generators (WTGs) installed on monopile foundations: • Installation of 53 WTGs with a pile diameter between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 3,500 kJ and a strike rate of 30 strikes per minute; • Soft start energy of 825 kJ modelled with slow ramp-up of energy for 40 minutes; • Anticipated maximum duration of piling at 3 hours and 40 minutes; and • Total of 71 days when piling may occur over a maximum construction period of 4 years. Offshore Substations Platforms (OSP) installed on monopile foundations: • Installation of 2 OSPs with a pile diameter between 7 m and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 3,500 kJ; • Soft start energy of 825 kJ modelled with slow ramp-up of energy for 40 minutes; • Average maximum duration of 3 hours and 40 minutes per pile; and • Total of 4 days when piling may occur over a maximum construction period of 4 years.
Injury and/or disturbance to marine mammals from vessel activities	✓	✓	✓	**Construction phase** Injury and/or disturbance to marine mammals from vessel activities during construction: • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the Landfall at any one time); • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer

Potential impact	Phase			Project Design Option 1
	C	O	D	
				vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 4 years. Within this period, offshore export cable installation may take place over a period of 12 months.
				Operations and Maintenance phase Injury and/or disturbance to marine mammals from vessel activities during operation and maintenance: • Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location. • Up to 30 Operations and Maintenance (O&M) vessels on site at any one time; and • Operational phase up to 36.5 years.
				Decommissioning phase Injury and/or disturbance during the decommissioning phase is anticipated to be similar in nature, but of lower magnitude, to the construction phase.
Changes in fish and shellfish community affecting prey resources	✓	✓	✓	**Construction phase** Project Design Option 1 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased Suspended Sediment Concentrations (SSC) and associated sediment deposition; • Injury and/or disturbance to fish and shellfish from underwater noise and vibration during pile driving and cable installation; and • Accidental pollution.
				Operations and Maintenance phase

Potential impact	Phase			Project Design Option 1
	C	O	D	
				Project Design Option 1 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased SSC and associated sediment deposition; • Accidental pollution; • Long-term habitat loss as a result of the presence of foundation structures, scour protection, and cable protection; • Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection, and cable protection; and • Changes in Electromagnetic Fields (EMF) from subsea cabling.
				Decommissioning phase Project Design Option 1 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition; and • Accidental pollution.
Accidental pollution	✓	✓	✓	**Construction phase** Accidental pollution in the Array Area during construction from: • Installation of 53 WTGs and 2 OSPs within the Array Area; • Installation of inter-array cables between 110-122 km in length, OSP interconnector cables between 25-28 km in length, and offshore export cables between 35-40 km in length; • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the Landfall at any one time; • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels,

Potential impact	Phase			Project Design Option 1
	C	O	D	
				tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • A maximum of 294 helicopter return trips over the construction phase and a maximum of 118 helicopter return trips per year.
				Operations and Maintenance phase Accidental pollution in the Array Area during O&M from: • Up to 30 O&M vessels on site at any one time; • Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location. • A maximum of 485 helicopter return trips per year; • Presence of 53 WTGs and 2 OSPs; and • Maintenance activities of 53 WTGs and 2 OSPs.
				Decommissioning phase Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 53 WTGs and 2 OSPs.
Changes in EMF from subsea electrical cabling	×	✓	×	**Operations and Maintenance phase** Presence of inter-array, OSP interconnector, and offshore export cables: • 66 kV inter-array cables between 110-122 km in length; • 220 kV OSP interconnector cables between 25-28 km in length; • 220 kV offshore export cables between 35-40 km in length; • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables; • Up to 15% of inter-array cable routes, up to 50% of OSP interconnector cable routes, and up to 20% of export cable routes requiring protection; and

Potential impact	Phase			Project Design Option 1
	C	O	D	
				• Operational phase up to 36.5 years.
Injury and/or disturbance to marine mammals from underwater noise during UXO clearance	✓	×	×	**Construction phase** The type, size, and number of possible UXO that may require clearance is currently unknown. An illustrative assessment is presented using charge weights (TNT equivalent) ranging from 25 to 800 kg, with an additional donor weight of 0.5 kg, for high order detonation. A charge weight of 0.5 kg is used to provide an illustrative assessment of a low order (deflagration) detonation.
Injury and/or disturbance to marine mammals from underwater noise during site surveys	✓	✓	×	**Construction phase** As the exact survey equipment to be deployed during site surveys has not yet been confirmed, the assessment has been based on equipment types and source levels anticipated to be used and considered representative of the range of available options. Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical (non-impulsive sonar based) surveys including Multibeam Echosounder (MBES), Side scan sonar (SSS), Sub-bottom Profiler (SBP), and Ultra-short Baseline (USBL); • Geophysical surveys including seismic refraction and sparker; and • Geotechnical surveys including seismic Cone Penetration Test (CPT), vibrocore, and grab sampling. **Operations and Maintenance phase** Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical surveys (inter-array cables) every six months for the first two years and annually thereafter; • Geophysical surveys (inter-connector cables) every six months for the first two years and annually thereafter; and • Geophysical surveys (export cables) every six months for the first two years and annually thereafter. The exact equipment to be deployed during the geophysical site surveys has not yet been confirmed. Therefore, the assessment has been based on the equipment types and source levels

Potential impact	Phase			Project Design Option 1
	C	O	D	
				assessed for the construction phase, which are considered representative of the range of equipment likely to be used. Injury and/or disturbance during operations and maintenance phase is anticipated to be similar in nature to the construction phase.
Injury and/or disturbance to marine mammals from dredging and trenching	✓	✓	×	**Construction phase** Injury and/or disturbance to marine mammals form dredging and trenching: • Backhoe dredging, grab or clamshell dredging for seabed lowering and feature clearance; • Mass/Controlled Flow excavation or water injection dredging for seabed lowering and feature clearance; • Suction hopper dredging for seabed lowering and feature clearance; • Exit pits for trenchless techniques will be achieved with dredging and use of excavators; and • Burial of offshore cables with the use of jet trenching, mechanical trenching and vertical injector. **Operations and Maintenance phase** • Scour protection repair and maintenance for WTG and OSP foundations at all assets every five years will require specialist dredging vessel; • Removal of excess seabed sediment and reburial of exposed cables; and • Trenching for cable repair and reburial once every five years.

Table 11.10: Project design parameters and impacts assessed-Project Design Option 2

Potential impact	Phase			Project Design Option 2
	C	O	D	
Injury and/or disturbance to marine mammals from underwater noise during piling	✓	×	×	**Construction phase** <u>Foundation installation:</u> WTGs installed on monopile foundations: • Installation of 47 WTGs with a pile diameter between 7 m and 11 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 3,500 kJ and a strike rate of 30 strikes per minute; • Soft start energy of 825 kJ modelled with slow ramp-up of energy for 40 minutes; • Anticipated maximum duration of piling at 3 hours and 40 minutes; and • Total of 63 days when piling may occur over a maximum construction period of 4 years. OSPs installed on monopile foundations: • Installation of 2 OSPs with a pile diameter between 7 m and 14 m within the Array Area; • Maximum of one foundation installed at any one time (within any 24 hour period); • Maximum hammer energy up to 3,500 kJ; • Soft start energy of 825 kJ modelled with slow ramp-up of energy for 40 minutes; • Anticipated maximum duration of piling at 3 hours and 40 minutes; and • Total of 4 days when piling may occur over a maximum construction period of 4 years.
Injury and/or disturbance to marine mammals from vessel activities	✓	✓	✓	**Construction phase** Injury and/or disturbance to marine mammals from vessel activities during construction: • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the Landfall at any one time); • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer

Potential impact	Phase			Project Design Option 2
	C	O	D	
				vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 4 years. Within this period, offshore export cable installation may take place over a period of 12 months.
				Operations and Maintenance phase Injury and/or disturbance to marine mammals from vessel activities during operation and maintenance: • Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location. • Up to 30 O&M vessels on site at any one time; and • Operational phase up to 36.5 years.
				Decommissioning phase Injury and/or disturbance during the decommissioning phase is anticipated to be similar in nature, but of lower magnitude, to the construction phase.
Changes in fish and shellfish community affecting prey resources	✓	✓	✓	**Construction phase** Project Design Option 2 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased SSC and associated sediment deposition; • Injury and/or disturbance to fish and shellfish from underwater noise and vibration during pile driving and cable installation; and • Accidental pollution
				Operations and Maintenance phase

Potential impact	Phase			Project Design Option 2
	C	O	D	
				Project Design Option 2 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased SSC and associated sediment deposition; • Accidental pollution; • Long-term habitat loss as a result of the presence of foundation structures, scour protection, and cable protection. • Alteration of seabed habitats arising from changes in physical processes as a result of the presence of foundation structures, scour protection, and cable protection; and • Changes in EMF from subsea cabling.
				Decommissioning phase Project Design Option 2 as described in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026) for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations (SSC) and associated sediment deposition; and • Accidental pollution.
Accidental pollution	✓	✓	✓	**Construction phase** Accidental pollution in the Array Area during construction from: • Installation of 47 WTGs and 2 OSPs within the Array Area; • Installation of inter-array cables between 110-122 km in length, OSP interconnector cables between 25-28 km in length, and offshore export cables between 35-40 km in length; and • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the offshore Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the Landfall at any one time. • A maximum of 4,150 vessel return trips over the construction phase and a maximum of 1,797 vessel return trips per year during the construction phase, comprised of jack-up vessels, tug/anchor handlers, cable installation vessels, guard vessels, survey vessels, crew transfer

Potential impact	Phase			Project Design Option 2
	C	O	D	
				vessels, scour/cable protection installation vessels, pre-installation boulder clearance vessels, sandwave clearance vessels, UXO clearance vessels and other support vessels; and • A maximum of 294 helicopter return trips over the construction phase and a maximum of 118 helicopter return trips per year.
				Operations and Maintenance phase Accidental pollution in the Array Area during O&M from: • Maximum of 1,359 vessel round trips per year comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels, from local ports or transiting from a previously operational location. • A maximum of 485 helicopter return trips per year; • Presence of 47 WTGs and 2 OSPs; and • Maintenance activities of 47 WTGs and 2 OSPs.
				Decommissioning phase Accidental pollution in the Array Area during decommissioning from: • Decommissioning of 47 WTGs and 2 OSPs.
Changes in EMF from subsea electrical cabling	×	✓	×	**Operations and Maintenance phase** Presence of inter-array, OSP interconnection and offshore export cables: • 66 kV inter-array cables between 110-122 km in length; • Fibre optic only (0kV) / 66kV / 220 kV OSP interconnector cables between 25-28 km in length; • 220 kV offshore export cables between 35-40 km in length; • Burial depth between 0-1.5 m for inter-array cables and 0-2.5 m for OSP interconnector and offshore export cables; • Up to 15% of inter-array cable routes, up to 50% of OSP interconnector cable routes, and 20% of export cable routes requiring protection; and • Operational phase up to 36.5 years.

Potential impact	Phase			Project Design Option 2
	C	O	D	
Injury and/or disturbance to marine mammals from underwater noise during UXO clearance	✓	×	×	**Construction phase** The type, size, and number of possible UXO that may require clearance is currently unknown. An illustrative assessment is presented using charge weights (TNT equivalent) ranging from 25 to 800 kg, with an additional donor weight of 0.5 kg, for high order detonation. A charge weight of 0.5 kg is used to provide an illustrative assessment of a low order (deflagration) detonation.
Injury and/or disturbance to marine mammals from underwater noise during site surveys	✓	✓	×	**Construction phase** As the exact survey equipment to be deployed during site surveys has not yet been confirmed, the assessment has been based on equipment and source levels anticipated to be used and considered representative of the range of available options. Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical (non-impulsive sonar based) surveys including MBES, SSS, SBP, and USBL; • Geophysical surveys including seismic refraction and sparker; and • Geotechnical surveys including seismic CPT, vibrocore, and grab sampling. **Operations and Maintenance phase** Injury and/or disturbance to marine mammals from underwater noise during site surveys: • Geophysical surveys (inter-array cables) every six months for the first two years and annually thereafter; • Geophysical surveys (inter-connector cables) every six months for the first two years and annually thereafter; and • Geophysical surveys (export cables) every six months for the first two years and annually thereafter. The exact equipment to be deployed during the geophysical site surveys has not yet been confirmed. Therefore, the assessment has been based on the equipment types and source levels assessed for the construction phase, which are considered to be representative of the range of survey equipment likely to be used. Injury and/or disturbance during operations and maintenance phase is anticipated to be similar in nature to the construction phase.

Potential impact	Phase			Project Design Option 2
	C	O	D	
Injury and/or disturbance to marine mammals from dredging and trenching	✓	✓	×	**Construction phase** Injury and/or disturbance to marine mammals form dredging and trenching: • Backhoe dredging, grab or clamshell dredging for seabed lowering and feature clearance; • Mass/Controlled flow excavation or water injection dredging for seabed lowering and feature clearance; • Suction hopper dredging for seabed lowering and feature clearance; • Exit pits for trenchless techniques will be achieved with dredging and use of excavators; and • Burial of offshore cables with the use of jet trenching, mechanical trenching and vertical injector. **Operations and Maintenance phase** • Scour protection repair and maintenance for WTG and OSP foundations at all assets every five years will require specialist dredging vessel; • Removal of excess seabed sediment and reburial of exposed cables; and • Trenching for cable repair and reburial once every five years.

11.6.2 Impacts scoped out of the assessment

11.6.2.1 On the basis of the baseline environment and the description of development outlined in Volume II, Chapter 4: Description of Development (Revised March 2026), a number of impacts are proposed to be scoped out of the assessment for marine mammals. These impacts are outlined, together with a justification for scoping them out, in Table 11.11.

Table 11.11: Impacts scoped out of the assessment for marine mammals

Potential impact	Justification
Increased SSC and associated deposition	Construction, operations and maintenance and decommissioning activities associated with the Proposed Development may result in temporary, localised increases in SSC and increased sediment deposition, as detailed in Volume II, Chapter 6: Coastal Processes (Revised March 2026) and Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling (Revised March 2026). Sediment plume modelling indicates that elevated SSCs are largely confined to the Array Area and Cable Corridor and Working Area, with sediment plumes typically not extending beyond approximately 10 km from the source and elevated concentrations are immeasurable within hours or days, often within one to two tidal cycles, following cessation of works. Sediment deposition is predicted to be greatest within 2 km of disturbance events and negligible beyond 10 km. As such, the predicted elevations in SSC are expected to be of limited spatial extent, short duration, and low magnitude. These changes are highly localised and will affect only a small proportion of the wider available habitat. Therefore, these elevations do not extend into, or overlap with any key areas for marine mammals (i.e. SACs designated for marine mammals) and the affected area is likely to be considered negligible in the context of the wider available habitat. Marine mammals are known to forage in naturally turbid waters with low visibility levels. For example, harbour porpoises and harbour seals were found to forage under strong tidal flows in the UK (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 by odontocetes (Hanke *et al.*, 2010; Hanke and Dehnhardt, 2013; Hanke *et al.*, 2013). With respect to seals, they are able to sense the environment by detecting water movements using mystacial vibrissae (whiskers) when vision is compromised. Consequently, temporary increases in SSC and reduced water clarity do not represent a credible direct impact pathway for marine mammals. Any potential indirect effects associated with changes in prey availability arising from increased SSC and sediment deposition are addressed within the assessment of changes to prey availability (section 11.9.3 and 11.10.3) and is informed by the detailed SSC modelling and the fish and shellfish assessment (Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026)). No additional indirect effects on marine mammals beyond those already assessed are anticipated.

Potential impact	Justification
	On this basis, increased SSC and associated deposition are not considered likely to result in significant effects on marine mammals and have been scoped out of the assessment.
Remobilisation of contaminated sediments	Sediment sampling undertaken for ABWP1 (Ramboll, 2016) and ABWP2 (Aquafact, 2025) has demonstrated that concentration of contaminants in the offshore sediments are low and below levels expected to result in adverse effects on marine mammals. Therefore, it is considered unlikely that there would be any pathways for an impact on marine mammals, including consideration of indirect effect through changes to the benthic or fish and shellfish communities (see Volume II, Chapter 9: Benthic Subtidal and Intertidal Ecology (Revised March 2026) and Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology (Revised March 2026)). On this basis, remobilisation of contaminated sediments is not considered likely to result in significant effects on marine mammals and has been scoped out of the assessment.
Injury and/or disturbance to marine mammals from operational underwater noise	Operational noise generated by operational wind turbines is primarily of low frequency (well below 1 kHz) (Thomsen *et al.*, 2006). For porpoises, dolphins and seals, the hearing sensitivity below 1 kHz is relatively poor and thus it is expected that an auditory injury or disturbance at this frequency would result in little impact to vital rates or behavioural changes. The low frequency noise produced during operations may be more likely to overlap with the hearing range of low frequency cetaceans such as minke whales. Minke whale communication signals are known to be below 2 kHz (Edds-Walton, 2000; Mellinger *et al.*, 2006; Gedamke *et al.*, 2001; Risch *et al.*, 2013; Risch *et al.*, 2014). Tubelli *et al.*, (2012) estimated the most sensitive hearing range (the region with thresholds within 40 dB of best sensitivity) of minke whales extend from 30 to 100 Hz up to 7.5 to 25 kHz. Based on the noise modelling outputs of offshore wind turbines, Marmo *et al.* (2013) reported that operational noise from wind turbines with monopile or gravity foundations would be audible underwater to minke whales as far as 18 km away. Whilst there is potential for whale displacement to occur around operational offshore windfarms, using threshold parameters of behavioural responses presented in Southall *et al.* (2007), Marmo *et al.* (2013) predicted that fewer than 10% of minke whales detecting the noise would exhibit behavioural responses, even under a precautionary approach, due to the relatively low sound pressure levels of noise produced (Marmo *et al.*, 2013). It is expected that the underwater noise from operating wind turbines would have a small footprint relative to the wider marine area used by minke whales, which in the context of the relevant MU (i.e. Celtic and Greater North Sea) (IAMMWG, 2023), is very large area in comparison. A number of studies have reported the presence of marine mammals within multiple operational windfarm footprints. For example, long-term monitoring at the Horns Rev and Nysted offshore windfarms in Denmark showed that both harbour porpoise and harbour seals were sighted regularly within the operational windfarm, and within two years of operation, the populations had returned to levels that were comparable with the wider area (Diederichs *et al.*, 2008). Similarly, a monitoring programme at the Egmond aan Zee offshore windfarm in the Netherlands reported that significantly more porpoise activity was recorded within the offshore windfarm compared to the reference area during the operational phase (Scheidat *et al.*, 2011), indicating the presence

Potential impact	Justification
	of the offshore windfarm was not adversely affecting harbour porpoise presence. In addition, Russell *et al.* (2014) found that some tagged harbour and grey seals demonstrated grid-like movement patterns as these animals moved between individual offshore wind turbines, suggestive of these structures being used for foraging. Previous reviews have also concluded that operational noise will have negligible barrier effects (Madsen *et al.*, 2006; Teilmann *et al.*, 2006a; Teilmann *et al.*, 2006b; Brasseur *et al.*, 2012). Norro *et al.* (2011) compared measurements of a range of different foundation methods and turbine ratings in the Belgian part of the North Sea, as well as comparing those to other European waters. The authors found a slight increase in Sound Pressure Level (SPL) compared to the ambient noise measured before the construction of the windfarms. They concluded that even the highest increases found within the dataset (20 to 25 dB re 1µ Pa) are likely to be within the natural range of variation in baseline noise and therefore, even with the long-term nature of this impact (lifespan of the windfarm), the operational noise would not cause a significant impact. Thomsen *et al.* (2023) used a simple propagation loss model to assess cumulative PTS and TTS over a 24 hour period. They assessed a 10 Megawatt (MW) and 20 MW turbine, and in both cases PTS impact ranges were small (no greater than 50 m from the sound source), with the authors concluding that the risk of cumulative PTS was negligible. Cumulative TTS was also negligible for the 10 MW turbine, whereas for the 20 MW turbine, impact ranges extended up to approximately 700 metres for low frequency cetaceans such as minke whales. Thomsen *et al.* (2023) noted that this could be larger than the distance between wind turbines, and thus the entire windfarm could be considered as the impacted area (with respect to cumulative TTS for low frequency cetaceans). However, this is TTS onset, over a period of 24 hours for one FHG, which as the authors acknowledge, given that these are highly mobile animals, it is unlikely TTS is a realistic impact. Other caveats noted are, the model is simple, and there are considerable uncertainties associated. Thomsen *et al.* (2023) also note that older turbine designs using gear boxes are approximately 10 dB louder, as compared to more recent turbine designs using direct drives. It is predicted therefore that any impact would be highly localised and unlikely to affect marine mammals. On this basis, operational underwater noise is not considered likely to result in injury and/or disturbance effects on marine mammals and has been scoped out of the assessment.

11.7 Methodology for assigning the significance of effects

11.7.1 Overview

11.7.1.1 The marine mammals impact assessment has followed the methodology set out in Volume II, Chapter 5: EIA Methodology (Revised March 2026). Specific to the marine mammals impact assessment, the following guidance documents have also been adhered to:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022);
- Guidance for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2024);

- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd, 2012);
- Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014);
- Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects (DCCAE, 2017);
- Ireland's National Biodiversity Plan 2017-2021 (Biodiversity Working Group, 2020);
- Ireland's 4th National Biodiversity Action Plan 2023–2030 (DHLGH, 2024);
- Marine Strategy Framework Directive, as amended 2017 (EC, 2008);
- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Part 1 (DCCAE, 2018a);
- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Part 2 (DCCAE, 2018b);
- CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities (CMS, 2017);
- Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects (Southall *et al.*, 2019);
- Guidance to manage the risk to mammals from manmade sound sources in Irish waters (DAHG, 2014);
- Policy on Offshore Windfarm Development (IWDG, 2020); and
- Review of Management Unit boundaries for cetaceans in UK waters (IAMMWG, 2023).

11.7.2 Impact assessment criteria

11.7.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of receptors and the magnitude of the impacts. This section describes the criteria applied in this Chapter to assign values to the sensitivity of the receptors (Table 11.12) and the magnitude of potential impacts (Table 11.13). The terms used to define sensitivity and magnitude are based on those which are described in further detail in Volume II, Chapter 5: EIA Methodology (Revised March 2026).

11.7.2.2 Both sensitivity and magnitude are assessed on a four-level scale to align with the EPA (2022) guidance: **High**, **Medium, Low** and **Negligible**. Magnitude is also further assessed as to whether the magnitude of the impact is adverse, neutral, or positive (see Volume II: Chapter 5: EIA Methodology (Revised March 2026)).

SENSITIVITY

11.7.2.3 Sensitivity refers to the potential of a receptor to be significantly affected (EPA, 2022). In defining the sensitivity for each receptor, the vulnerability, recoverability and value/importance of that resource or user group has been taken into consideration.

11.7.2.4 The criteria used to define the sensitivity of the receptors in this Chapter are outlined in Table 11.12Table 11.12 and based on EPA (2022) guidance.

11.7.2.5 The value of the receptor is not included in the definitions of criteria used to determine the sensitivity of marine mammals as all marine mammals are considered to have a high value given that all are either listed under Annex II of the Habitats Directive as species of Community Interest and/or are listed under Annex IV of the Habitats Directive as EPS of Community Interest and in need of strict protection.

Table 11.12: Definitions of criteria relating to the sensitivity of the receptor

Receptor sensitivity	Definition
High	Adaptability: The receptor cannot avoid or adapt to an impact. Tolerance: The receptor has no tolerance to accommodate the proposed form of change. Recoverability: The effect on the receptor is anticipated to be permanent and the receptor will not have any ability to recover from an impact.
Medium	Adaptability: The receptor has limited ability to avoid or adapt to an impact. Tolerance: The receptor has limited tolerance to accommodate the proposed form of change. Recoverability: The effect on the receptor is anticipated to be long-term and the receptor will have limited ability to recover from an impact.
Low	Adaptability: The receptor has reasonable ability to avoid or adapt to an impact. Tolerance: The receptor has reasonable tolerance to accommodate the proposed form of change. Recoverability: The effect on the receptor is anticipated to be medium to short-term and the receptor will have the ability to fully recover from an impact.
Negligible	Adaptability: The receptor is able to avoid or adapt to an impact. Tolerance: The receptor is able to tolerate the proposed form of change. Recoverability: The effect on the receptor is anticipated to be temporary and the receptor will have the ability to fully recover from an impact.

MAGNITUDE

11.7.2.6 In assigning magnitude, the spatial extent, duration, frequency and reversibility of the impact from the construction, operations and maintenance, or decommissioning phases of the Proposed Development have been considered, where applicable.

11.7.2.7 The criteria used to define magnitude of impact in this Chapter are outlined in Table 11.13 and based on EPA (2022) guidance.

Table 11.13: Definition of terms relating to the magnitude of an impact

Magnitude	Definition
High	Duration: The impact is anticipated to result in a permanent change to the receptor. Frequency: The impact will occur constantly throughout the relevant project phase. Probability: The impact is reasonably expected to occur. Consequences (adverse): The impact would have a permanent change on a sufficient number of individuals to affect the long-term viability of the population and/or favourable conservation status. Consequences (positive): Long term increase in the population size.
Medium	Duration: The impact is anticipated to result in a change to the receptor that will last for up to one year. Frequency: The impact will occur constantly throughout a relevant project phase. Probability: The effect is reasonably expected to occur. Consequences (adverse): The impact would have a temporary change on most individuals and a permanent impact on a small proportion of the population, although would not affect the long-term viability of the population. Consequences (positive): Increase in population health and/or size as a result of benefits to the supporting habitat.

Magnitude	Definition
Low	Duration: The impact is anticipated to result in a change to the receptor that will last days at most. Frequency: The impact will occur frequently throughout a relevant project phase. Probability: The effect is unlikely to occur. Consequences (adverse): The impact would result in a short-term and/or intermittent change to a small proportion of the population but is unlikely to alter the population trajectory. Consequences (positive): Short term benefit to the supporting habitat resulting in increased reproductive potential but unlikely to increase population health and/or size.
Negligible	Duration: The impact is anticipated to result in a change to the receptor that will last a day at most. Frequency: The impact will occur once or infrequently throughout a relevant project phase. Probability: The effect is unlikely to occur. Consequences (adverse): The impact would result in a very short term, recoverable change to a very small proportion of the population and would not alter the population size or trajectory. Consequences (positive): Very minor benefit to the supporting habitat influencing foraging efficiency of a limited number of individuals, but not increasing population health and/or size.

SIGNIFICANCE OF EFFECT

11.7.2.8 The significance of the effect upon marine mammals is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 11.14. Where a range of significance of effect is presented in Table 11.14, the final assessment for each effect is based upon expert judgement.

Table 11.14: Significance of effect matrix

			Baseline Environment - Sensitivity			
			High	Medium	Low	Negligible
Description of Impact - Magnitude	Adverse Impact	High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		Low	Moderate*	Slight	Slight	Imperceptible
	Neutral Impact	Negligible	Not Significant	Not Significant	Not Significant	Imperceptible
	Positive Impact	Low	Moderate*	Slight	Slight	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible

**Moderate levels of effect have the potential, subject to the assessor's professional judgement to be significant or not significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and/or magnitude of change relating to the factors evaluated. These evaluations are explained as part of the assessment, where they occur.*

11.7.3 Factored In Measures

11.7.3.1 The Project Design Options set out in Volume II, Chapter 4: Description of Development (Revised March 2026) includes a number of designed-in measures and management measures (or controls) which have been factored into the Proposed Development and are committed to be delivered by the Developer as part of the Proposed Development.

11.7.3.2 These 'Factored In Measures' are standard measures applied to offshore wind development, including lighting and marking of the Proposed Development, use of 'soft-starts' for piling operations etc, to reduce the potential for impacts. Factored In Measures relevant to the marine mammal assessment are presented in Table 11.15. These measures are integrated into the

description of development and have therefore been considered in the impact assessment (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development. This approach is in line with EPA guidance which states that 'in an EIAR it may be useful to describe avoidance measures that have been integrated into the proposed proposal' (EPA, 2022).

Table 11.15: Factored In Measures

Factored In Measures	Justification
Environmental Management Plan (EMP) providing the overarching framework for environment management during construction, operations and maintenance, and decommissioning phases of the Proposed Development. The EMP includes mitigation/monitoring measures and commitments made within the EIAR and a Marine Pollution Contingency Plan (MPCP) which will include key emergency contact details (including the EPA and Irish Coast Guard (IRCG)). An EMP is included in Volume III, Appendix 25.1: Environmental Management Plan (Revised March 2026).	Measures will be adopted to ensure that the potential for release of pollutants from construction, operations and maintenance, and decommissioning is minimised. These mitigation measures are: Storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, specifically; • The Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 (as amended) (Schedule 4, Part 5);International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 (as amended). (Annex II, and Annex III regulations); • International Convention for the Safety of Life at Sea (SOLAS) (Chapter VII); and • OSPAR Annex III: On the Prevention and Elimination of Pollution from Offshore Sources. Double skinning and labelling (direction of flow and contents) of pipes and clearly labelled storage tanks containing hazardous substances; • Storage of these substances in impenetrable bunds; • Working vessels shall handle all wastes in accordance with International Maritime Organisation *(*IMO) requirements and in accordance with the requirements of national legislation (i.e. Sea Pollution Acts 1991 to 1999; Sea Pollution (Miscellaneous Provisions) Act 2006) as applicable; • All waste and/or litter, including potential pollutants produced during construction, operations and maintenance, and decommissioning phases of the Proposed Development shall be stored and returned to shore for authorised disposal at suitable facilities; and • Vessel refuelling will only take place in port or under permit from the IRCG. In this manner, accidental release of contaminants from vessels will be strictly controlled, thus providing protection for marine life across all phases of the Proposed Development. Any accidental pollution of the marine environment shall be immediately reported to the IRCG and to any other local authorities who are likely to be affected by such pollution.
Cables will be buried where possible and protected where not possible as set out in Volume II, Chapter 4 Description of Development	Commitment to the burial of cables where possible and protected where not possible, as set out in Volume II, Chapter 4: Description of Development (Revised March 2026). While burial of cables will not reduce the strength of potential EMF, it does increase the distance between the source of EMF (i.e. the operational cables)

Factored In Measures	Justification
(Revised March 2026).	and marine mammal receptors, thereby potentially reducing the potential effect on those receptors.
Marine Mammal Mitigation Plan (MMMP) detailing the piling methodology, duration of piling, ramp-up and soft-start procedures, maximum piling energy and details of mitigation and monitoring parameters. A MMMP is included in Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026).	The implementation of a MMMP will mitigate for the risk of permanent auditory injury to marine mammals within a 'mitigation zone'. The mitigation zone is determined considering the potential for instantaneous auditory injury based on the initial hammer strike energy of 825 kJ (i.e. soft-start hammer energy). The ramp-up and soft-start will provide an audible cue to allow marine mammals to flee the area before piling at increased hammer energy commences. These measures will help to mitigate any potential for auditory injury. ADDs will be used prior to the ramp-up and soft-start to ensure marine mammals are deterred.
MMMP for UXO clearance detailing the clearance methodologies, and details of mitigation and monitoring parameters (Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)).	A UXO MMMP will be implemented during any UXO clearance required. The MMMP will include measures to ensure the risk of instantaneous PTS to marine mammals is negligible. The exact mitigation measures contained with the UXO MMMP are yet to be determined because the number, size, condition, and location of UXO that may require clearance are currently unknown, but measures will be in line with the latest relevant guidance. Multiple measures are available and have been implemented elsewhere for UXO clearance, such as the use of ADDs and scarer charges to displace animals to beyond the instantaneous PTS impact range, or noise abatement techniques where appropriate.
MMMP for site surveys, detailing the survey equipment to be deployed, details of mitigation and monitoring parameters (Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)).	Proposed mitigation has been described in the MMMP, and will be implemented during site surveys and will include measures to ensure the risk of PTS to marine mammals is negligible.
Environmental Vessel Management Plan (EVMP) is informed by best practice guidance to minimise the risk to marine mammals from vessel activities	The implementation of an EVMP which includes best practice guidance measures to minimise the potential for collision risk, potential injury to, and disturbance of marine mammals from vessel activities.

Factored In Measures	Justification
(Volume III, Appendix 25.10: Environmental Vessel Management Plan).	
Rehabilitation Schedule (Volume III, Appendix 4.1: Rehabilitation Schedule).	The Rehabilitation Schedule sets out the methodology and schedule for decommissioning of the Proposed Development. The Rehabilitation Schedule confirms that there will be no piling operations during decommissioning of the monopiles.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339).	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out.	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.

11.7.4 Assessment methodology for injury and/or disturbance from underwater noise during pile driving

11.7.4.1 The noise levels generated by pile driving were predicted by Subacoustech Environmental Ltd using their Impulse Noise Sound Propagation and Impact Range Estimator (INSPIRE) model. Full details of the underwater noise modelling and the resulting impact areas and ranges are detailed in the Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026).

11.7.4.2 Project Design Option 1 is comprised of the installation of 53 WTG monopile foundations of 7 to 11 m pile diameter for WTG and 2 OSP monopile foundations of 7 to 14 m pile diameter (Table 11.9). For the purposes of underwater noise modelling, the maximum pile diameter within this range has been applied to ensure the assessment represents a precautionary, representative scenario.

11.7.4.3 Project Design Option 2 is comprised of the installation of 47 WTG monopile foundations of 7 m to 11 m pile diameter for WTG and 2 OSP monopile foundations of 7 to 14 m pile diameter (Table 11.10). Similarly, for underwater noise modelling, the maximum pile diameter within this range has been applied to ensure the assessment represents a precautionary, representative scenario.

11.7.4.4 Piling activities were modelled for WTG monopiles at three locations: the North (N), Central (C), and Southwest (SW). In addition, two locations were modelled for OSP monopiles: North OSP (N-OSP), and South OSP (S-OSP).

11.7.4.5 Two foundation scenarios were used for modelling. To ensure a precautionary and representative assessment of underwater noise, the maximum pile diameter within each design range was applied to both scenarios. For WTG locations, pile diameters range from 7 to 11 m, and for OSP locations from 7 to 14 m. Therefore, the largest diameter in each range was used for modelling:

- 11 m monopile foundations at the N, C and SW WTG locations, installed with a maximum blow energy of 3,500 kJ; and
- 14 m monopile foundations at the N-OSP and S-OSP location, installed with a maximum blow energy of 3,500 kJ.

11.7.4.6 Further, utilising the two foundation scenarios presented above for each of the Project Design Options, there were two mitigation scenarios modelled. The first is the ramp-up mitigation scenario, which is considered to be the base case (detailed in Paragraphs 11.7.4.7 to 11.7.4.8 and Table 11.16). The second is the extended ramp-up mitigation scenario (detailed in Paragraphs 11.7.4.9 to 11.7.4.10 and Table 11.17). The Applicant has committed to implementing the extended ramp-up mitigation in order to further reduce the potential significance of effects and to comply with the Danish standard (see Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026) for further details).

RAMP-UP MITIGATION SCENARIO

11.7.4.7 The ramp-up mitigation scenario comprises a ramp-up (soft-start) commencing at 825 kJ for a period of 40 minutes, followed by the gradual ramping up of hammer energy up to the maximum hammer energy of 3,500 kJ.

11.7.4.8 The soft start and ramp-up scenarios used for modelling of the ramp-up mitigation scenario are presented in Table 11.16.

Table 11.16: Summary of the soft start and ramp-up scenario used for the ramp-up mitigation modelling for piling

	825 kJ	825 kJ	1,550 kJ	2,275 kJ	3,500 kJ
Number of strikes	12	600	400	400	4,600
Duration	20 min	20 min	13 min 20 sec	13 min 20 sec	153 min 20 sec
Strike rate	0.6 blow/min	30 blow/min			

EXTENDED RAMP-UP MITIGATION SCENARIO

11.7.4.9 The extended ramp-up mitigation scenario comprises a ramp-up (soft-start) commencing at 400 kJ for a period of 60 minutes, followed by the gradual ramping up of hammer energy up to the maximum hammer energy of 3,500 kJ.

11.7.4.10 The soft start and ramp-up scenarios used for modelling of the extended ramp-up mitigation scenario are presented in Table 11.17.

Table 11.17: Summary of the soft start and ramp-up scenario used for the extended ramp-up mitigation scenario for piling

	400 kJ	400 kJ	800 kJ	1,500 kJ	2,275 kJ	3,500 kJ
Number of strikes	18	450	600	600	600	3,600
Duration	30 min	30 min	20 min	20 min	20 min	120 min
Strike rate	0.6 blow/min	15 blow/min	30 blow/min			

Approach to PTS and TTS-onset

11.7.4.11 The PTS-onset thresholds used to assess the potential for auditory injury to marine mammals during pile driving are those presented in Southall *et al.* (2019) for impulsive noise (Table 11.18). The TTS-onset thresholds are also presented (Table 11.18), whereby TTS is not regarded as injury given its temporary nature and any impacts relating to the effects of TTS are considered to be captured in the quantitative assessment of disturbance. Further details are presented in Volume III, Appendix 11.5: Temporary Threshold Shift (TTS) Position Paper - SMRU Consulting (RFI March 2026).

11.7.4.12 Impulsive sound sources, such as pile driving, have high peak sound pressure, short duration, fast rise-time, and broad frequency content at source.

11.7.4.13 Both instantaneous Sound Pressure Level (SPL_{peak}) and cumulative Sound Exposure Level (SEL_{cum}) PTS and TTS-onset thresholds have been presented by Southall *et al.* (2019) (Table 11.18) and are used within this assessment.

11.7.4.14 Southall *et al.* (2019) propose the SPL_{peak} being either unweighted or flat weighted across the entire frequency band of a FHG because the direct mechanical damage to the auditory system that is associated with high peak sound pressures is not frequency dependent and is therefore restricted to the audible frequency range of a species. Unweighted SPL_{peak} values are therefore included in this assessment for instantaneous PTS and TTS (Table 11.18).

11.7.4.15 The SEL_{cum} thresholds considers the SEL received by an animal and the duration of exposure, accounting for the accumulated exposure over a 24-hour period. Southall *et al.* (2019) recommends the application of SEL_{cum} for the individual activity alone (i.e., not for multiple activities occurring within the same area or over the same time). To inform this impact assessment, sound modelling has considered the SEL_{cum} over a piling event. It is important to note that the physiological damage that sound energy can cause is mainly restricted to energy occurring in the frequency range of a species' hearing range. Therefore, for the cumulative SEL (SEL_{cum}), sound has been weighted based on species group specific weighting curves presented in Southall *et al.* (2019).

Table 11.18: PTS and TTS-onset thresholds for impulsive noise (Southall *et al.*, 2019)

Species	FHG	Cumulative PTS (SEL_{cum} dB re 1 μPa^2s weighted)	Instantaneous PTS (SPL_{peak} dB re 1 µPa unweighted)	Cumulative TTS (SEL_{cum} dB re 1 μPa^2s weighted)	Instantaneous TTS (SPL_{peak} dB re 1 µPa unweighted)
Harbour porpoise	Very High Frequency (VHF) cetacean	155	202	140	196
Dolphin species (bottlenose dolphin, Risso's dolphin, common dolphin	High Frequency (HF) cetacean	185	230	170	224
Minke whale	Low Frequency (LF) cetacean	183	219	168	213
Seal species (in water) (grey seal, harbour seal)	Phocid (in water) (PCW)	185	218	170	212

11.7.4.16 To quantify the impact of underwater noise on marine mammals with regard to PTS and TTS, the instantaneous (SPL_{peak}) and cumulative (SEL_{cum}, over 24 hours) PTS and TTS-onset impact ranges (the area around the piling location within which the noise levels exceed the PTS or TTS-onset thresholds for the relevant FHG) are determined using the recent thresholds presented by Southall *et al.* (2019). Further information on the modelling approach and the methods used the calculate PTS and TTS-onset impact ranges is provided in Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026).

11.7.4.17 The ranges that indicate TTS-onset were modelled and are presented in this impact assessment for both Project Design Options. The current set of TTS-onset thresholds presented by Southall *et al.* (2019) (Table 11.18) define a TTS-onset as the exposure required to produce a 6 dB shift in the hearing threshold. However, data upon which these thresholds are based for TTS-onset in marine mammals from impulsive noise, such as pile driving, is extremely limited. It has been necessary to determine exposure functions for TTS in order to estimate the levels at which the onset of PTS could occur, as experiments inducing PTS in animals is considered unethical. Predicted exposures of 40 dB of TTS are considered to result in PTS onset (Southall *et al.*, 2007). For the purposes of developing these thresholds, TTS was considered to be "the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability", and which "is typically the minimum amount of threshold shift that can be differentiated in most experimental conditions" (Southall *et al.*, 2007). Thus, using a threshold for the onset of TTS would typically result in overestimates of potential ranges at which ecologically significant effects could occur. Furthermore, as TTS-onset is defined primarily as a means of predicting PTS-onset, there is currently no threshold for TTS-onset that would indicate a

biologically significant amount of TTS. Therefore, it was not possible to carry out a quantitative assessment of the sensitivity, magnitude, or significance of the impact of TTS on marine mammals.

11.7.4.18 The number of individuals that may be affected by PTS relative to the reference population was quantified by multiplying the onset impact ranges by the density estimates for each species and calculating the proportion of the reference population.

Behavioural disturbance

DOSE-RESPONSE FUNCTIONS

11.7.4.19 A species-specific dose-response approach was used for the assessment of disturbance to marine mammals from underwater noise during pile driving. This approach was based on current best practice methodology to provide evidence-based estimates rather than the fixed behavioural threshold approach.

11.7.4.20 The application of a dose-response function is used to quantify the probability of a response from an animal to a stressor or stimulus, which will vary according to the dose of stressor or stimulus received by the animal (Dunlop *et al.*, 2017). Therefore, it is based on the assumption that not all animals in an impact zone will respond, unlike traditional methods of threshold assessment.

11.7.4.21 For the purpose of this assessment, the dose is the received single-strike SEL_{SS} which is considered to be best practice for this type of assessment (Southall *et al.*, 2021). SEL_{SS} contours at 5 dB intervals generated by noise modelling (see Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026)) were overlain on species density surfaces to quantify the number of animals receiving each SEL_{SS}, and subsequently the number of animals likely to be disturbed based on the dose-response curve.

11.7.4.22 This impact assessment for cetaceans uses the dose-response curve that was developed by Graham *et al.* (2017b) for harbour porpoise using data collected during the first six weeks of piling during Phase 1 of the Beatrice offshore windfarm.

11.7.4.23 Following the development of this dose-response curve, additional data from the remaining piling events have been processed and showed that the responses of harbour porpoises to piling noise diminishes over the construction period (Graham *et al.*, 2019). Therefore, the use of the dose-response curve from the initial piling event in this assessment can be considered conservative.

11.7.4.24 In the absence of species-specific dose-response data for dolphins or minke whales, this dose-response curve has been adopted for all cetaceans, however it is considered that the application of the porpoise dose-response curve to other cetacean species is highly over-precautionary. This is because harbour porpoises are highly responsive to anthropogenic disturbance, with multiple studies showing response via avoidance and/or reduced vocalisation to various anthropogenic noise sources (Benhemma-Le Gall *et al.*, 2021; Brandt *et al.*, 2013; Brandt *et al.*, 2018; Thompson *et al.*, 2013; Thompson *et al.*, 2020; Sarnocińska *et al.*, 2020). Other cetacean species, including bottlenose dolphin and common dolphin, have shown less of a response to underwater noise in comparison to harbour porpoise (Fernandez-Betelu *et al.*, 2021; Kastelein *et al.*, 2006; Stone *et al.*, 2017).

11.7.4.25 For seals, the dose-response function used is derived from harbour seal telemetry data collected during pile driving activities at the Lincs offshore windfarm in 2011 – 2012 and is presented in Whyte *et al.* (2020). The study presented the percentage change in harbour seal density at the Lincs offshore windfarm and has conservatively assumed that all seals will be disturbed at SEL_{SS} >180 dB re 1 μPa^2s. There are no corresponding data for grey seals and, as such, the harbour seal dose-response function is applied to the grey seal disturbance assessment. This is considered an appropriate proxy for grey seal as both species are categorised within the same FHG. However, it is likely to result in an over-estimation of grey seal response as this assessment

has concluded that grey seals are less sensitive to behavioural disturbance than harbour seals, therefore the application of the harbour seal dose-response function to grey seal is considered conservative.

LEVEL B HARASSMENT – FIXED NOISE THRESHOLDS

11.7.4.26 In the absence of specific-specific empirical data for dolphin species and minke whale and given that the application of the harbour porpoise dose-response curve (Graham *et al.,* 2017b) is highly over-precautionary, the numbers of animals predicted to experience behavioural disturbance using the United States (US) National Marine Fisheries Service (NMFS) Level B harassment thresholds for strong disturbance (NMFS, 2005 (as referenced in NMFS, 2025)) are presented alongside the dose-response assessment methodology to provide context on the potential extent of disturbance.

11.7.4.27 In the US, under the 1994 Amendments to the Marine Mammal Protection Act, Level B harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild, by causing disruption of behavioural patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (NMFS, 2005).

11.7.4.28 The threshold predicts that Level B harassment will occur when an animal is exposed to received sound levels above 160 dB re 1 µPa (rms) from non-explosive impulsive sounds sources, such as seismic airguns, impact pile driving, or intermittent sound sources, such as non-tactical sonar or scientific (Guan and Brookens, 2021; NMFS, 2023). The threshold is based on studies of grey whale (also low-frequency cetaceans) responses to playbacks signals from air guns above 160 dB re 1µPa (rms), which showed that the animal's exhibited an avoidance response (Malme *et al.,* 1984). Beyond the 160 dB re 1 µPa (rms) threshold, the behavioural responses are likely to become less severe, for example, minor changes in speed, direction and/or dive profile, modification of vocal behaviour and minor changes in respiratory rate (Southall *et al.,* 2007). However, it is important to note that marine mammal responses to disturbance will, depend on the individual and the context. For example, previous experience and acclimatisation will affect whether an individual exhibits an aversive response to noise, particularly in a historically noisy area.

Underwater noise assumptions

11.7.4.29 The subsea noise model assumptions and limitations highlighted in Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026) are summarised below:

- The modelling assumed the maximum hammer energy would be reached at all locations, whereas this is unlikely to be the case;
- The soft-start and ramp-up procedure simulated does not allow for short pauses in piling (for realignment) and therefore the modelled SEL_{cum} is likely to be an overestimate since, in reality, these pauses will reduce the time between noise exposures that animals experience whilst fleeing;
- The modelling assessment assumed that all animals swim directly away from the noise source at a constant and conservative average speed. A constant fleeing speed of 3.25 m/s was used for minke whale (Blix and Folkow, 1995) and 1.5 m/s was used for all other species (Otani *et al.*, 2000), as these speeds are industry standard. The average speed of 1.5 m/s recorded in Otani *et al.* (2000) was averaged across horizontal and vertical movements, however the authors note that horizontal speed was significantly faster than vertical speed and cite a maximum speed of 4.3 m/s. Similarly, Leatherwood *et al.* (1982) reported harbour porpoise swim speeds of approximately 6.2 m/s. Therefore, swim speeds are considered to be a precautionary estimate of flee speeds as marine mammals are expected to be able to swim at much faster speeds under stress conditions (Kastelein *et al.*, 2018). The calculated PTS- and TTS-onset impact ranges therefore represent the minimum starting distances from the piling location for animals to flee and prevent them from receiving a dose higher than the threshold.

- The use of the SEL_{cum} metric is described as an equal-energy rule where exposures of equal energy are assumed to produce the same noise-induced threshold shift regardless of how the energy is distributed over time. This means that for intermittent noise, such as piling, the equal-energy rule overestimates the effects since the quiet periods between noise exposures will allow some recovery of hearing compared to continuous noise; and
- The model overestimates the noise exposure an animal receives since it does not account for any time that marine mammals spend at the surface and the reduced sound levels near the surface.

11.7.4.30 These assumptions lead to a conservative determination of the impact ranges, and therefore an extremely precautionary assessment.

ASSUMPTIONS ASSOCIATED WITH PTS-ONSET

11.7.4.31 There are no empirical data on the PTS-onset threshold for auditory injury for marine mammals, as to test this would be unethical. Therefore, PTS-onset thresholds are estimated based on extrapolating from TTS-onset thresholds developed by the NMFS (NMFS, 2018) and those previously presented by Southall *et al.* (2007). For impulsive noise, such as pile driving, TTS-onset is defined at the lowest level that exceeds natural recorded variation in hearing sensitivity (6 dB) and assume that PTS-onset occurs from exposures resulting in 40 dB or more of TTS measured approximately four minutes after exposure (NMFS, 2018).

11.7.4.32 Furthermore, the number of animals predicted to be within the PTS-onset impact ranges assume that all animals are impacted, although the dose-response function adopted by Donovan *et al.* (2017) predicts that only 18-19% of animals will actually experience PTS at the PTS-onset threshold level. Therefore, the number of animals predicted to be within PTS-onset impact ranges are precautionary.

CHARACTERISTICS OF IMPULSIVE NOISE

11.7.4.33 Marine mammals have greater sensitivity to impulsive noise (with respect to hearing damage) which is reflected in the noise exposure risk thresholds as lower SELs are specified for impulsive noise compared to non-impulsive noise (Southall *et al.*, 2007). Therefore, PTS-onset is predicted to occur at lower weighted SEL_{cum} than for non-impulsive sounds (Southall *et al.*, 2007).

11.7.4.34 However, the sound signal of certain sound sources, such as impact piling, lose their impulsive characteristics as a result of propagation effects, and could potentially be characterised as non-impulsive beyond a certain distance (Southall *et al.*, 2019). Generally, the change in noise characteristics with increasing distance result in exposures becoming less physiologically damaging as the sharp transient peaks become less prominent (Southall *et al.*, 2007). This has implications for predicting potential impacts of offshore activities within this impact assessment, as a result of taking a more conservative approach. As the PTS-onset thresholds for impulsive noise are lower than for non-impulsive noise (Southall *et al.*, 2007), the estimated risk of auditory damage is therefore likely to be overestimated where impulsive noise becomes non-impulsive as a result of propagation.

11.7.4.35 Hastie *et al.* (2019) used the signal duration, rise time, crest factor, and peak pressure divided by signal duration to estimate the transition from impulsive to non-impulsive characteristics of impact piling noise during offshore wind turbine foundation installation at the Wash, southeast England and in the Moray Firth, northeast Scotland. The study found that the noise signal experienced a high degree of change in its impulsive characteristics with increasing distance, with the greatest change occurring within ~10 km from the source (Hastie *et al.*, 2019). Predicted PTS-onset impact ranges based on the impulsive noise thresholds used in this assessment may therefore be overestimates in cases where the impact ranges lie beyond this, resulting in the presentation of a precautionary assessment within this Chapter.

11.7.4.36 It is important to note that there are no comparative studies that evaluate TTS-onset from impulsive noise for marine mammal species at present (Southall *et al.,* 2021).

PREDICTING THE RESPONSE OF AN ANIMAL TO UNDERWATER NOISE

11.7.4.37 The ability to predict the response of an animal to underwater noise and the number of animals potentially exposed to levels of noise that may cause an impact is uncertain. The high spatial and temporal variation in marine mammal abundance and distribution in any area makes it difficult to predict how many animals may be present within the range of noise impacts. As a result, all methods for determining at-sea abundance and distribution suffer from a range of biases and uncertainties.

11.7.4.38 Limited empirical data is available to inform predictions relating to the extent to which animals may experience auditory damage or display responses to noise. The current methods for predicting behavioural responses are based on received sound levels, but it is likely that factors other than noise levels alone will also influence the probability of response and the strength of response, such as previous experience, behavioural and physiological context, proximity to activities, duty cycle and pulse characteristics of the sound. However, it is not possible to adequately take these factors into account when predicting a behavioural response at present. This assessment makes use of the monitoring work that has been carried out during the construction of the Beatrice offshore windfarm and therefore uses the most recent and site-specific information on disturbance to harbour porpoise because of pile driving noise (Graham *et al.*, 2017a; Graham *et al.*, 2019).

TTS-ONSET ASSUMPTIONS

11.7.4.39 As outlined in 11.7.4.13., using a threshold for the onset of TTS typically results in overestimates of potential ranges at which ecologically significant effects could occur. Coupled with the precautionary assumptions in the model, particularly with respect to the SEL_{cum} metric, this means that estimates of TTS are likely to be unrealistic and very conservative, and therefore should be interpreted with caution.

11.7.4.40 In addition, it is important to note that there are no thresholds to determine a biologically significant effect on marine mammals from TTS, therefore a qualitative assessment of TTS has been presented within this Chapter.

11.7.5 Assessment methodology for injury and/or disturbance from underwater noise during UXO clearance

11.7.5.1 The noise levels generated from UXO clearance were predicted by Subacoustech Environmental Ltd. Full details of the underwater noise modelling and resulting impact ranges are detailed in Volume III, Appendix 11.1: Underwater Noise Assessment (Revised March 2026).

11.7.5.2 As the detailed confirmatory surveys have not yet been completed, it is not possible at this time to determine how many items of UXO will require clearance. Alternatively, a review of recent information has been used to define parameters for consideration with respect to UXO clearance within this Chapter.

11.7.5.3 A selection of explosive sizes has been considered based on what might be present, and in each case, it has been assumed that the maximum explosive charge in each device is present and detonates with the clearance. The range of charge weights (TNT equivalent) for the potential UXO devices that have been modelled are 25, 55, 120, 240, 525, 700, and 800 kg. In each case, an additional donor weight of 0.5 kg has been included to initiate detonation. Low order deflagration has also been assessed, which assumes that the donor or shaped charge (charge weight of 0.5

kg) detonates fully to initiate a burnout of the explosive but without the follow-up detonation of the UXO. No mitigation has been considered within the modelling.

11.7.5.4 Estimation of the source noise level for each charge weight has been carried out in accordance with the methodology of Soloway and Dahl (2014). Unweighted UXO clearance source levels for each charge weight are presented in Table 11.19.

Table 11.19: Unweighted SPL_{peak} and SEL_{ss} source levels used for UXO modelling

Charge weight (kg) (TNT equivalent)	SPL_{peak} source level (dB re 1 µPa @ 1 m)	SEL_{ss} source level (dB re 1 $\mu Pa^2{}_s$ @ 1 m)
0.5 (low order)	272.1	217.1
25 + donor	284.9	228.0
55 + donor	287.5	230.1
120 + donor	290.0	232.3
240 + donor	292.3	234.2
525 + donor	294.8	236.4
700 + donor	295.8	237.2
800 + donor	296.2	237.5

Approach to PTS and TTS-onset

11.7.5.5 The PTS-onset thresholds used to assess the potential for auditory injury to marine mammals during UXO clearance are those presented in Southall *et al.* (2019) for impulsive noise (Table 11.18) as it is currently advised by UK statutory nature conservation bodies (SNCBs) (Natural England and the Marine Management Organisation) that these thresholds should be used for impact assessment from UXO detonation on marine mammals. This has been followed within this assessment as the most appropriate alternative given that Irish-specific guidance on UXO detonation does not exist. However, the suitability of these criteria is currently being discussed because there a lack of empirical evidence regarding UXO detonations using these metrics, particularly, the range-dependent characteristics of the peak sounds, and whether current propagation models can accurately predict the range at which these thresholds are reached.

11.7.5.6 The TTS-onset thresholds are also presented (Table 11.18), although it is important to note that there is currently no threshold for TTS-onset that would indicate a biologically significant impact as a result of TTS. Therefore, it was not possible to carry out a quantitative assessment of the sensitivity, magnitude, or significance of the impact of TTS on marine mammals. Any impacts relating to the effects of TTS are considered to be captured in the quantitative assessment of disturbance.

Behavioural disturbance

11.7.5.7 Unlike pile driving, there are no dose-response functions available that describe the magnitude and short-term nature of the behavioural impact of UXO detonation on marine mammals.

11.7.5.8 Both piling and explosive sound sources are categorised as ‘impulsive’, however the number of pulses and overall duration of noise emission which drive the behavioural response are drastically different. Behavioural responses to a single UXO detonation are expected to be a one-off startle

response or aversive behaviour; whereas animals are anticipated to be continuously driven out of an impacted area by the series of pulses that are emitted during pile driving, enabling a dose-response to be quantified. Therefore, the empirically-derived dose-response curves used for assessment of behavioural disturbance for pile driving are not applicable to the assessment of UXO clearance.

11.7.5.9 Given that there are no appropriate dose-response functions available for behavioural disturbance from UXO detonation, other disturbance thresholds have been considered and are summarised in the sections below.

EFFECTIVE DETERRENCE RANGES (EDRS)

HIGH ORDER CLEARANCE

11.7.5.10 There is no national guidance available on the methodology that should be used to assess disturbance from UXO clearance. Available guidance on assessing the significance of noise disturbance against the conservation objectives of harbour porpoise SACs in England, Wales, and Northern Ireland (JNCC, 2025) advises that an EDR of 20 km around the source location should be used to determine the area of impact from a high order UXO detonation. To note, this is recommended specifically for high order clearance of charge weights up to 263 kg, as that is the maximum charge weight cleared in the underpinning evidence base.

11.7.5.11 The recommended 20 km EDR is derived from Majewska *et al.* (2025) where the EDR is calculated using data from van Geel *et al.* (2024). This study was conducted during the construction of the East Anglia ONE OWF where a total of 81 high order UXO detonations took place over the campaign. Findings from van Geel *et al.* (2024) recorded reduced harbour porpoise presence/acoustic activity up to a distance of 20 km for UXOs weighing 101 and 250 kg net explosive quantity.

11.7.5.12 Majewska *et al.* (2025) recommended that the EDR for high order UXO clearance should be in the range of 15-20 km. However, given the limited empirical evidence, and remaining uncertainty, the UK SNCB's advice is to use the upper end of that range (i.e. 20 km).

11.7.5.13 The 20 km EDR assumes that all animals are disturbed within this radius (i.e. 1,256.64 km^2) and has been applied to all marine mammal species for high order detonations given that agreed metrics of disturbance for other marine mammal species are not available and there is a lack of empirical data on the likelihood of response to explosives.

11.7.5.14 However, it is important to note that the behavioural disturbance from a single UXO detonation would not result in the same widespread and prolonged displacement that pile driving does (JNCC, 2020). Furthermore, there is no direct evidence to support the assumption that all marine mammal species will respond in the same way to a high order UXO clearance as harbour porpoise do to pile driving of jacket foundations (Dähne *et al.,* 2013).

LOW ORDER CLEARANCE

11.7.5.1 The available guidance on assessing the significance of noise disturbance against the conservation objectives of harbour porpoise SACs in England, Wales, and Northern Ireland (JNCC, 2025) advises that an EDR of 5 km around the source location should be used to determine the area of impact from a low-order UXO clearance.

11.7.5.2 This recommended 5 km EDR is well-supported by evidence from sound measurement studies, which includes six studies comprising of 166 clearance events (Majewska *et al.,* 2025).

11.7.5.3 The 5 km EDR assumes that all animals are disturbed within this radius (78.54 km^2) and has been applied to all marine mammal species for low order detonations given that agreed metrics of

disturbance for other marine mammal species are not available and there is a lack of empirical data on the likelihood of response to explosives.

11.8 Assessment of the significance of effects

11.8.1.1 The impacts of the construction, operations and maintenance and decommissioning phases of both Project Design Options forming the Proposed Development have been assessed for marine mammals. The potential impacts arising from the construction, operations and maintenance and decommissioning phases of the Proposed Development are listed in Table 11.9 and Table 11.10, along with the project parameters against which each impact has been assessed.

11.8.1.2 A description of the potential effect on marine mammals caused by each identified impact is provided in Section 11.9 and Section 11.9.7.

11.9 Assessment of Project Design Option 1

11.9.1 Impact 1 – Injury and/or disturbance to marine mammals from underwater noise during pile driving

11.9.1.1 This impact assessment focusses on elevations in underwater noise and vibration as a result of pile driving during construction.

11.9.1.2 Underwater noise has the potential to impact marine mammals if the frequency is within their hearing range (Table 11.18) and the sound levels are greater than the relevant thresholds for the FHG in which the species is categorised (Table 11.20; Southall *et al.*, 2019).

Table 11.20: Marine mammal hearing groups and ranges (Southall *et al*., 2019)

Functional Hearing Group (FHG)	Relevant species	Generalised hearing range
VHF cetacean	Harbour porpoise	275 Hz to 160 kHz
HF cetacean	Bottlenose dolphin, Risso's dolphin, common dolphin	150 Hz to 160 kHz
Low Frequency (LF) cetacean	Minke whale	7 Hz to 35 kHz
PCW	Grey seal, harbour seal	50 Hz to 86 kHz

11.9.1.3 Impacts to marine mammals from underwater noise range from changes in behaviour and masking that affect 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), displacement and disturbance (Brandt *et al.*, 2011; Culloch *et al.*, 2016; Graham *et al.*, 2019; Pirotta *et al.*, 2014; Stone *et al.*, 2017), injury and mortality (Reichmuth *et al.*, 2019; Schaffeld *et al.*, 2019).

11.9.1.4 The potential for auditory injury is related to the level of the underwater sound, its frequency relative to the hearing bandwidth of the animals, and by the duration of exposure. Exposure to loud, underwater noise can lead to a reduction in hearing sensitivity (a shift in hearing threshold) which may be temporary (TTS) or permanent (PTS).

11.9.1.5 TTS has been included in the assessment as a precautionary measure because it has the potential to have negative effects on an animal's ability to use natural sounds, including

communication, navigation, and prey location, and consequently, could lead to a reduction in the fitness of the animal.

11.9.1.6 This impact assessment will be divided into an assessment of auditory injury (PTS), TTS, and behavioural disturbance due to underwater noise during pile driving.

SENSITIVITY OF THE RECEPTOR

AUDITORY INJURY – PTS

11.9.1.7 All species of cetaceans rely on sonar for navigation, finding prey and communication (Southall *et al.*, 2007). The ecological consequences of PTS (a permanent and irreversible hearing impairment) are uncertain, although a loss of hearing could affect key life functions such as communication, predator detection, foraging, mating and maternal fitness, and could lead to a change in an animal's health or vital rates (Erbe *et al.*, 2018). Relating a potential loss in hearing to a biologically significant response is challenging due to a paucity of empirical data, however a potential consequence of a disruption in key life functions is that the health of impacted animals would deteriorate and potentially lead to reduced birth rate in females and mortality of individuals.

11.9.1.8 At a Department of Business, Energy, and Industrial Strategy (BEIS)-funded expert elicitation workshop in 2018, experts discussed the nature, extent, and potentially consequences of PTS to marine mammal species in the UK (Booth and Heinis, 2018). Using the best and most recent data available on the effects of PTS on marine mammals, the experts concluded that PTS did not mean animals were deaf, and the magnitude and frequency band in which PTS occurs is critical to assessing the effect on vital rates.

11.9.1.9 The onset of PTS was defined by Southall *et al.* (2007) as a non-recoverable elevation of the hearing threshold of 6 dB. It has been assumed that PTS-onset occurs after TTS has grown to 40 dB, based on TTS growth rates obtained from scientific literature. Studies of auditory injury in relation to a typical piling sequence have suggested that hearing impairment caused by exposure to piling noise 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). For piling noise, most energy is between ~30 – 500 Hz, with a peak 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 TTS in a relatively narrow frequency band in both harbour porpoise and harbour seals (Finneran, 2015), with statistically significant TTS occurring at 4 and 8 kHz, respectively (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). As a result, at an expert elicitation workshop, it was agreed that any threshold shifts to hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein *et al.*, 2017). It was also agreed that a PTS of 6 – 18 dB in a narrow frequency band in the 2 – 10 kHz region is unlikely to significantly affect the ability of individuals to survive and reproduce (Kastelein *et al.*, 2017).

HARBOUR PORPOISE (VERY HIGH FREQUENCY CETACEANS)

11.9.1.10 During an expert elicitation workshop, experts discussed the nature, extent, and potentially consequences of PTS to harbour porpoises; concluding that the probability of PTS significantly affecting the survival and reproduction of harbour porpoises was very low (Booth and Heins, 2018).

11.9.1.11 Furthermore, data collected during the construction of offshore windfarms have shown that harbour porpoise detections around the pile driving area decline for several hours prior to the commencement of pile driving (Benhemma-Le Gall *et al.*, 2021; Benhemma-Le Gall *et al.*, 2023; Brandt *et al.*, 2018; Graham *et al.*, 2019). For example, during the installation campaigns of both

Beatrice and Moray East offshore windfarms, harbour porpoise acoustic detections gradually declined by up to 33% during the 48-hour period prior to piling (Benhemma-Le Gall *et al.*, 2023). It is assumed that this is due to an increase in other construction-related activities and the presence of vessels in advance of pile driving which act as a deterrent to harbour porpoise, therefore reducing the risk of auditory injury (Benhemma-Le Gall *et al.*, 2023). Therefore, it is highly unlikely that harbour porpoise will be present in the immediate vicinity of the pile driving at the start of the activity. Consequently, the assessment of underwater noise in relation to pile driving, which assumes harbour porpoises will be present in the immediate vicinity during pile driving, is extremely precautionary.

11.9.1.12 PTS is a permanent effect which cannot be recovered from, although evidence does not suggest that PTS from piling will significantly impact the survival or reproductive rates of harbour porpoise. As a result, they are considered to be of high adaptability, reasonable tolerance, have no recoverability, and are of high value. Therefore, harbour porpoises are assessed as having a Low sensitivity to PTS from underwater noise during pile driving.

DOLPHIN SPECIES (HIGH FREQUENCY CETACEANS)

11.9.1.13 The ecological consequences of PTS for bottlenose dolphin, Risso's dolphin, and common dolphin are uncertain but could result in effects that influence survival and reproductivity, as discussed in paragraph 11.9.1.7.

11.9.1.14 As described for harbour porpoise, studies have shown that there are frequency-specific differences in the onset and growth of noise-induced threshold shifts in relation to the characteristics of the noise source and hearing sensitivity of the receiving species. At a BEIS-funded expert elicitation workshop in 2018, experts concluded that the probability of PTS significantly affecting the survival and reproduction of bottlenose dolphins was very low, assuming an impact a 6 dB PTS in the 2 – 10 kHz range (Booth and Heinis, 2018).

11.9.1.15 PTS is a permanent effect which cannot be recovered from, although evidence does not suggest that PTS from piling will significantly impact the survival or reproductive rates of dolphin species. As a result, bottlenose dolphins, Risso's dolphins, and common dolphins are considered to be of high adaptability, reasonable tolerance, have no recoverability, and are of high value. Therefore, bottlenose dolphins, Risso's dolphins, and common dolphins are assessed as having a Low sensitivity to PTS from underwater noise during pile driving.

MINKE WHALE (LOW FREQUENCY CETACEANS)

11.9.1.16 The low frequency noise produced during pile driving may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whales. Although very little is known about minke whale hearing, it is likely that they use sound for communication and are thought to be capable of hearing sounds through their skull bones (Cranford and Krysl, 2015).

11.9.1.17 As for other FHGs above, it is assumed that animals experiencing PTS would suffer a biological effect that could impact on the health and vital rates of the animal (Erbe *et al.*, 2018) and could ultimately lead to reduced birth rate in females or mortality of individuals.

11.9.1.18 Tubeli *et al.* (2012) estimated the most sensitive hearing range for minke whales to extend from 30 to 100 Hz up to 7.5 to 25 kHz. This suggests that a 6 dB PTS in the 2 – 10 kHz range would only affect a small region of their hearing. Furthermore, several studies have demonstrated that minke whale communication signals are below 2 kHz (Edds-Walton, 2000; Gedamke *et al.*, 2001; Mellinger *et al.*, 2006; Risch *et al.*, 2013; 2014).

11.9.1.19 PTS is a permanent effect which cannot be recovered from, although evidence does not suggest that PTS from piling will significantly impact the survival or reproductive rates of minke whale as only a small region of their hearing would be potentially affected. As a result, they are considered

to be of high adaptability, reasonable tolerance, have no recoverability, and are of high value. Therefore, minke whales are assessed as having a Low sensitivity to PTS from underwater noise during pile driving.

GREY AND HARBOUR SEAL (PHOCIDS IN WATER)

11.9.1.20 Seals use sound both in air and water for communication, predator avoidance, and reproductive interactions, and are less dependent on hearing for foraging than cetaceans (Deecke *et al.*, 2002). Seals have very well developed tactile sensory systems that are 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).

11.9.1.21 Any threshold shifts in hearing caused by pile driving would manifest in the range of 2 – 10 kHz (Kastelein *et al.*, 2017). At a BEIS-funded export elicitation workshop in 2018, experts concluded that the probability of PTS significantly affecting the survival and reproduction of grey and harbour seals was very low, assuming a 6 dB PTS in the 2 – 10 kHz range (Booth and Heinis, 2018).

11.9.1.22 Calculations of SELs of tagged seals during the construction of the Lincs offshore windfarm (Southern North Sea, UK) estimated that at least 50% of tagged seals would have received a dose of sound greater than published thresholds for PTS (Hastie *et al.*, 2015), although it is important to note that published thresholds have since been updated in Southall *et al.* (2019) and therefore this estimate is now expected to be lower. For example, Whyte *et al.* (2020) found that the percentage of tagged seals predicted to experience PTS-onset varied from 0 to 17% depending on the onset threshold applied. The extent of offshore windfarm construction within the Wash over the last decade and the degree of overlap with foraging ranges of harbour seals in this region would suggest that a large number of individuals within the Wash population may have experienced levels of sound that have the potential to cause PTS (Russell *et al.*, 2016). However, the increase in the Wash harbour seal population during this period suggests that either the survival and fitness of individuals is not affected or that seals are not developing PTS despite predictions of exposure that indicate that they should be.

11.9.1.23 PTS is a permanent effect which cannot be recovered from, although, seals do not generally use hearing as the primary sensory function for locating prey and evidence does not suggest that PTS from piling will significantly impact the survival or reproductive rates of seals. As a result, they are considered highly adaptable, reasonably tolerant, have no recoverability, and are of high value. Therefore, grey and harbour seals are assessed as having a Low sensitivity to PTS from underwater noise during pile driving.

BEHAVIOURAL DISTURBANCE

HARBOUR PORPOISE

11.9.1.24 Harbour porpoises are particularly vulnerable to disturbance because they are small cetaceans which makes them susceptible to heat loss and as a result, requires them to forage frequently in order to maintain a high metabolic rate with little energy remaining for fat storage (Rojano-Doñate *et al.*, 2018; Wisniewska *et al.*, 2016). Therefore, there is a risk of changes to their overall fitness if they are displaced from high-quality foraging grounds or if their foraging efficiency is disturbed, and they are unable to find alternative suitable foraging grounds that will provide sufficient food to meet their metabolic needs. However, results from studies using Digital Acoustic Recording Tags (DTAGs) suggest that harbour porpoises are able to respond to short-term reductions in food intake and may have some resilience to disturbance (Wisniewska *et al.*, 2016).

11.9.1.25 Several studies have shown that harbour porpoises are displaced during periods of pile driving (Benhemma-Le Gall *et al.*, 2021; Brandt *et al.*, 2016; Graham *et al.*, 2019;). For example, monitoring of harbour porpoise during piling at Beatrice offshore windfarm in northeast Scotland

indicated that porpoises were displaced from the immediate vicinity of the piling activity with a 50% probability of response occurring at approximately 7 km at the first piled location (Graham *et al.*, 2019). However, the 50% probability of response reduced to 1.3 km by the final piling location, suggesting that the response of harbour porpoise diminished over the construction period (Graham *et al.*, 2019).

11.9.1.26 This is further supported by studies at eight offshore windfarms in the German North Sea where declines in porpoise detection of >90% were recorded at noise levels above 170 dB compared to a baseline period of 24 to 48 hours (Brandt *et al.*, 2016). A decline in detections of 25% at noise levels between 145 and 150 dB showed a decrease in effect with increase in distance from the piling location (Brandt *et al.*, 2016). Furthermore, the detection rates showed that animals were only displaced from the area for a short period (one to three days) (Brandt *et al.*, 2011; Brandt *et al.*, 2016; Brandt *et al.*, 2018; Dähne *et al.*, 2013).

11.9.1.27 Recent studies at two offshore windfarms in Scotland showed that detections of clicks, associated with echolocation, and buzzing, associated with prey capture, in the short range (2 km) did not cease in response to piling, suggesting that porpoises were not completely displaced from the piling area (Benhemma-Le Gall *et al.*, 2021). Furthermore, the study suggests that animals that experience displacement may be able to compensate for missed foraging opportunities and increased energy expenditure of fleeing the piling area as detections of both clicks and buzzing were positively related to the distance from the piling activity (Benhemma-Le Gall *et al.*, 2021) which could be due to an increase in foraging activities beyond the piling impact range.

11.9.1.28 At an expert elicitation workshop in 2018, experts agreed that juvenile and adult survival were unlikely to be significantly affected by missed foraging opportunities as a result of disturbance from piling (Booth *et al.*, 2019). As a result, harbour porpoises are considered to be of high adaptability, reasonable tolerance, have high recoverability, and are of high value. Therefore, harbour porpoises are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during piling driving.

BOTTLENOSE DOLPHIN

11.9.1.29 A study of bottlenose dolphin response to impulsive noise (including the piling campaigns of Beatrice offshore windfarm and Moray East offshore windfarm, northeast Scotland), suggest that these activities did not cause displacement of the species from the southern coast of the Moray Firth (Fernandez-Betelu *et al.*, 2021). At the small temporal scale, dolphin detections increased, and the species remained within the predicted impacted area close to the offshore activities, for a median of two hours per day, on days with impulsive noise. This could be due to modifications in group size and/or behaviour, or changes in vocalisation rate or amplitude in response to impulsive noise generated by offshore activities. It is also important to note that bottlenose dolphin occurrence is largely influenced by various natural drivers, such as prey abundance, which could be deemed of higher importance in affecting their occurrence. Other studies in the Cromarty Firth, northeast Scotland have suggested small spatial and temporal scale disturbance of bottlenose dolphins from piling activities have occurred previously, as evidenced by a slight reduction of the presence, detection positive hours, and the encounter duration in the vicinity of construction works, although dolphins were not excluded entirely from the area (Graham *et al.*, 2017a).

11.9.1.30 There is potential for behavioural disturbance due to underwater noise to result in disruption in foraging and resting activities and an increase in travel and energetic costs (Marley *et al.*, 2017; Pirotta *et al.*, 2015), although evidence suggests that this will occur on a small spatial and temporal scale. Furthermore, New *et al.* (2013) showed that while there is potential for disturbance to affect bottlenose dolphin behaviour and health, which will then impact vital rates and population dynamics, individuals are able to compensate for immediate behavioural responses to disturbances caused by vessel activity. This suggests that they have some capability to adapt their behaviour and tolerate certain levels of temporary disturbance. As a

result, bottlenose dolphins are considered to be of high adaptability, reasonable tolerance, have high recoverability, and are of high value. Therefore, bottlenose dolphins are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during piling driving.

RISSO'S DOLPHIN

11.9.1.31 Limited information on the response of Risso's dolphin to pile driving exists and there are few studies to investigate the effects of other impulsive noise sources, such as seismic surveys. The frequency range of seismic airguns may be similar to that of low-frequency noise produced by pile driving, although its duration and cumulative acoustic energy levels will differ. A study on the effects of seismic operations in UK waters showed no response by Risso's dolphin to seismic airguns (Stone *et al.*, 2017). During controlled experiments where Risso's dolphin were exposed to simulated military sonar (SPLs of 135 dB re 1µPa), no clear behavioural response was recorded (Southall *et al.*, 2011).

11.9.1.32 The limited information available for the impacts of pile driving, construction-related activity and seismic surveys on Risso's dolphins make it challenging to assess the risk for this species. Based on evidence available, Risso's dolphin are considered to be of high adaptability, reasonable tolerance, high recoverability, and of high value. Therefore, Risso's dolphin are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during piling driving.

COMMON DOLPHIN

11.9.1.33 Limited information on the response of common dolphins to pile driving exists, with few studies investigating impacts of any impulsive sound source on this species. The majority of evidence for the response of common dolphins to seismic surveys (an impulsive sound source) shows no change in occurrence or sighting densities of common dolphin during active surveys (Kavanagh *et al.*, 2019; Stone *et al.*, 2017). Similarly, a monitoring study in northwest Ireland investigating the effects of construction-related activity, including but not limited to seismic surveys, multi-beam surveys, remotely operated vehicle (ROV) surveys, dredging, back filling, rock trenching, rock placement, rock breaking, pipe laying and umbilical laying, during the construction of a gas pipeline found no changes in occurrence of common dolphin as a result of these construction - related activities in the area (Culloch *et al.*, 2016).

11.9.1.34 The limited information available for the impacts of pile driving, construction-related activity and seismic surveys on common dolphins make it challenging to assess the risk to this species. However, there is evidence to suggest that common dolphins are able to adjust their whistle characteristics to account for masking as a result of anthropogenic noise (Papale *et al.*, 2015), suggesting some tolerance and adaptability. As a result, common dolphins are considered to be of high adaptability, reasonable tolerance, have high recoverability, and are of high value. Therefore, common dolphins are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during pile driving.

MINKE WHALE

11.9.1.35 Limited information on the behavioural responses of minke whales to underwater noise is available. A study on the behavioural sensitivity of minke whale reactions to sonar signals showed that they displayed prolonged avoidance, increase in swim speed directly away from the source, and cessation of feeding for a received SPL of 146dB re 1µPa and long-term (6 hour) avoidance of the area for a received SPL of 158dB re 1µPa (Sivle *et al.*, 2015). A study detailing minke whale responses to the Lofitech 'seal scarer' ADD showed minke whales within 500 m and 1,000 m of the source (source level of 204dB re 1 µPa at 1 m) exhibiting responses of increased swim speeds and movement away from the source (McGarry *et al.*, 2017). A similar avoidance behaviour to an ADD was also reported by Boisseau *et al.* (2021). Marine mammal monitoring showed that fine-

scale temporal occurrence of minke whales was reduced by the presence of construction related activity (which did not include pile driving but did assess vessel presence as a proxy for other activities, including seismic surveys and multi-beam surveys) in Broadhaven Bay, northwest Ireland (Culloch *et al.*, 2016).

11.9.1.36 Minke whale are seasonal migrants to Irish (and UK) waters, where they forage on pelagic schooling fish during the summer months (Whooley, 2016). Minke whales are highly adapted to spatial movement. Tracking and habitat-use studies demonstrate that they routinely forage across broad spatial ranges, shifting their distribution in response to prey availability at both fine and regional scales (MacDougall and Robinson, 2025). Their foraging behaviour is adaptable, with individuals exploiting a variety of prey resources, including surface-associated and deeper-water prey patches, and adjust their feeding strategies seasonally to follow movements of prey (sandeels, sprat, and krill) (Friedlaender *et al.,* 2014; Cade *et al.,* 2023). Further, studies indicate that minke whales undertake broad-scale, seasonal movements across diverse habitats over the annual cycle (Eerkes-Medrano *et al.,* 2021).

11.9.1.37 Collectively, these studies show that minke whales possess a high degree of foraging flexibility and can access alternative prey patches across extensive spatial ranges. Given their large body size, substantial energetic reserves, and broad scale movement capacity, minke whales are well equipped to tolerate temporary displacement from localised foraging areas. Consequently, they are expected to recover from any short term disruption to foraging more effectively than smaller species such as harbour porpoise, and temporary displacement is unlikely to result in measurable impacts on vital rates. As a result, minke whales are considered to be of high adaptability, reasonable tolerance, have high recoverability, and are of high value. Therefore, minke whales are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during piling driving.

GREY SEAL

11.9.1.38 Limited information on the behavioural responses of grey seals to underwater noise is available. Studies in the Netherlands collected telemetry data from 20 grey seals in 2014 during the during the construction of the Luchterduinen windfarm and from 16 grey seals in 2015 during the construction of the Gemini windfarm (Aarts *et al.*, 2018). The most common response suggested a change in behaviour from foraging to horizontal movement, although various other responses were recorded including, altered surfacing and diving behaviour, changes in swim direction, and no response (Aarts *et al.*, 2018). Data from this study also showed that seals returned to the area on subsequent trips, despite receiving multiple exposures.

11.9.1.39 During an expert elicitation workshop in 2018, it was concluded that grey seals were considered to have a reasonable ability to compensate for missed foraging opportunities due to disturbance from underwater noise given their generalist diet, adequate fat stores, mobility, and life history (Booth *et al.*, 2019). In general, experts agreed that grey seals would be more robust to the effects of disturbance than harbour seals as they have larger energy store and are more generalist in their diet and more adaptable in their foraging strategies (Booth *et al.*, 2019). Experts also agreed that moderate-high levels of repeated disturbance would be required for any effect on grey seal fertility rates (Booth *et al.*, 2019).

11.9.1.40 Grey seals are highly adaptable to a changing environment. They can adjust their metabolic rate and foraging strategies and can compensate for lost opportunities due to their generalist diet, mobility, and adequate fat stores (Smout *et al.*, 2014; Stansbury *et al.*, 2015). They are also able to tolerate periods of fasting as part of their life history because of their large body size and thick layer of blubber (i.e. more energy reserve) (Pomeroy *et al.*, 1999). In addition, they are wide ranging and can travel large distances (up to 488 km) between different haul out and foraging regions, although on average, distances tend to be approximately 65 km (McConnell *et al.*, 1999). As a result, grey seals are considered to be of high adaptability, reasonable to high tolerance,

have high recoverability, and are of high value. Therefore, grey seals are assessed as having a Negligible sensitivity to behavioural disturbance from underwater noise during piling driving.

HARBOUR SEAL

11.9.1.41 Behavioural disturbance of harbour seals as a result of underwater noise during pile driving could have an effect on both survival if it results in the separation of a pup from its mother, and reproduction via body condition if it results in the animal spending less time feeding or conserving energy by resting (Booth *et al.*, 2019).

11.9.1.42 A study of telemetry tagged harbour seals in the Wash, southeast England showed displacement during piling with a 19 to 83% reduction in abundance compared to during piling breaks (Russell *et al.*, 2016). The study shows that abundance was significantly reduced up to 25 km from the piling activity (Russell *et al.*, 2016). However, seals within the area returned to usage levels similar to non-piling periods within two hours of cessation of the piling activity, suggesting that the duration of displacement was short-term.

11.9.1.43 It is possible that displacement of harbour seals could result in an increased energetic cost if they are required to travel greater distances to compensate for missed foraging opportunities, which could potentially affect the reproductive success of a small number of individuals. However, during an expert elicitation workshop in 2018, the experts considered it unlikely that an individual would repeatedly return to an area where it had been previously displaced, and therefore unlikely to result in reduced foraging opportunities over a number of days that would be required to reduce body condition or fertility (Booth *et al.*, 2019).

11.9.1.44 Harbour seals have been reported to travel up to 273 kilometres from a haul-out whilst foraging, although they tend to remain within 50 km of their haul-out site and show high site fidelity (Carter *et al.*, 2022). The identified harbour seal haul-outs at Wexford Harbour, north Bull Island and Lambay island are situated approximately 50 km, 55 km and 62 km away from the Proposed Development, respectively, which suggests there is a low likelihood of harbour seals from these haul-outs using waters within the Proposed Development.

11.9.1.45 During the expert elicitation workshop in 2018, the experts also agreed that harbour seals have a reasonable ability to compensate for missed foraging opportunities from disturbance (from exposure to low frequency broadband pulsed noise such as piling driving) due to their generalist diet, adequate fat stores, mobility, and life-history traits (Booth *et al.*, 2019), for example, they have a thick layer of blubber for energy storage that enables them to tolerate periods of fasting when hauled out between foraging trips or during breeding and moulting periods. Therefore, they are likely to have capacity to tolerate short-term displacement from foraging grounds during piling activity. As a result, harbour seals are considered to be of high adaptability, reasonable tolerance, have high recoverability, and are of high value. Therefore, harbour seals are assessed as having a Low sensitivity to behavioural disturbance from underwater noise during piling driving.

Construction phase

MAGNITUDE OF IMPACT: RAMP-UP MITIGATION SCENARIO

AUDITORY INJURY – PTS: RAMP-UP MITIGATION SCENARIO

11.9.1.46 The following section provides the quantitative assessment of the impact of PTS from pile driving on marine mammals, based on the ramp-up mitigation scenario. The predicted areas and maximum impact ranges for auditory injury (PTS-onset) from pile driving for each marine mammal species are also presented in Table 11.21 to Table 11.25. This includes the prediction of impact for each of the five modelling locations. A precautionary approach has been taken in this impact

assessment by using the highest value density estimate where multiple robust estimates were available.

11.9.1.47 For harbour porpoise, the maximum instantaneous PTS-onset impact range was 680 m for the installation of a 11 m monopile at the C WTG location (Table 11.22). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) using the site-specific DAS density estimate. Using the cumulative PTS-onset thresholds, the maximum impact range was 1,700m (1.7 km) for the installation of a 11 m monopile at the C WTG location (Table 11.22). This equates to a maximum of two animals experiencing auditory injury (<0.01% of the reference population) using the site-specific DAS density estimate. Using the density estimate from SCANS-IV, which covers a larger spatial scale, this would be <1 animal (<0.01% of the reference population) that would experience auditory injury due to instantaneous PTS-onset, and <1 animal (<0.01% of the reference population) that would experience auditory injury due to cumulative PTS-onset (Table 11.22).

11.9.1.48 For dolphin species, the maximum instantaneous PTS-onset impact range was <50 m at all piling locations. This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for all dolphin species. Using the cumulative PTS-onset thresholds, the maximum impact range for dolphin species was <50 m at all piling locations, and as such, a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for all dolphin species.

11.9.1.49 For minke whale the maximum instantaneous PTS-onset impact range was 60 m for the installation of a 11 m monopile at the C WTG location (Table 11.22). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) using both the Rogan *et al.* (2018) and Hammond *et al.* (2021) density estimates. Using the cumulative PTS-onset thresholds, the maximum impact range was 7,100 m (7.1 km) for the installation of a 11 m monopile at the C WTG location (Table 11.22). This equates to a maximum of three animals experiencing auditory injury (<0.01% of reference population), using the density estimate from Rogan *et al.* (2018).

11.9.1.50 For seals, the maximum instantaneous PTS-onset impact range was 70 m for the installation of a 11 m monopile at the C WTG location (Table 11.22). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population). Using the cumulative PTS-onset thresholds, the maximum impact range was <50 m at all piling locations. This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population).

11.9.1.51 The impact is restricted to active piling days during the construction phase that is reasonably expected to occur. It is considered to result in a very small proportion of the population affected, although auditory injury (PTS) is expected to have a permanent change to the receptor. As part of an expert elicitation workshop, experts in the relevant fields of marine mammal science discussed the nature, extent, and consequence of hearing threshold shifts on marine mammal arising from repeated exposures to low-frequency impulsive noise (Booth and Heinis, 2018). It was acknowledged that energy from piling noise primarily concentrates between about 30 and 500 Hz, and peaks between 100 and 300 Hz with extension to above 2 kHz (Kastelein *et al.*, 2015a, Kastelein *et al.*, 2016). The experts agreed that PTS and TTS as a result of piling would occur between the frequency range of 2 to 10 kHz (Kastelein *et al.*, 2017), with PTS of 6 to 18 dB within this narrow range. They concluded that such change is not likely to adversely and significantly impact the survival and reproductive rates of marine mammals, including minke whales, which have a hearing range in the lower frequencies (paragraphs 11.10.1.18 and 11.10.1.19).Therefore, the magnitude of impact is assessed as Low adverse for harbour porpoise and minke whale as between one and three animals may be impacted. For dolphin and seal species, a maximum of one animal (less than 1 as presented in Table 11.21 to Table 11.25) is predicted to experience auditory injury (PTS), therefore the magnitude of impact is assessed as Negligible adverse.

Table 11.21: PTS-onset from pile driving at the N WTG location based on the ramp-up mitigation scenario[2]

Species	Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	1.0	580	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01

[2] Further information on the density estimates presented here can be found in Table 11.7

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Grey seal	0.08	0.01	60	<1	<0.01
Harbour seal	0.0003	0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL$_{cum}$)					
Harbour porpoise	0.38	0.6	820	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	16	4,100	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Harbour seal	0.0003	<0.01	<50	<1	<0.01

Table 11.22: PTS-onset from pile driving at the C WTG location based on the ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	1.3	680	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	60	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	0.01	70	<1	<0.01
Harbour seal	0.0003	0.01	70	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Harbour porpoise	0.38	3.3	1,700	2	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	57	7,100	3	0.01
	0.017			1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

Table 11.23: PTS-onset from pile driving at the SW WTG location based on the ramp-up mitigation scenario[2]

Species	Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	0.89	580	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	0.01	60	<1	<0.01
Harbour seal	0.0003	0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Harbour porpoise	0.38	2.8	1,500	1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	37	5,800	2	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

Table 11.24: PTS-onset from pile driving at the N-OSP location based on the ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	0.79	520	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	60	<1	<0.01
Harbour seal	0.0003	<0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Harbour porpoise	0.38	0.23	520	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	7.1	3,000	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

Table 11.25: PTS-onset from pile driving at the S-OSP location based on the ramp-up mitigation scenario[2]

Species	Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	0.36	380	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	<50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals	% of reference population
Harbour porpoise	0.38	0.09	370	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	0.28	790	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

TTS: RAMP-UP MITIGATION SCENARIO

11.9.1.52 The following section provides the qualitative assessment of the impact of TTS from pile driving on marine mammals. The predicted areas and maximum impact ranges for TTS-onset from pile driving at each of the five modelling locations are presented in Table 11.26. As outlined in section 11.7.4, no assessment of the number of animals, magnitude, sensitivity, or significance of effect has been undertaken because there are no thresholds to determine a biologically significant effect from TTS-onset.

11.9.1.53 For harbour porpoises, the maximum instantaneous TTS-onset impact range was 1,600 m (1.6 km) for the installation of a 11 m monopile at the C WTG location (Table 11.26). Using the cumulative TTS-onset thresholds, the maximum impact range for harbour porpoise was 35,000 m (35 km) for the installation of a 11 m monopile at the C WTG location (Table 11.26).

11.9.1.54 For dolphin species, the maximum instantaneous TTS-onset impact range was <50 m at all piling locations (Table 11.26). Using the cumulative TTS-onset thresholds, the maximum impact range for dolphin species was <50 m at all piling locations (Table 11.26).

11.9.1.55 For minke whale, the maximum instantaneous TTS-onset impact range was 140 m for the installation of a 11 m monopile at the C WTG location (Table 11.26). Using the cumulative TTS-onset thresholds, the maximum impact range for minke whale was 60,000 m (60 km) for the installation of a 11 m monopile at the C WTG location (Table 11.26).

11.9.1.56 For seals, the maximum instantaneous TTS-onset impact range was 160 m for the installation of a 11 m monopile at the C WTG location (Table 11.26). Using the cumulative TTS-onset thresholds, the maximum impact range for seals was 16,000 m (16 km) for the installation of a 11 m monopile at the C and SW WTG location (Table 11.26).

Table 11.26: TTS-onset from pile driving at WTG and OSP locations based on the ramp-up mitigation scenario

Species	Impact	Piling location				
		N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
Instantaneous TTS-onset (unweighted SPL_{peak})						
Harbour porpoise (VHF cetacean)	Area (km^2)	4.9	5.8	4.6	3.8	1.7
	Maximum range (m)	1,400	1,600	1,400	1200	880
Bottlenose dolphin, Risso's dolphin, common dolphin (HF cetacean)	Area (km^2)	<0.01	<0.01	<0.01	<0.01	<0.01
	Maximum range (m)	<50	<50	<50	<50	<50
Minke whale (LF cetacean)	Area (km^2)	0.05	0.06	0.04	0.04	0.02
	Maximum range (m)	120	140	120	110	80
Grey seal, harbour seal (PCW)	Area (km^2)	0.06	0.07	0.06	0.05	0.03
	Maximum range (m)	140	160	140	130	100
Cumulative TTS-onset (weighted SEL_{cum})						
Harbour porpoise (VHF cetacean)	Area (km^2)	1000	1600	1600	900	1000
	Maximum range (m)	30,000	35,000	34,000	29,000	28,000
Bottlenose dolphin, Risso's dolphin, common dolphin (HF cetacean)	Area (km^2)	<0.01	<0.01	<0.01	<0.01	<0.01
	Maximum range (m)	<50	<50	<50	<50	<50
Minke whale (LF cetacean)	Area (km^2)	3,100	4500	4100	2500	1900
	Maximum range (m)	53,000	60,000	59,000	49,000	41,000
Grey seal, harbour seal (PCW)	Area (km^2)	200	340	370	160	180
	Maximum range (m)	13,000	16,000	16,000	12,000	11,000

BEHAVIOURAL DISTURBANCE: RAMP-UP MITIGATION SCENARIO

11.9.1.57 The number of each marine mammal species predicted to experience behavioural disturbance as a result of pile driving is presented in Table 11.27 and Table 11.28 and assessed as the proportion of the respective reference population (as presented in Table 11.7). For dolphin species and minke whale, numbers of animals predicted to experience behavioural disturbance have been calculated using both the dose-response method (Graham *et al.,* 2017b) (see Table 11.27) and Level B harassment thresholds (NMFS, 2005) (see Table 11.28). The predictions for the N WTG, C WTG, SW WTG, N-OSP, and S-OSP modelling locations are presented separately. Disturbance from concurrent piling has not been assessed as piling is limited to one installation per day for Project Design Option 1 (see Table 11.9). A precautionary approach has been taken in this impact assessment by using the higher value density estimate where multiple estimates were available.

11.9.1.58 iPCoD modelling was conducted to determine whether the level of disturbance is expected to result in population level impacts. The results of the iPCoD modelling show that there is no significant effect of disturbance resulting from pile driving at the Proposed Development to harbour porpoise, bottlenose dolphin, minke whale, grey seal, and harbour seal. Furthermore, for minke whale, grey seal, and harbour seal, impacted population is predicted to continue at a stable trajectory at exactly the same size as the un-impacted population. For further information see Volume III, Appendix 11.3: Phase 1 Irish Offshore Windfarms: Cumulative iPCoD Modelling.

Table 11.27: Predicted impact of disturbance to marine mammals from pile driving at WTG and OSP locations using dose-response curves based on the ramp-up mitigation scenario; # = number of animals disturbed; % = the percentage of the reference population[2]

Species	Density	Impact	Piling location				
			N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
Harbour porpoise	0.38	#	1,456	1,908	1,753	1,270	1,109
		%	2.33	3.05	2.80	2.03	1.77
	0.2803	#	1,074	1,408	1,293	937	818
		%	1.72	2.25	2.07	1.50	1.31
	Grid-cell specific	#	447	586	538	390	340
		%	0.72	0.94	0.86	0.62	0.54
Bottlenose dolphin[3]	0.0201	#	78	101	93	68	59
		%	26.62	34.47	31.74	23.21	20.14
	0.2352	#	902	1,181	1,085	786	687
		%	307.85	403.07	370.31	268.26	234.47

[3] The variation in the number of bottlenose dolphins predicted to be disturbed by pile driving reflects differences in the spatial scales and survey methodologies used to derive density estimates. The variation of these methodologies, and their implications for the assessment, are outlined in paragraphs 11.9.1.64 to 11.9.1.72.

Species	Density	Impact	Piling location				
			N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
		%[4]	10.84	14.19	13.04	9.45	8.26
	Grid-cell specific	#	760	995	914	662	578
		%	259.39	339.59	311.95	225.94	197.27
		%[4]	9.13	11.96	10.98	7.96	6.95
Risso's dolphin	0.031	#	119	156	143	104	91
		%	0.97	1,27	1.17	0.85	0.74
Common dolphin	0.0272	#	105	137	126	91	80
		%	0.10	0.13	0.12	0.09	0.08
	Grid-cell specific	#	227	297	273	198	173
		%	0.22	0.29	0.27	0.19	0.17
Minke whale	0.045	#	173	226	208	151	132
		%	0.86	1.12	1.03	0.75	0.66

[4] There is a substantial difference between the SCANS-III and SCANS-IV density and abundance estimates for bottlenose dolphins in the Irish Sea. SCANS-IV estimates 8,326 animals in blocks CS-D and CS-E (Gilles *et al.,* 2023), whereas SCANS-III estimated 288 animals for the equivalent survey blocks, from which the current MU population size of 293 animals is derived (IAMMWG, 2023). When assessing impacts on bottlenose dolphins using SCANS-IV density estimates (both the block-wide uniform densities (0.2352/km^2) and the grid-cell-specific density), it is therefore more appropriate and robust to compare the resulting number of animals impacted against a population estimate that aligns with SCANS-IV, which is 8,326 animals. Hence, a second impact % has been presented to reflect this.

Species	Density	Impact	Piling location				
			N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
	0.017	#	66	86	79	57	50
		%	0.33	0.43	0.39	0.28	0.25
	Grid-cell specific	#	18	23	22	16	14
		%	0.09	0.11	0.11	0.08	0.07
Grey seal	0.08	#	89	132	118	76	65
		%	5.35	7.94	7.10	4.57	3.91
Harbour seal	0.0003	#	1	1	1	1	1
		%	0.55	0.55	0.55	0.55	0.55

Table 11.28 Predicted impact of disturbance to marine mammals from pile driving using level B harassment threshold based on the ramp-up mitigation scenario; # = number of animals disturbed; % = the percentage of the reference population[2]

Species	Density	Impact	Piling location				
			N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
Bottlenose dolphin[3]	0.0201	#	16	23	23	14	12
		%	5.46	7.85	7.85	4.78	4.10
	0.2352	#	179	259	259	153	132
		%	61.09	88.40	88.40	52.22	45.05
		%[4]	2.15	3.11	3.12	1.84	1.59
	Grid-cell specific	#	151	218	218	129	111
		%	51.54	74.40	74.40	44.03	37.88
		%[4]	1.82	2.62	2.62	1.55	1.34
Risso's dolphin	0.031	#	24	35	35	21	18
		%	0.20	0.29	0.29	0.17	0.15
Common dolphin	0.0272	#	21	30	30	18	16
		%	0.02	0.03	0.03	0.02	0.02
	Grid-cell specific	#	45	65	65	39	34
		%	0.04	0.06	0.06	0.04	0.03
Minke whale	0.045	#	35	50	50	30	26

Species	Density	Impact	Piling location				
			N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
		%	0.17	0.25	0.25	0.15	0.13
	0.017	#	13	19	19	12	10
		%	0.06	0.09	0.09	0.06	0.05
	Grid-cell specific	#	4	6	6	3	3
		%	0.02	0.03	0.03	0.01	0.01

HARBOUR PORPOISE

11.9.1.59 Using the site-specific density estimate of 0.38 animals/km^2 from the DAS, it was estimated that a maximum of 1,908 animals (3.05% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27). This is considered to be highly conservative because it assumes that the density within the site-specific Marine Mammal Study Area is the same across the wider extent of the Irish Sea of which the noise contours extend across. As a result, alternative estimates have also been presented.

11.9.1.60 Using the uniform density estimate of 0.2803 animals/km^2 from the wider SCANS-IV surveys, it was estimated that a maximum of 1,408 animals (2.25% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27). While this is considered to be a more realistic estimate of density across the wider disturbance area compared to the estimated density from the site-specific DAS, it assumes a uniform density of animals across the Irish Sea which is not realistic.

11.9.1.61 In order to account for the non-uniform density of harbour porpoise across the Irish Sea, the number of animals disturbed was also presented using the modelled density surfaces derived from SCANS-IV. Using this approach, it was estimated that a maximum of 586 animals (0.94% of the reference population) will experience behavioural disturbance as a result of pile driving at the C WTG location (Table 11.27).

11.9.1.62 At its furthest point from the source, the 120 SEL_{ss} dB re 1µPa^2$_s$ disturbance contour reaches the Welsh coastline, extending northwards to approximately 68 km north of the north coast of Wales, and southwards to approximately 87 km south of the south coast of Wales (Figure 11.4). This suggests that behavioural response from harbour porpoise may not be localised and could extend across the Irish Sea, although extremely low numbers (21 animals from pile driving of the 11 m monopile at the C WTG location) of harbour porpoise are expected to respond at this received level.

11.9.1.63 The impact on harbour porpoises is considered to result in a small proportion of the population affected with change expected to be recoverable, occur relatively frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory. Therefore, the magnitude of impact is assessed as Low adverse for harbour porpoises.

BOTTLENOSE DOLPHIN

11.9.1.64 Using the uniform density estimate of 0.0201 animals/km^2 from the ObSERVE surveys, it was estimated that a maximum of 101 animals (34.47% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27). This is considered to be conservative because it assumes that the density within stratum 5 (western Irish Sea) is the same across the wider extent of the Irish Sea of which the noise contours extend across.

11.9.1.65 Using the uniform density estimate of 0.2352 animals/km^2 from the wider SCANS-IV surveys, it was estimated that a maximum of 1,181 animals (403.07% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27). This is not considered to be realistic as it assumes a uniform density and does not capture the variability in coastal and offshore population densities and distributions within the Irish Sea.

11.9.1.66 In order to account for the non-uniform density of bottlenose dolphin across the Irish Sea, modelled density surfaces derived from SCANS-IV were also used to calculate the number of animals disturbed. Using this approach, it was estimated that a maximum of 995 animals (339.59% of the reference population) will experience behavioural disturbance as a result of pile

driving of the 11 m monopile at the C WTG location (Table 11.27). Both of these approaches are over-predicting the number of animals available in the area that could be disturbed by pile driving as the number of animals calculated exceeds the reference population size of 293. Therefore, these calculations are not considered to be robust.

11.9.1.67 The noise contours extend to cover the majority of the Irish Sea MU (Figure 11.4), which is used as the reference population for bottlenose dolphin (Table 11.27). Therefore, it is anticipated that the majority of the reference population of 293 dolphins will be within the disturbance contours.

11.9.1.68 However, the number and proportion of bottlenose dolphin disturbed during pile driving was calculated using the dose-response curve for harbour porpoise from Graham *et al.* (2017b), as there is no corresponding species-specific data available for bottlenose dolphin. However, studies suggest that bottlenose dolphins are typically less sensitive to behavioural disturbance than harbour porpoise (Culloch *et al.*, 2016; Kastelein *et al.*, 2006; Stone *et al.*, 2017). Therefore, it is expected that the probability of response to underwater noise from pile driving would be lower.

11.9.1.69 To demonstrate this, the number and proportion of bottlenose dolphin disturbed during pile diving have also been calculated using the Level B harassment threshold and presented in Table 11.28. When comparing these numbers against those calculated using the dose-response curve, they are considerably lower, for example, a maximum of 259 animals are estimated to experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C and SW WTG location and using the uniform density estimate of 0.2352 animals/km^2 from the wider SCANS-IV surveys (Table 11.28) compared to 1,181 animals estimated at the C WTG location using the dose-response curve (Table 11.27). This suggests that the dose-response method results in a very conservative calculation of the number and proportion of bottlenose dolphins disturbed.

11.9.1.70 Furthermore, the reference population does not take into account the connectivity of the reference population with other areas. Studies have shown large scale movement of bottlenose dolphins around Ireland and indicated connectivity with the population on the west coast of Ireland (O'Brien *et al.*, 2010). Long distance movements from the Atlantic to the North Sea between populations in the UK and Ireland have also been reported by Robinson *et al.* (2012). Therefore, the size of the reference population used from the Irish Sea MU is likely to be an under-representation of the number of bottlenose dolphins that may be present in the MU Study Area. Equally, the most recent abundance estimates from the semi-resident population at Cardigan Bay in West Wales (which is within the Irish Sea MU) alone were 232 individuals (95% CI: 119 to 451; Cuthbertson *et al.*, 2025). The design of broad scale surveys, such as SCANS, used to derive MU population estimates are not able to capture localised, coastal populations such as that of Cardigan Bay, providing further evidence to suggest that the reference population size has been under-estimated.

11.9.1.71 Furthermore, it is important to highlight the significant difference between the SCANS-III and SCANS-IV abundance estimates of bottlenose dolphins in the Irish Sea. The SCANS-IV abundance estimate for the Irish Sea (blocks CS-D and CS-E) is 8,326 animals (Gilles *et al.,* 2023) whereas the MU population is derived from the lower SCANS-III abundance estimates, resulting in a population size of 293 (IAMMWG, 2023). As a result, the number of animals predicted to be disturbed using the density estimate from SCANS-IV is not comparable with the MU population size, resulting in a highly unrealistic proportion of the MU population estimated as impacted given that the population size is under-estimated. If the population size is taken to be 8,326 animals, the percentage of the population predicted to be disturbed reduces to 14.19%, when assuming 1,181 animals are disturbed using the dose-response curve, and 3.11% when using the Level B harassment threshold.

11.9.1.72 The impact on bottlenose dolphins is considered to result in a temporary change to most individuals, occur relatively frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is unlikely to have long-term

consequences that would affect the population trajectory. Therefore, the magnitude of impact is assessed as Medium adverse for bottlenose dolphins.

RISSO'S DOLPHIN

11.9.1.73 Using the uniform density estimate of 0.031 animals/km^2 from the wider SCANS-III surveys as the most conservative density estimate available, it was estimated that a maximum of 156 animals (1.27% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27). While it is it unrealistic to assume a uniform density of animals across the Irish Sea, modelled density surfaces could not be derived for Risso's dolphin due to insufficient data (Lacey *et al.*, 2022; Gilles *et al.*, 2025).

11.9.1.74 Limited information on the response of Risso's dolphin to behavioural disturbance to pile driving is available. Therefore, the number and proportion of Risso's dolphin disturbed was calculated using the dose-response curve for harbour porpoise from Graham *et al.* (2017b; Figure 11.4) and is therefore likely to be an over-estimate (section 11.7.4). Due to the lack of species-specific data to apply to the dose-response curve for Risso's dolphin, the number and proportion of Risso's dolphin disturbed during piling was also calculated using the Level B harassment threshold and presented in Table 11.28. When comparing these numbers against those calculated using the dose-response curve, they are considerably lower, with a maximum of 35 animals are estimated to experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C and SW WTG location (Table 11.28) compared to 156 animals estimated at the C WTG location using the dose-response curve (Table 11.27). This suggests that the dose-response method results in a very conservative calculation of the number and proportion of Risso's dolphins disturbed.

11.9.1.75 The impact on Risso's dolphins is considered to result in a small proportion of the population affected with change expected to be recoverable, occur relatively frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory. Therefore, the magnitude of impact is assessed as Low adverse for Risso's dolphins.

COMMON DOLPHIN

11.9.1.76 Using the uniform density estimate of 0.0272 animals/km^2 from the wider SCANS-IV surveys, it was estimated that a maximum of 137 animals (0.13% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.77 In order to account for the non-uniform density of common dolphin across the Irish Sea, modelled density surfaces derived from SCANS-IV were also used to calculate the number of animals disturbed. Using this approach, it was estimated that a maximum of 297 animals (0.29% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.78 Limited information on the response of common dolphin to behavioural disturbance to pile driving is available. Therefore, the number and proportion of common dolphin disturbed was calculated using the dose-response curve for harbour porpoise from Graham *et al.* (2017b; Figure 11.4) and is therefore likely to be an over-estimate (section 11.9). Due to the lack of species-specific data to apply to the dose-response curve for common dolphin, the number and proportion of common dolphin disturbed during piling was also calculated using the Level B harassment threshold and presented in Table 11.28. When comparing these numbers against those calculated using the dose-response curve, they are considerably lower, with a maximum of 65 animals are estimated to experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C and SW WTG location and using the non-uniform density of common dolphin across the Irish

Sea, modelled density surfaces derived from SCANS-IV (Table 11.28) compared to 297 animals estimated using the dose-response curve (Table 11.27). This suggests that the dose-response method results in a very conservative calculation of the number and proportion of common dolphins disturbed.

11.9.1.79 The impact on common dolphins is considered to result in a very small proportion of the population affected with change expected to be recoverable, occur relatively frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory. Therefore, the magnitude of impact is assessed as Low adverse for common dolphins.

MINKE WHALE

11.9.1.80 Using the uniform density estimate of 0.045 animals/km^2 from the ObSERVE surveys, it was estimated that a maximum of 226 animals (1.12% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.81 Using the wider SCANS-III density estimate of 0.017 animals/km^2, it was estimated that a maximum of 86 animals (0.43% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.82 In order to account for the non-uniform density of minke whale across the Irish Sea, modelled density surfaces derived from SCANS-IV were also used to calculate the number of animals disturbed. Using this approach, it was estimated that a maximum of 23 animals (0.11% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.83 Limited information on the response of minke whale to behavioural disturbance to pile driving is available. Therefore, the number and proportion of minke whale disturbed was calculated using the dose-response curve for harbour porpoise from Graham *et al.* (2017b; Figure 11.4) and is therefore likely to be an over-estimate (section 11.9). Due to the lack of species-specific data to apply to the dose-response curve for minke whale, the number and proportion of minke whale disturbed during piling was also calculated using the Level B harassment threshold and presented in Table 11.28. When comparing these numbers against those calculated using the dose-response curve, they are considerably lower, with a maximum of 50 animals are estimated to experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C and SW WTG location and using the uniform density estimate of 0.045 animals/km^2 (Table 11.28) compared to 226 animals estimated at the C WTG location using the dose-response curve (Table 11.27). This suggests that the dose-response method results in a very conservative calculation of the number and proportion of minke whales disturbed.

11.9.1.84 It is also important to note that minke whales are expected to be mostly if not entirely absent in autumn and winter, and therefore any pile driving that occurs within these months is expected to have negligible impact on minke whales.

11.9.1.85 The impact on minke whale is considered to result in a small proportion of the population affected with change expected to be recoverable, occur relatively frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory and is only applicable to spring and summer months due to the seasonal presence of minke whales. Therefore, the magnitude of impact is assessed as Low adverse for minke whale.

GREY SEAL

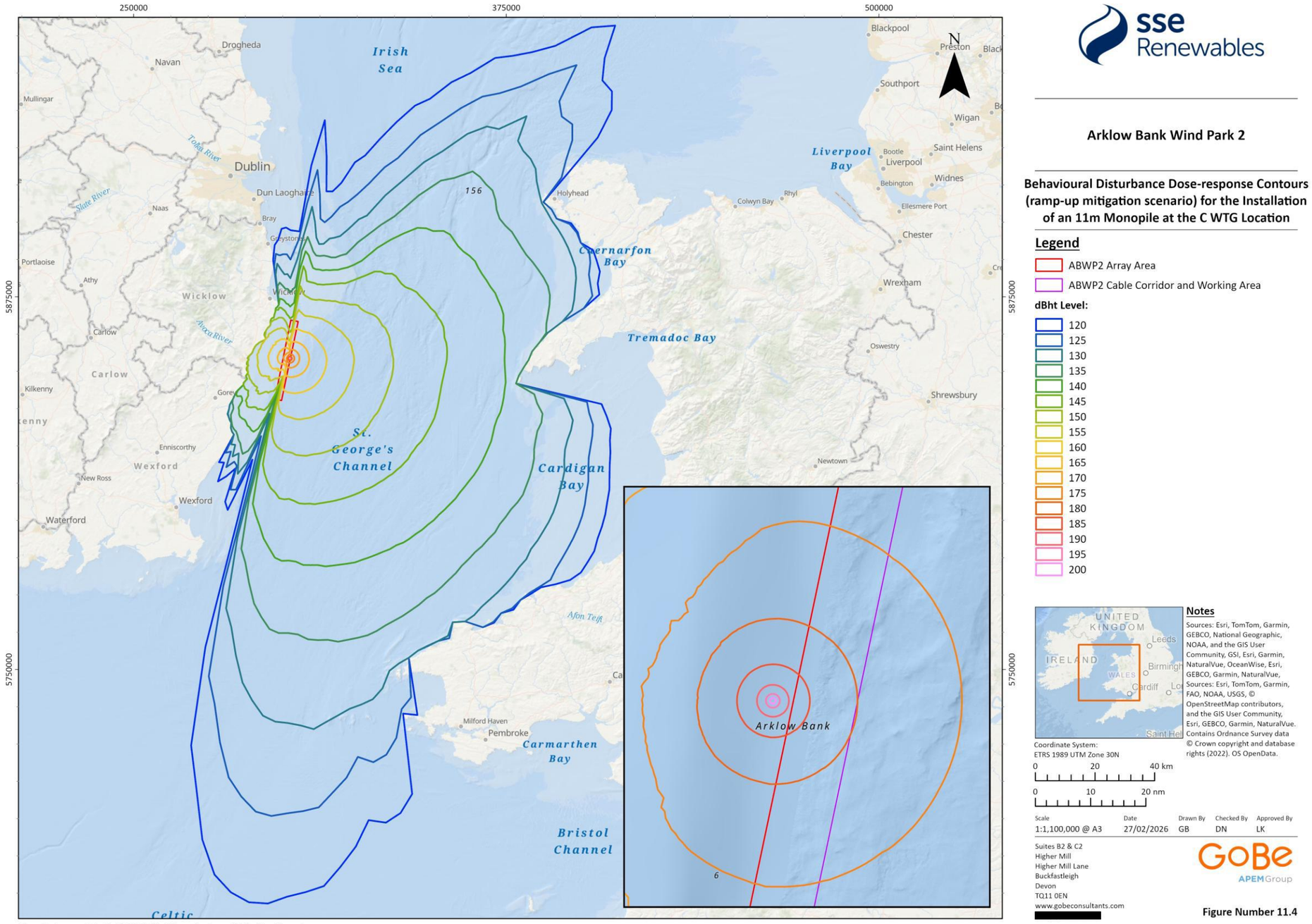
11.9.1.86 Using the averaged grid-cell specific densities derived from Carter *et al.* (2020), it was estimated that a maximum of 132 animals (7.94% of the reference population) will experience behavioural disturbance as a result of pile driving of the 11 m monopile at the C WTG location (Table 11.27).

11.9.1.87 The impact on grey seal is considered to result in a small to medium proportion of the population affected with change expected to be recoverable, occur frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory. Therefore, the magnitude of impact is assessed as Low to Medium adverse for grey seal.

HARBOUR SEAL

11.9.1.88 Using the averaged grid-cell specific densities derived from Carter *et al.* (2020), it was estimated that a maximum of 1 animal (0.55% of the reference population) will experience behavioural disturbance as a result of pile driving in any location (Table 11.27).

11.9.1.89 The impact on harbour seal is considered to result in a very small number and proportion of the population affected with change expected to be recoverable, occur frequently throughout the construction phase, is reasonably expected to occur, and have intermittent and temporary consequences but is very unlikely to affect the population trajectory. Therefore, the magnitude of impact is assessed as Low adverse for harbour seal.



sse Renewables

Arklow Bank Wind Park 2

Behavioural Disturbance Dose-response Contours (ramp-up mitigation scenario) for the Installation of an 11m Monopile at the C WTG Location

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area

dBht Level:

- 120
- 125
- 130
- 135
- 140
- 145
- 150
- 155
- 160
- 165
- 170
- 175
- 180
- 185
- 190
- 195
- 200

Notes

Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community, GSI, Esri, Garmin, NaturalVue, OceanWise, Esri, GEBCO, Garmin, NaturalVue, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 20 40 km
0 10 20 nm

Scale	Date	Drawn By	Checked By	Approved By
1:1,100,000 @ A3	27/02/2026	GB	DN	LK

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Figure Number 11.4

Figure Reference: Ark_Fig11.4_5dB11mMonopile_CentralWTG_Unmitigated

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Figure 11.4: Behavioural disturbance dose-response contours (ramp-up mitigation scenario) for the installation of an 11 m monopile at the C WTG location

SIGNIFICANCE OF EFFECT: RAMP-UP MITIGATION SCENARIO:

AUDITORY INJURY – PTS: RAMP-UP MITIGATION SCENARIO

11.9.1.90 For harbour porpoise, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from PTS to harbour porpoise from underwater noise during pile driving **is Slight adverse**, which is **not significant** in EIA terms.

11.9.1.91 For bottlenose dolphin, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Negligible**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from PTS to bottlenose dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.92 For Risso's dolphin, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Negligible**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to Risso's dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.93 For common dolphin, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Negligible**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from PTS to common dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.94 For minke whale, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to minke whale from underwater noise during pile driving **is Slight adverse**, which is **not significant** in EIA terms.

11.9.1.95 For grey and harbour seal, the magnitude of the impact of PTS from underwater noise during pile driving has been assessed as **Negligible**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from PTS to grey and harbour seal from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

BEHAVIOURAL DISTURBANCE: RAMP-UP MITIGATION SCENARIO

11.9.1.96 For harbour porpoise, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from disturbance to harbour porpoise from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

11.9.1.97 For bottlenose dolphin, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Medium adverse**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from disturbance to bottlenose dolphin from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

11.9.1.98 For Risso's dolphin, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from disturbance to Risso's dolphin from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

11.9.1.99 For common dolphin, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from disturbance to common dolphin from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

11.9.1.100 For minke whale, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from disturbance to minke whale from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

11.9.1.101 For grey seal, the magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low to Medium adverse**, with the sensitivity of the receptor being **Negligible**. Therefore, the significance of effect from disturbance to grey seal from underwater noise during pile driving is **Imperceptible**, which is **not significant** in EIA terms.

11.9.1.102 For harbour seal, magnitude of the impact of disturbance from underwater noise during pile driving has been assessed as **Low adverse**, with the sensitivity of the receptor being **Low.** Therefore, the significance of effect from disturbance to grey seal from underwater noise during pile driving is **Slight adverse**, which is **not significant** in EIA terms.

RESIDUAL EFFECTS ASSESSMENT: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.103 The ramp-up mitigation scenario concluded no significant effects in EIA terms from injury and/or disturbance to marine mammals from underwater noise during pile driving. Nevertheless, the Applicant has committed to additional mitigation to further reduce the potential significance of the effect. The additional mitigation committed to by the Applicant is the extended ramp-up mitigation scenario outlined in Section 11.7.4.

11.9.1.104 Therefore, the assessment of residual effects has used the extended ramp-up mitigation scenario in the modelling and other quantitative aspects to inform the assessment of potential effects.

11.9.1.105 Impact piling for the WTG and OSP foundations was modelled for the extended ramp-up mitigation scenario at the same five representative locations modelled for the ramp-up mitigation scenario presented above, allowing direct comparison of potential impacts and informing the assessment conclusions.

MAGNITUDE OF IMPACT: EXTENDED RAMP-UP MITIGATION SCENARIO

AUDITORY INJURY – PTS: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.106 For harbour porpoise, the maximum instantaneous PTS-onset impact range was 680 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.30). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) using both the site-specific DAS and SCANS-IV density estimates. Using the cumulative PTS-onset thresholds, the maximum impact range was <50 m at all piling locations under the extended ramp-up mitigation scenario (Table 11.29 to Table 11.33). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for both density estimates. However, as the Developer has committed to additional mitigation in combination with the extended ramp-up mitigation scenario (see Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)), the predicted injury range of 680 m is within the R_{safe} distance of 1,000 m. Therefore, the extended ramp-up mitigation approach and implemented mitigation measures will provide effective mitigation of this distance. Hence, it is considered to result in complete displacement of animals from the impact range leading to no animals experiencing auditory injury.

11.9.1.107 For dolphin species, the maximum instantaneous PTS-onset impact range was <50 m at all piling locations under the extended ramp-up mitigation scenario (Table 11.29 to Table 11.33). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for all dolphin species. Using the cumulative PTS-onset thresholds, the maximum impact range for dolphin species was <50 m at all piling locations under the extended ramp-up

mitigation scenario, and as such, a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for all dolphin species (Table 11.29 to Table 11.33). However, as the Developer has committed to additional mitigation in combination with the extended ramp-up mitigation scenario (see Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)), the predicted injury range of >50 m is within the R_{safe} distance of 1,000 m. Therefore, the extended ramp-up mitigation approach and implemented mitigation measures will provide effective mitigation of this distance. Hence, it is considered to result in complete displacement of animals from the impact range leading to no animals experiencing auditory injury.

11.9.1.108 For minke whale, the maximum instantaneous PTS-onset impact range was 60 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.30). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) using both the Rogan *et al.* (2018) and Hammond *et al.* (2021) density estimates. Using the cumulative PTS-onset thresholds, the maximum impact range was 870 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.30). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population) for both density estimates. However, as the Developer has committed to additional mitigation in combination with the extended ramp-up mitigation scenario (see Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)), the predicted injury range of 60 m is within the R_{safe} distance of 1,000 m. Therefore, the extended ramp-up mitigation approach and implemented mitigation measures will provide effective mitigation of this distance. Hence, it is considered to result in complete displacement of animals from the impact range leading to no animals experiencing auditory injury.

11.9.1.109 For seals, the maximum instantaneous PTS-onset impact range was 70 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.30). This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population). Using the cumulative PTS-onset thresholds, the maximum impact range was <50 m at all piling locations under the extended ramp-up mitigation scenario. This equates to a maximum of one animal experiencing auditory injury (<0.01% of the reference population). However, as the Developer has committed to additional mitigation in combination with the extended ramp-up mitigation scenario (see Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)), the predicted injury range of 70 m is within the R_{safe} distance of 1,000 m. Therefore, the extended ramp-up mitigation approach and implemented mitigation measures will provide effective mitigation of this distance. Hence, it is considered to result in complete displacement of animals from the impact range leading to no animals experiencing auditory injury.

Table 11.29: PTS-onset from pile driving at the N WTG location based on the extended ramp-up mitigation scenario[2]

Species	Density (animals/km²)	Area (km²)	Maximum range (m)	Number of animals*	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	1.0	580	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	0.01	60	<1	<0.01
Harbour seal	0.0003	0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Harbour porpoise	0.38	<0.01	<50	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	0.04	170	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

**The predicted number of individuals that could be within the area of PTS-onset (both instantaneous and cumulative) from pile driving is fewer than one animal for all species assessed, when multiplying the density estimate by the area of PTS-onset. However, this does not take into account the avoidance and deterrent-based mitigation measures committed to by the Applicant. The maximum PTS-onset ranges for all species falls within the 1,000 m R_{safe} distance, which will be fully mitigated through the use of an ADD, alongside monitoring (visual or acoustic) to confirm deterrence of all animals beyond the 1,000 m R_{safe} distance. Therefore, the extended ramp-up mitigation and other mitigation measures will ensure that all marine mammals are displaced from the area where PTS could occur, consequently no animals are expected to experience PTS.*

Table 11.30: PTS-onset from pile driving at the C WTG location based on the extended ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	1.3	680	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	60	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	0.01	70	<1	<0.01
Harbour seal	0.0003	0.01	70	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Harbour porpoise	0.38	<0.01	<50	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	0.58	870	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

**The predicted number of individuals that could be within the area of PTS-onset (both instantaneous and cumulative) from pile driving is fewer than one animal for all species assessed, when multiplying the density estimate by the area of PTS-onset. However, this does not take into account the avoidance and deterrent-based mitigation measures committed to by the Applicant. The maximum PTS-onset ranges for all species falls within the 1,000 m R_{safe} distance, which will be fully mitigated through the use of an ADD, alongside monitoring (visual or acoustic) to confirm deterrence of all animals beyond the 1,000 m R_{safe} distance. Therefore, the extended ramp-up mitigation and other mitigation measures will ensure that all marine mammals are displaced from the area where PTS could occur, consequently no animals are expected to experience PTS.*

Table 11.31: PTS-onset from pile driving at the SW WTG location based on the extended ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	0.9	580	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	0.01	60	<1	<0.01
Harbour seal	0.0003	0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Harbour porpoise	0.38	<0.01	<50	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	0.08	330	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

**The predicted number of individuals that could be within the area of PTS-onset (both instantaneous and cumulative) from pile driving is fewer than one animal for all species assessed, when multiplying the density estimate by the area of PTS-onset. However, this does not take into account the avoidance and deterrent-based mitigation measures committed to by the Applicant. The maximum PTS-onset ranges for all species falls within the 1,000 m R_{safe} distance, which will be fully mitigated through the use of an ADD, alongside monitoring (visual or acoustic) to confirm deterrence of all animals beyond the 1,000 m R_{safe} distance. Therefore, the extended ramp-up mitigation and other mitigation measures will ensure that all marine mammals are displaced from the area where PTS could occur, consequently no animals are expected to experience PTS.*

Table 11.32: PTS-onset from pile driving at the N-OSP location based on the extended ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Instantaneous PTS-onset (unweighted SPL_{peak})					
Harbour porpoise	0.38	0.8	520	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	60	<1	<0.01
Harbour seal	0.0003	<0.01	60	<1	<0.01
Cumulative PTS-onset (weighted SEL_{cum})					

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
Harbour porpoise	0.38	<0.01	<50	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	0.02	120	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

**The predicted number of individuals that could be within the area of PTS-onset (both instantaneous and cumulative) from pile driving is fewer than one animal for all species assessed, when multiplying the density estimate by the area of PTS-onset. However, this does not take into account the avoidance and deterrent-based mitigation measures committed to by the Applicant. The maximum PTS-onset ranges for all species falls within the 1,000 m R_{safe} distance, which will be fully mitigated through the use of an ADD, alongside monitoring (visual or acoustic) to confirm deterrence of all animals beyond the 1,000 m R_{safe} distance. Therefore, the extended ramp-up mitigation and other mitigation measures will ensure that all marine mammals are displaced from the area where PTS could occur, consequently no animals are expected to experience PTS.*

Table 11.33: PTS-onset from pile driving at the S-OSP location based on the extended ramp-up mitigation scenario[2]

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
		Instantaneous PTS-onset (unweighted SPL_{peak})			
Harbour porpoise	0.38	0.4	380	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	<50	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
		Cumulative PTS-onset (weighted SEL_{cum})			
Harbour porpoise	0.38	<0.01	<50	<1	<0.01
	0.2803			<1	<0.01
	Grid-cell specific			<1	<0.01
Bottlenose dolphin	0.0201	<0.01	<50	<1	<0.01
	0.2352			<1	<0.01
	Grid-cell specific			<1	<0.01
Risso's dolphin	0.031	<0.01	<50	<1	<0.01
Common dolphin	0.0272	<0.01	<50	<1	<0.01
	Grid-cell specific			<1	<0.01
Minke whale	0.045	<0.01	70	<1	<0.01
	0.017			<1	<0.01
	Grid-cell specific			<1	<0.01
Grey seal	0.08	<0.01	<50	<1	<0.01
Harbour seal	0.0003	<0.01	<50	<1	<0.01

**The predicted number of individuals that could be within the area of PTS-onset (both instantaneous and cumulative) from pile driving is fewer than one animal for all species assessed, when multiplying the density estimate by the area of PTS-onset. However, this does not take into account the avoidance and deterrent-based mitigation measures committed to by the Applicant. The maximum PTS-onset ranges for all species falls within the 1,000 m R_{safe} distance, which will be fully mitigated through the use of an ADD, alongside monitoring (visual or acoustic) to confirm*

Species	Density (animals/km^2)	Area (km^2)	Maximum range (m)	Number of animals*	% of reference population
deterrence of all animals beyond the 1,000 m R_{safe} distance. Therefore, the extended ramp-up mitigation and other mitigation measures will ensure that all marine mammals are displaced from the area where PTS could occur, consequently no animals are expected to experience PTS.					

TTS: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.110 For harbour porpoise, the maximum instantaneous TTS-onset impact range was 1,600 m (1.6 km) for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.34). Using the cumulative TTS-onset thresholds, the maximum impact range for harbour porpoise was 30,000 m (30 km) for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.34).

11.9.1.111 For dolphin species, the maximum instantaneous TTS-onset impact range was <50 m at all piling locations under the extended ramp-up mitigation scenario (Table 11.34). Using the cumulative TTS-onset thresholds, the maximum impact range for dolphin species was <50 m at all piling locations under the extended ramp-up mitigation scenario (Table 11.34).

11.9.1.112 For minke whale, the maximum instantaneous TTS-onset impact range was 140 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.34). Using the cumulative TTS-onset thresholds, the maximum impact range for minke whale was 51,000 m (51 km) for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.34).

11.9.1.113 For seals, the maximum instantaneous TTS-onset impact range was 160 m for the installation of a 11 m monopile at the C WTG location under the extended ramp-up mitigation scenario (Table 11.34). Using the cumulative TTS-onset thresholds, the maximum impact range for seals was 12,000 m (12 km) for the installation of a 11 m monopile at the C and SW WTG location under the extended ramp-up mitigation scenario (Table 11.34).

11.9.1.114 As outlined in paragraph 11.7.4.17, no assessment of the number of animals, magnitude, sensitivity, or significance of effect is given because there are no thresholds to determine a biologically significant effect from TTS-onset.

Table 11.34: TTS-onset from pile driving at WTG and OSP locations based on the extended ramp-up mitigation scenario

Species	Impact	Piling location				
		N-WTG	C-WTG	SW-WTG	N-OSP	S-OSP
Instantaneous TTS-onset (unweighted SPL_{peak})						
Harbour porpoise (VHF cetacean)	Area (km^2)	4.9	5.8	4.6	3.8	1.7
	Maximum range (m)	1400	1600	1400	1200	880
Bottlenose dolphin, Risso's dolphin, common dolphin (HF cetacean)	Area (km^2)	<0.01	<0.01	<0.01	<0.01	<0.01
	Maximum range (m)	<50	<50	<50	<50	<50
Minke whale (LF cetacean)	Area (km^2)	0.05	0.06	0.04	0.04	0.02
	Maximum range (m)	120	140	120	110	80
Grey seal, harbour seal (PCW)	Area (km^2)	0.06	0.07	0.06	0.05	0.03
	Maximum range (m)	140	160	140	130	100
Cumulative TTS-Onset (weighted SEL_{cum})						
Harbour porpoise (VHF cetacean)	Area (km^2)	690	1100	1100	570	670
	Maximum range (m)	25000	30000	29000	24000	24000
Bottlenose dolphin, Risso's dolphin, common dolphin (HF cetacean)	Area (km^2)	<0.01	<0.01	<0.01	<0.01	<0.01
	Maximum range (m)	<50	<50	<50	<50	<50
Minke whale (LF cetacean)	Area (km^2)	2100	3200	2900	1600	1100
	Maximum range (m)	44000	51000	50000	41000	33000
Grey seal, harbour seal (PCW)	Area (km^2)	78	170	180	58	61
	Maximum range (m)	8800	12000	12000	7900	7400

BEHAVIOURAL DISTURBANCE: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.115 As the dose-response relationship for behavioural disturbance and Level B harassment assessment are based on single-strike sound exposure level (SEL_{ss}), only the maximum hammer energy has been considered in the disturbance assessment. This approach reflects the fact that SEL_{ss} is based on the highest energy strike rather than cumulative energy over time. Therefore, the maximum hammer energy (3,500 kJ) is the same for the extended ramp-up mitigation scenarioand the ramp-up mitigation scenario, and therefore, the predicted behavioural disturbance effects under the extended ramp-up mitigation scenario are consistent with those identified for the precautionary assessment (see Table 11.27 and Table 11.28; Figure 11.4).

SIGNIFICANCE OF EFFECT: EXTENDED RAMP-UP MITIGATION SCENARIO

AUDITORY INJURY – PTS: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.116 Implementation of the extended ramp-up mitigation scenario results in a reduction in the number of animals predicted to experience PTS, leading to a material change in conclusions for some receptors, compared to the ramp-up mitigation scenario.

11.9.1.117 For harbour porpoise, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible,** with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to harbour porpoise from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.118 For bottlenose dolphin, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to bottlenose dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.119 For Risso's dolphin, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to Risso's dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.120 For common dolphin, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible,** with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to common dolphin from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.121 For minke whale, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to minke whale from underwater noise during pile driving is **Not Significant**, which is **not significant** in EIA terms.

11.9.1.122 For grey and harbour seal, the magnitude of the impact of PTS from underwater noise during pile driving under the extended ramp-up mitigation scenario has been assessed as **Negligible**, with the sensitivity of the receptor being **Low**. Therefore, the significance of effect from PTS to grey and harbour seal from underwater noise during pile driving is Not **Significant**, which is **not significant** in EIA terms.

BEHAVIOURAL DISTURBANCE: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.123 As outlined in Section 11.9.1.116, as the maximum hammer energy (3,500 kJ) is the same for both the precautionary and the extended ramp-up mitigation scenario, the predicted behavioural disturbance effects are unchanged between scenarios. Accordingly, under the extended ramp-up mitigation scenario, the magnitude and significance of behavioural disturbance effects range are the same as those reported for the ramp-up mitigation scenario (ranging from **Imperceptible** to **Slight adverse**; Sections 11.9.1.96 to 11.9.1.102), all of which are **Not Significant** in EIA terms.

RESIDUAL EFFECTS ASSESSMENT CONCLUSION: EXTENDED RAMP-UP MITIGATION SCENARIO

11.9.1.124 The significance of the residual effect from underwater noise and vibration during piling is not significant in EIA terms and, therefore, no further mitigation measures are required for the purposes of the EIA assessment to avoid a significant effect.

11.9.1.125 However, the Developer has committed to the implementation of a MMMP (Volume III, Appendix 25.2: Marine Mammal Mitigation Plan (Revised March 2026)) which will further reduce any risk of disturbance to marine mammals.

11.9.2 Impact 2 – Injury and/or disturbance to marine mammals from vessel activities

11.9.2.1 Increased vessel movement during the construction, operations and maintenance, and decommissioning phases of the Proposed Development has the potential to result in a range of impacts on marine mammal receptors. These include injury or death due to collision with vessels, avoidance behaviour or displacement, and masking of vocalisations or changes in vocalisation rate.

11.9.2.2 The area surrounding the Proposed Development experiences a relatively low level of vessel traffic due to the presence of the shallow Arklow Bank sandbank, with higher traffic in the coastal areas and immediate surrounding waters (see Volume II, Chapter 15: Shipping and Navigation (Revised March 2026)).

11.9.2.3 The shipping and navigation baseline study (Volume III, Appendix 15.1: Navigational Risk Assessment (Revised March 2026)) recorded 29 days of vessel traffic data between 7th July and 14th August 2023. There was an average of 36 to 37 unique vessels per day recorded within the shipping and navigation Study Area (which is defined as Array Area and a 10 nm buffer). The busiest day recorded 59 unique vessels within the shipping and navigation Study Area. The main vessel types within the shipping and navigation Study Area were cargo vessels (40%), recreational vessels (31%) and fishing vessels (10%).

SENSITIVTY OF THE RECEPTOR

INJURY FROM VESSEL ACTIVITIES

11.9.2.4 During construction of the windfarm, a potential source of impact from increased vessel activity is physical trauma from collision with a boat or ship. In general, three consequences of vessel collision are defined: direct (injuries to the animals that are the immediate result of collision), long-term (a decrease in the fitness of the animal over time), and population consequences (Schoeman *et al.*, 2020). With regards to injuries, both fatal and non-fatal injuries between marine mammals and vessels have been documented (Laist *et al.*, 2001; Vanderlaan *et al.*, 2008; Cates *et al.*, 2017). Fatal collisions have been evidenced via carcasses washing up on beaches (Laist *et al.*, 2001; Peltier *et al.*, 2019); carcasses caught on vessel bows (Laist *et al.*, 2001; Peltier *et al.*, 2019); and floating carcasses which have strong evidence of ship strike, such as propeller cuts,

significant bruising, oedema, internal bleeding radiating from a specific impact site, fractures and ship paint marks (Jensen and Silber, 2003; Douglas *et al.*, 2008). Fatalities from ship strikes, however, often go unreported (Authier *et al.*, 2014). For non-fatal injuries, evidence of animals which have survived ship strikes with non-fatal injuries from propellers has been widely documented (Wells *et al.*, 2008; Luksenburg, 2014).

11.9.2.5 Although many species of marine mammals are able to detect and avoid vessels, it is unclear why some individuals do not always move out of the path of an approaching vessel (Schoeman *et al.*, 2020), although it has been suggested that behaviours such as resting, foraging, nursing, and socialising could distract animals from detecting the risk posed by vessels (Dukas, 2002). It is also possible that animals do not hear vessels when they are near the surface. Collisions between cetaceans and vessels, however, are not necessarily lethal on all occasions (Wells *et al.*, 2008; Luksenburg, 2014).

11.9.2.6 Harbour porpoises, dolphins, and seals are relatively small and highly mobile, and given observed responses to noise, are expected to detect vessels in close proximity and largely avoid collision. For example, several studies have shown that harbour porpoise typically avoid vessels (Benhemma-Le Gall *et al.*, 2021; Benhemma-Le Gall *et al.*, 2023; Brandt *et al.*, 2018; Heinänen and Skov, 2015).

11.9.2.7 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 marine mammal is engaged in. There is currently a lack of information on the frequency of occurrence of vessel collisions with marine mammals in Irish waters, and there is little evidence from marine mammals stranded in the Irish Sea to suggest that injury from vessel collisions is a significant cause of marine mammal mortality. In the UK, the Cetacean Strandings Investigation Programme (CSIP) documents the annual number of reported strandings and the cause of death for those individuals examined at post-mortem. According to the most recent CSIP report, post-mortems were conducted on 69 out of the 532 reported harbour porpoise strandings in 2018. A cause of death was established in 60 examined individuals and, of these, one individual died from physical trauma due to vessel strike and two individuals had died from physical trauma of an unknown cause, which could have been due to vessel strike (CSIP, 2019). For bottlenose dolphin, post-mortems were conducted on one out of the nine reported strandings in 2018; the cause of death was not associated with vessel collision (CSIP, 2019). For Risso's dolphin, post-mortems were conducted on two out of the 15 reported strandings in 2018; the cause of death was not associated with vessel collision (CSIP, 2019). For common dolphin, post-mortems were conducted on 45 out of the 191 reported strandings in 2018 and a cause of death was established for 43 individuals. Of these, two individuals had died from physical trauma of an unknown cause, which could have been due to vessel strike (CSIP, 2019). For minke whale, post-mortems were conducted on three out of the 28 reported strandings in 2018. Of these, one individual had died due to vessel strike (CSIP, 2019). Overall, 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 significant cause of mortality in RoI and UK waters.

11.9.2.8 Collision risk for seals is less understood than for cetaceans, however trauma ascribed to collisions with vessels has been identified in a small proportion of both live stranded (Goldstein *et al.*, 1999) and dead stranded seals in the US (Swails, 2005). In these cases, however, less than 2% of all dead necropsied seals had vessel collision attributed to cause of death. A study in the Moray Firth showed that seals use the same areas as vessels during trips between haul-outs and foraging sites but that seals tended to remain beyond 20 m from vessels (only three instances over 2,241 days of seal activity resulted in passes at less than 20 m) (Onoufriou *et al.*, 2016), suggesting that the possibility of a risk of collision is very low.